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## The effects of scheduling acetaminophen and methocarbamol administration on postoperative opioid use and related side effects among cardiac surgery patients

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The document mentioned above has been reviewed and accepted by the student's advisor, on behalf of the advisory committee, and by the Assistant Dean for MSN and DNP Studies, on behalf of the program; we verify that this is the final, approved version of the student's DNP Project including all changes required by the advisory committee. The undersigned agree to abide by the statements above.

Whitney Jamison, Student

Dr. Melanie Hardin-Pierce, Advisor

The Effects of Scheduled Acetaminophen and Methocarbamol Administration on Postoperative Opioid  
Use and Related Side Effects Among Cardiac Surgery Patients

Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Nursing Practice  
at the University of Kentucky

By

Whitney Jamison

Lexington, Kentucky

2020

## ABSTRACT

### Purpose

Opioid therapy is commonly prescribed to combat surgical pain in hospitals across the United States and is associated with many negative side effects including dependence and nausea. The purpose of this study was to retrospectively examine the effects of scheduling acetaminophen and methocarbamol administration postoperatively throughout the cardiac surgery patients' hospital stay. Through retrospective chart reviews, the aims of postoperative opioid use, postoperative opioid use according to hospital length of stay, antiemetic use, and opioid prescription at discharge were compared between two cohorts: a scheduled acetaminophen and methocarbamol cohort and a non-scheduled cohort.

### Setting & Population

The study takes place at The University of Kentucky's Cardiovascular Intensive Care Unit and telemetry floors at Albert B. Chandler Medical Center in Lexington, Kentucky. Coronary artery bypass graft (CABG) and valve replacement surgical patients were the target population. A total of 77 patients were included in this retrospective study divided into two cohorts. The scheduled cohort had 27 patients and the non-scheduled cohort had 50. The mean age for scheduled cohort was 60.8 while nonscheduled was 59.5 while 97.4 percent of the participants were white.

### Results

The scheduled cohort had a sum of opioids mean of 23.5 and the non-scheduled cohort had a sum of opioids mean of 25.5. There was no significant difference in means between the two cohorts ( $p=.47$ ). There was no significant difference between the two cohorts of hospital length of stay less than one week and greater than one week ( $p=.07$ ,  $.533$  respectively); however, less than one week, the  $p$  value was lower ( $p=.07$ ) and when examining the mean scores of scheduled less than one week with a mean of 15.6, and non-scheduled less than one week with a mean of 22.1; clinical relevance can be argued. No significant association existed ( $p=.753$ ) between those discharged home on opioids between the two cohorts; however, clinical relevance is argued. No significant difference between the two cohorts and antiemetic use ( $p=.107$ ).

### Conclusion

Limitations to the study included the setting being a single center study with a minimally diverse patient population and strict inclusion/ exclusion criteria that impeded sample size. When developing future studies, consideration should be given to hospital LOS due to this study's clinically relevant findings. Future research is needed for cardiac surgery patients and ways to mitigate those discharged home on opioids. Future studies could alter the "scheduling" definition to include patients receiving

acetaminophen and methocarbamol greater than or equal to four times in a 24-hour period (+ or – four hours). Future research could also include more in-depth communication among all disciplines involved including ways to mitigate the technological errors encountered in this study. Dissemination of the surgical guidelines published by the American Pain Society (2016) and The Enhanced Recovery After Surgery Society (2019) that promote scheduling acetaminophen postoperatively could occur in an educational in-person session to the cardiac surgery service line and serve as beneficial along with this study's clinically relevant findings. Notable ethical concerns include the primary investigator's employment as a nurse within UK's Cardiovascular Intensive Care Unit. This study contributes to the knowledge of the effects related to scheduling postoperative acetaminophen and methocarbamol among cardiac surgery patients and has the potential to offer insight on future study designs.

## Acknowledgements

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## **DEDICATION**

I would like to dedicate this DNP project to my late father, Keith Jamison. He was very happy and impressed when I got accepted into the University of Kentucky's DNP program. I know he would be grinning at me with pride regarding this project's entirety. My project required a vast amount of time and labor; thankfully my Dad taught me with hard work and determination anything is possible. His support and love will forever reside in my heavy heart.

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## **BACKGROUND and SIGNIFICANCE**

Opioid therapy is commonly prescribed to combat surgical pain in hospitals across the United States and is associated with many negative side effects including dependence, constipation, and nausea (Chisolm-Burns, et al., 2016). High rates of post-surgical opioid addiction span the United States; (Compton, Mena Sethi, & Sigman, 2017) meanwhile, Kentucky is the fifth leading state in the nation's opioid epidemic with a 40 percent increase in drug overdose rates in the last five years (Office of Drug Control Policy, 2018). One in eight cardiac surgery patients are at risk for opioid dependence and patients who begin taking opioids for the first time, known medically as opioid naïve, after a heart operation are at risk for chronic use (The Society of Thoracic Surgeons, 2019). Opioid dependence is not the only side effect warranting attention. Nausea has been reported to occur in 25 percent of patients treated with opioids (Kane-Gill et al., 2014; American Pain Society, 2016).

Incision-related and intraoperative bone and tissue manipulation are just some of the many common causes of postoperative pain experienced by surgical patients (Mueller et al., 2000). Cardiac surgery patients may experience previously stated causes of surgical pain, in addition to chest tube associated pain (Mueller et al., 2000). Chest tubes are placed in cardiac surgery patients to drain intrathoracic fluids caused from surgery and to facilitate lung expansion; however, manipulation and movement of these chest tubes during the postoperative recovery process can produce significant pain for the patient (Mueller et al., 2000). Chest, upper-back and shoulder muscle tightness are common sources of cardiac surgery post-operative pain as well (The Society of Thoracic Surgeons, 2009).

Opioid therapy is the first line treatment therapy for pain among cardiac surgery patients in the cardiovascular intensive care unit at the University of Kentucky Chandler Medical Center. Adjunctive pain management therapy is often recognized as an alternative way to reduce opioid use postoperatively. Scheduling acetaminophen and methocarbamol is intermittently used in my unit among cardiac surgery patients but is not standard therapy. Two surgical guidelines suggest clinicians provide adults with acetaminophen in conjunction with opioids (American Pain Society's Clinical Practice Guideline on Management of Postoperative Pain, 2016; Enhanced Recovery After Surgery Society's Guidelines for Care in Perioperative Cardiac Surgery, 2019). The combination of opioids and acetaminophen is associated with less postoperative pain and/or opioid use compared to opioids alone (American Pain Society, 2016). Both surgical guidelines previously mentioned also recommend scheduling acetaminophen with postoperative CABG patients (American Pain Society, 2016; Engelman et al. 2019). Along with acetaminophen use, adjunctive methocarbamol, a skeletal muscle relaxant, is associated with diminished postoperative pain and opioid consumption (Hidalgo & Pusic, 2005; Looke & Kluth, 2013).

## PURPOSE STATEMENT

The purpose of this study was to examine effects of scheduled acetaminophen and methocarbamol administration on postoperative cardiac surgery patients during their entire hospital stay. This was completed through retrospective chart review comparisons between a historical control, referred to as non-scheduled cohort, and the scheduled acetaminophen/ methocarbamol intervention cohort (referred to as the scheduled cohort). The following aims and associated objectives guided this research:

**Aim One: Does scheduling acetaminophen and methocarbamol postoperatively impact the average postoperative opioid use among cohorts?**

- **Objective One-** Postoperative opioid use per patient as evidenced by total number of occurrences of opioid administrations (oxycodone, hydrocodone, morphine and hydromorphone) on patients' medication administration records (MARs) throughout entire hospital length of stay.

**Aim Two: Does scheduling acetaminophen and methocarbamol postoperatively impact the average postoperative opioid use among cohorts when examining patients with hospital length of stay less than one week and greater than one week?**

- **Objective Two-** Postoperative opioid use per patient as evidenced by total number of occurrences of opioid administrations on patients' MARs for patients with hospital length of stay (LOS) less than one week and more than one week throughout hospital stay. **Aim Three: Does scheduling acetaminophen and methocarbamol postoperatively impact the average amount of those discharged home on opioids among cohorts?**
- **Objective Three-** Side effect of potential dependence as evidenced by number of opioid prescriptions at discharge.

**Aim Four: Does scheduling acetaminophen and methocarbamol postoperatively impact the average postoperative antiemetic use among cohorts?**

- **Objective Four-** Side effect of postoperative nausea as evidenced by total number of occurrences of ondansetron and promethazine administrations on MARs throughout hospital stay.

## THEORETICAL and CONCEPTUAL FRAMEWORK

My DNP project was grounded in Kolcaba's Comfort Theory (2002) which is patient-centered and central to nursing values. Kolcaba identifies three types of comfort:

1. Relief (a state in which comfort needs are met)
2. Ease (the state of calm or contentment)

3. Transcendence (the state in which one overcomes and rises above problems or pain) (Kolcaba, 2002).

Kolcaba's Comfort Theory states when patients are most comfortable, they engage more in health-seeking behaviors that include internal and external behaviors. In turn, when patients engage in health-seeking behaviors more, the institution benefits in such areas as reduced cost of care, length of stay, increased patient satisfaction, enhanced financial stability, and more positive publicity (Kolcaba, 2002). Kolcaba's Comfort Theory can be applied to this DNP final project through the conceptual framework illustrated in appendix one. This conceptual framework among cardiac surgical patients supports an individualized patient approach and highlights the optimal types of comfort they experience while recovering postoperatively via the scheduling of acetaminophen and methocarbamol. First, patients experience a state of pain relief after scheduled acetaminophen and methocarbamol is administered. Next, patients experience the ease, or calm, of the new postoperative pain management therapy working to minimize pain and possibly reduce postoperative opioid use and associated side effects as they progress through their hospital stay. Finally, transcendence of the patient occurs after discharge when they leave the hospital and overcome the risk of experiencing postoperative opioid associated side effects.

### **LITERATURE REVIEW**

A literature review was done to synthesize the existing published, peer-reviewed research involving postoperative opioid-associated side effects of dependence and nausea to provide support for scheduling acetaminophen and/or methocarbamol postoperatively. The following searches produced 17 studies related to opioid use, acetaminophen, and methocarbamol use in the surgical population: postoperative cardiac surgery/ surgical patients, postoperative opioid use, acetaminophen and methocarbamol postoperative opioid use, postoperative opioid complications.

Opioid therapy is commonly prescribed to combat surgical pain in hospitals. High rates of postsurgical opioid addiction span the United States; (Compton et al., 2017) meanwhile, Kentucky is the fifth leading state in the nation's opioid epidemic with a 40 percent increase in overdose rates in the last five years (Office of Drug Control Policy, 2018). Opioid exposure before surgery is a known risk factor for abuse postoperatively (Compton et al., 2017; Hah, Bateman, Ratliff, Curtin, & Sun, 2017) but what about those with no history of opioid exposure? Multiple retrospective cohort studies have shown postoperative opioid use among opioid naïve surgical patients to be associated with opioid dependence (Brescia et al., 2019; Sun, Darnell, Baker, & Mackey, 2016; Brummett et al., 2017; Clarke et al., 2014; Calcaterra et al., 2015; Mechcatie, 2018) suggesting all those exposed to opioids postoperatively are at risk for dependence including those opioid naïve and tolerant.

When reviewing opioid naïve postoperative patients, Brescia et al. (2019)'s study highlighted one in eight cardiac (12.5 percent) opioid naïve surgery patients are at risk for opioid dependence while Sun et al., (2016) concluded a variety of surgical procedures are affiliated with opioid dependence among opioid naïve patients including total knee arthroplasty, open and laparoscopic cholecystectomy, open appendectomy, cesarean delivery, functional endoscopic sinus surgery, cataract surgery, and transurethral prostate resection. Brummett et al. (2017) discovered among opioid naïve major and minor surgical patients that 5.9- 6.5 percent developed new, persistent opioid use 90-180 days after the surgical procedure. One Canadian retrospective cohort study found among opioid naïve patients who had major elective surgery including cardiac procedures- 49 percent were discharged home with an opioid prescription while 3.1 percent continued to receive opioids for more than 90 days postoperatively (Clarke, Soneji, Ko, Yun, & Wijeyesundera, 2014). Narrative reviews infer opioids administered during and after surgery may precipitate opioid dependence despite opioid naïve or tolerant status (Hah, Bateman, Ratliff, Curtin, & Sun, 2017; Clark & Schumacher, 2017).

One retrospective cohort study at a single institution examined opioid dependence among CABG patients (Hirjii, et al., 2019). The study defined postoperative opioid dependence as having an opioid prescription 90 days after discharge including those participants that were preoperatively opioid naïve and opioid exposed (Hirjii, et al., 2019). The study concluded 3.2 percent of opioid naïve and 21.7 percent of opioid exposed patients were opioid dependent 90 days after discharge while 72 percent of opioid naïve postoperative CABG patients were discharged home with opioids (Hirjii, et al., 2019)

Multiple studies associated postoperative opioid dependence with opioid prescription at discharge (Hirjii et al., 2019; Clarke et al., 2014; Brummett et al., 2017). In fact, two retrospective cohorts concluded long duration of postoperative opioid prescriptions as a greater indicator of abuse/dependence than increased dosage rates (Mechcatie, 2018; Shah, Hayes & Martin, 2017).

According to the literature, postoperative opioid side effects do not just involve dependence. Many sources cite constipation, respiratory depression, and nausea as some of the most commonly experienced opioid-related side effects (Kane-Gill et al., 2014; Swegle & Logemann, 2006). Nausea has been reported to occur in 25 percent of patients treated with opioids while constipation is the most common adverse effect (Kane-Gill et al., 2014; American Pain Society, 2016).

The opioid associated adverse drug events named above (OAADE), also known as opioid-related side effects, do not come without consequence. The presence of OAADEs was associated with a 29 percent increase in hospitalization costs, and a 55 percent longer length of stay (Urman et al., 2019). OAADEs increased hospital length of stay by as much as 4 days in one systematic review (Kane-Gill et al., 2014). Few prospective studies exist relating cost and consequence of opioid associated adverse drug events among postoperative patients in general, as well as postoperative cardiac patients.

Postoperative opioid dependence and the associated side effect of nausea are surgical complications deserving attention and a directed effort at mitigating exposure among opioid naïve and tolerant patients postoperatively. Postoperative opioids should be kept to a minimum or avoided entirely (Enhanced Recovery After Surgery Society and European Society of Thoracic Surgeons, 2019). More prospective random control trials and cohort studies are needed examining the cardiac surgery patient population and associated their specific opioid-related side effects.

Adjunctive pain management therapy is often recognized as an alternative way to reduce opioid use postoperatively. Two surgical guidelines suggest clinicians provide adults with acetaminophen in conjunction with opioids (American Pain Society's Clinical Practice Guideline on Management of Postoperative Pain, 2016; Enhanced Recovery After Surgery Society's Guidelines for Care in Perioperative Cardiac Surgery, 2019). The combination of opioids and acetaminophen is associated with less postoperative pain and/or opioid use compared to opioids alone (American Pain Society, 2016; Engelman et al., 2019). Both surgical guidelines previously mentioned also recommend scheduling acetaminophen with postoperative CABG patients (American Pain Society, 2016; Engelman et al., 2019). Acetaminophen is a vital part of postoperative pain control and reduces opioid consumption by as much as 20 percent according to another set of postoperative pain management guidelines published by Enhanced Recovery After Surgery Society and European Society of Thoracic Surgeons (2019).

Utilization of acetaminophen (intravenous and oral) was associated with decreased opioid use postoperatively among studies (Looke & Kluth, 2013; MicNicol et al., 2011; Jelacic et al., 2016). Single dose acetaminophen was studied for postoperative pain in adults (MicNicol et al., 2016). A systematic review (Toms, McQuay, Derry, & Moore, 2008) provided support for acetaminophen serving as effective analgesia among 37- 50 percent of patients experiencing acute postoperative pain. Clearly, more studies are warranted examining scheduled acetaminophen efficacy among the cardiac surgery patient population where more than a single dose of acetaminophen will be administered. Comparative analysis of postoperative opioid consumption alongside scheduled oral acetaminophen administration should be examined to determine acetaminophen's association with postoperative opioid use and effects.

One randomized, placebo-controlled trial claimed a 27 percent decrease in 24-hour postoperative opioid use among cardiac surgery patients after scheduled IV acetaminophen for the first 24 hours (Jelacic et al., 2016). Limitations included a small sample size of 68 participants confined to one hospital setting. Conversely, another single-center randomized control trial repeated IV acetaminophen administration postoperatively for 24 hours among cardiac surgery patients with a slightly bigger sample size of 147 patients to yield no reduction in opioid use among the participants (Mamoun et al., 2016). These studies contribute to an increased need for more research involving scheduled postoperative acetaminophen IV and PO administration among the cardiac surgery patient population.

Methocarbamol is a skeletal muscle relaxant originally developed for musculoskeletal pain (Hidalgo & Pusic, 2005). Studies have associated methocarbamol use with diminished postoperative pain and opioid consumption (Hidalgo & Pusic, 2005; Looke & Kluth, 2013), however, limited data exists examining its efficacy among postoperative cardiac surgery patients. Looke & Kluth (2013) examined preoperative acetaminophen IV and methocarbamol PO administration on postoperative opioid use among total hip and knee replacement surgical patients for 48-hours postoperatively resulting in a significant difference in postoperative mean opioid use. The study also suggests a role for methocarbamol when muscle spasm is of concern (Looke & Kluth, 2013). One could argue mediastinal and intercostal muscle spasms play a role in postoperative cardiac surgery pain while the Society of Thoracic Surgeons (2009) claim chest, upper-back and shoulder muscle tightness are common sources of cardiac surgery postoperative pain. Postoperative methocarbamol and acetaminophen were not examined among the total hip and knee replacement surgical patient population. Studies involving the cardiac surgery patient and methocarbamol administration are warranted.

To summarize this review of literature, limited research exists among the cardiac surgical patient population examining postoperative opioid dependence and associated side effect of nausea. Limited evidence exists examining the efficacy of scheduling acetaminophen and methocarbamol postoperatively among all surgical patients including the cardiac surgery patient population. Synthesis of evidence findings support postoperative opioid use among opioid naïve and tolerant patients as a risk for opioid dependence as well as opioid prescriptions at discharge. Few prospective studies exist relating cost and consequence of opioid associated side effects among postoperative patients in general, as well as in postoperative cardiac surgery patients. Acetaminophen is supported by two postoperative pain management guidelines in cardiac surgery while limited studies exist examining methocarbamol postoperatively. See appendix two for a full synthesis of evidence table.

## **DESIGN**

This project involved retrospective chart review comparisons between two cohorts. The first cohort, or scheduled cohort, involved scheduling acetaminophen and methocarbamol administration postoperatively to cardiac surgery patients and the second cohort involved a non-scheduled control not receiving the medications on a scheduled basis. The non-scheduled cohort was still offered the medications (acetaminophen and methocarbamol) on an as needed basis. Scheduled was defined as receiving acetaminophen and methocarbamol each greater than or equal to four times in 24 hours; patients receiving both acetaminophen and methocarbamol greater than or equal to four times in a 24-hour period during their hospital stay were placed into the scheduled cohort. Individuals receiving the medications less than four times in a 24-hour period were assigned to the non-scheduled cohort. Both

cohorts were offered standard postoperative opioid therapy. The study involved 77 total patients. The scheduled cohort consisted of 27 patients and the non-scheduled cohort consisted of 50 patients. Retrospective chart reviews of CABG and valve surgery patients included those admitted to the hospital from January 1, 2017- June 1, 2019.

Data was collected initially from the University of Kentucky's Center for Clinical and Translational Research (CCTS) and validated through electronic health record (EHR) chart reviews conducted by the primary investigator and included demographic statistics such as age, gender, procedure type, and hospital LOS as well as the following objective one through four.

## **METHODS**

### **Study Setting**

The University of Kentucky's Cardiovascular Intensive Care Unit (CVICU) is where this study's patients were admitted and spent the majority of their hospital stay. The patients were then transferred from the CVICU to the associated step-down telemetry floors. The CVICU is comprised of 32 beds and more than 30 providers while being known as one of the largest cardiovascular ICU's in the nation offering some of the most innovative technological therapies. These therapies include left/ right ventricular assist devices, extracorporeal membrane oxygenation, continuous renal replacement therapy, temporary percutaneous ventricular assist devices, intra-aortic balloon pumps, total artificial hearts, ultrasound enhanced pulmonary artery thrombolysis, coronary artery bypass grafts, valve replacements, coronary artery stents, heart and lung transplants, esophagectomies, pneumonectomies, and lobectomies. Nurses in the intensive care unit are staffed to provide care for one or two patients depending on acuity. Surgical patients are recovered in the CVICU and then transferred to the service line's acute care floor to prepare for discharge.

UK Healthcare's mission is dedicated to the health of the people of Kentucky, striving to provide advanced patient care and serving as an information resource (University of Kentucky Albert B. Chandler Medical Center, 2019). UK Healthcare also has a strategic plan containing a foundation related to patient-centered care. This project aligned with UK Healthcare's mission and strategic plan because it examined ways to reduce patients' postoperative opioid use in order to reduce opioid-related complications. This project is focused on examining potentially harmful opioid related side effects for the patient (patient-centered) while also studying the effects of scheduling evidenced-based medications (acetaminophen and methocarbamol) postoperatively.

### **Target Population**

The target population involved cardiac surgery patients specifically coronary artery bypass grafts, and valve replacements taking place January 1, 2017- June 1, 2019. Participant inclusion criteria

for both cohorts included: males and females, all ages greater than 18 years of age, valve and/or coronary artery bypass graft surgery, and all presenting ethnicities. Exclusion criteria for both cohorts was non-valve or non-coronary artery bypass graft cardiothoracic surgical patients, patients less than 18 years of age, patients expiring during their hospital stay, pregnant patients, patients on postoperative opioid PCAs or continuous opioid infusions, patients with chronic pain disorders (fibromyalgia, chronic back pain), patients with diagnosed opioid use disorder, patients with a hospital length of stay greater than 14 days, and patients requiring mechanical circulatory support postoperatively such as extracorporeal membrane oxygenation or left/ right ventricular assist devices. Patients were also excluded from the study if they only received one or none of the medications (acetaminophen and methocarbamol) in the scheduled or non-scheduled cohorts. The two cohorts were divided into two cohorts; the scheduled cohort patients received acetaminophen (intravenous and/ or by mouth) and methocarbamol greater than or equal to four times in a 24-hour period during their hospital stay. The non-scheduled cohort involved patients receiving acetaminophen (intravenous and/ or by mouth) and methocarbamol less than four times in a 24-hour period during their hospital stay.

### **Facilitators and Barriers**

According to Melnyk and Fineout-Overholt (2015), facilitators are individuals carrying out a specific role with certain education and skills to ease the transition of applying evidence-based practice. Facilitators of this DNP project were the CVICU managers, providers, nurses, pharmacists, university statisticians, office of research representatives, and committee members/ clinical mentors- all of whom were willing to offer input and guidance to facilitate the success of this study. Barriers of this retrospective study included the data collection technological errors from medication counts on all charts. The PI was then faced with a time constraint of recounting all medications involved in the objectives of this study for every patient to verify an accurate medication count. The PI and CCTS data collector also encountered a language barrier involving miscommunication between medical and nonmedical backgrounds. This miscommunication was unintentional and required the PI and data collector to meet several times to resubmit data collection algorithms for the computerized system to collect the data.

To complete this study, consistent consultation between multiple disciplines had to occur in order to enable creative process development strategies. These consultation methods between CCTS, pharmacy, statistician, and committee members involved emails, and in person meetings occurring weekly to monthly at various project stages. These strategies created systems that facilitated the data collection process on trial and error basis.



## **Procedure**

UK Institutional Review Board (IRB) exempt approval was obtained for this project on August 26, 2019 and the study will remain open until August 25, 2025. Informed consent was waived due to the minimal risk to the subject (retrospective study), the rights and welfare of subjects were not adversely affected, and the research could not have practically been achieved without the requested waiver. A waiver of authorization was also obtained. The University of Kentucky Chief of Cardiac Surgery Division, Dr. Michael Sekela formally approved this study.

Participants' EHR data was initially collected and deidentified via CCTS and medical record numbers were given to the primary investigator (PI) in order to verify the data's accuracy. The PI verified accuracy of all participating patients' data after receiving it from CCTS. The data was collected, verified, and stored on an encrypted, password protected personal laptop.

The chart-based data collection for this study included system related issues. The PI met with CCTS consultant to categorize data collection identifiers designed to pull data from UK's patient database. The data collection period was from September 2019 to January 2020. Next, the data was reevaluated by the PI who verified each variable and cohort assignments for each participant twice in the electronic health record before statistical analysis in February 2020. Initially, the study had 577 total participants after CCTS' final data collection. The primary researcher found the following exclusion criteria was mistakenly included in the initial data received from CCTS: opioid use disorder, continuous opioid PCAs, and those not receiving both scheduled acetaminophen and methocarbamol; these patients were excluded. Duplicate MRNs were also discovered especially in patients having both a CABG and valve surgery in one procedure, so those patients were also excluded. After these exclusions, a total of 77 patients were included. A table of study measures utilized in the data collection process for CCTS is included in appendix three.

## **Data Analysis**

The finalized data was analyzed by the PI and university statistician, Amanda Wiggins. Material resources involved in the study included the PI's already purchased computer, flash drive, IBM SPSS software version 24, and printer with paper and ink.

Descriptive statistics were utilized in IBM SPSS version 24 to examine percentages of the nominal variables of gender, procedure type, discharged on opioids, hospital LOS, and race while the continuous variables of age, sum of opiates, sum of nausea medications, and individual counts of oxycodone/ hydrocodone/ hydromorphone/ morphine/ promethazine/ ondansetron were analyzed descriptively via measures of central tendency and dispersion (mean, median, minimum, maximum, standard deviation) for both cohorts. A demographic variable table and objective variable table is included in appendices four and five, respectfully.

Comparisons between cohorts (scheduled versus non-scheduled) were conducted using the chi-square test of association for nominal variables, or two-sample t-test for continuous measures. An alpha level of .05 was used to determine statistical significance.

## RESULTS

A total of 77 patients were included in the retrospective study divided into two cohorts. The scheduled cohort had a total of 27 patients, and non-scheduled cohort had a total of 50. The mean age for scheduled cohort was 60.8 while non-scheduled was 59.5. Both cohorts had more male participants than females; the scheduled cohort (51.9 percent males) and non-scheduled cohort (64 percent males). Overall, 97.4 percent (n=75) of all 77 participants identified their race as white. The scheduled cohort consisted of 14 CABGs (51.9 percent), 9 valves (33.3 percent), and 4 CABG and valve (14.8%). The nonscheduled cohort was comprised of 35 CABGs (70 percent), 13 valves (26 percent), and 2 CABG and valve (4 percent). Overall, 51.9 percent (n= 40) of all patients were hospitalized more than one week while 48.1 percent (n=37) were less than one week. The variables hospital LOS greater than one week and less than one week was analyzed with a chi square test of independence and produced a p value of .057 indicating a slight significant difference between the two groups. This indicates an association exists between scheduling acetaminophen and methocarbamol and hospital length of stay. A demographic variable table is included in appendix four.

The first objective analyzed resulted in the scheduled cohort having a sum of opioids mean of 23.5, with a standard deviation of 12.5; the non-scheduled cohort had a sum of opioids mean of 25.5 with a standard deviation of 10.6. Sum of opioids was defined as total number of occurrences of opioid administrations per patient on each patient's MAR (ex. morphine count + oxycodone count + hydrocodone count = sum of opioids). There was no significant difference in means between the two cohorts indicating no significant difference between the two cohorts of scheduling (acetaminophen and methocarbamol) and postoperative opioid use ( $p = .47$ ).

In the second objective, there was no significant difference between the two cohorts (scheduled and non-scheduled) of hospital length of stay less than one week and greater than one week and sum of opioids ( $p = .07$ ,  $.533$  respectively); however, less than one week, the p value was substantially lower ( $p = .07$ ) and the mean scores of scheduled less than one week and sum of opioids,  $n = 9$  with a mean of 15.6 (SD 6.1), non-scheduled less than one week  $n = 28$  with a mean of 22.1 (SD 9.8). This indicated an independent difference between those receiving the scheduled medications (acetaminophen/methocarbamol) and hospital length of stay.

The third objective statistically studied yielded no significant association ( $p = .753$ ) between discharged on opioids and scheduled versus non-scheduled cohorts. In the scheduled cohort ( $n = 27$ ),

44.4 percent (n=12) were not discharged home on opioids while 48.1 percent were (n=13); however, 7.4 percent were unknown (n=2). In the non-scheduled cohort (n=50), 36 percent (n=18) were not discharged home on opioids, 54 percent were (n=27), and 10 percent were unknown (n=5). 17.4 percent collectively were unknown.

The fourth objective analyzed produced no significant difference between the two cohorts of scheduled and non-scheduled ( $p = .107$ ) and sum of nausea medications. The means of the scheduled and non-scheduled cohorts were 3.222 (SD 2.736), and 2.08 (SD 3.04) respectively, which indicated no association between scheduled and non-scheduled cohorts and postoperative antiemetic use. Sum of nausea medications was defined as total number of occurrences of ondansetron and promethazine administrations on each patient's MAR (ex. ondansetron count + promethazine count = sum of nausea medications).

An objectives variable table is included in appendix five.

## DISCUSSION

In this retrospective study the effects of scheduling acetaminophen and methocarbamol postoperatively to assess outcomes of postoperative opioid use and the associated side effects of dependence and nausea were statistically analyzed along with single dose cost analysis of the study's scheduled/ non-scheduled medications. Overall, the study did not produce statistical independence in any of the objectives analyzed but when compared to the limited existing research some similarities and differences exist. The aims and clinical significance of the study results will be discussed below.

### **Aim One: Does scheduling acetaminophen and methocarbamol postoperatively impact the average postoperative opioid use among cohorts?**

Unfortunately, this study did not see a significant difference in the sum of opioids consumed postoperatively between the scheduled and non-scheduled cohorts ( $p = .470$ ); however, this result does not coincide with the postoperative pain management guidelines that claim postoperatively scheduling acetaminophen alone can reduce opioid use (American Pain Society, 2016; Engelman et al., 2019). One could argue that this study may produce different results should the definition of "scheduling" be altered to include more patients in the scheduled cohort. During the data collection process, many participants were assigned to the non-scheduled cohort because they missed the 24-hour window of receiving methocarbamol and acetaminophen four times in a 24-hour period by minutes to hours. Not only might this balance the cohort sample sizes (n= 27 and 50), but also might produce altered mean results for opioid use between the two cohorts along with altering all the other measured outcome results. Adjustments in the exclusion criteria might also increase the overall sample size which is further discussed in the limitations section.

**Aim Two: Does scheduling acetaminophen and methocarbamol postoperatively impact the average postoperative opioid use among cohorts when examining patients with hospital length of stay less than one week and greater than one week?**

When comparing p values of all demographic data collected in this study, a determination was made that the variable of hospital LOS (greater than and equal to or less than one week) had the most significance ( $p=.057$ ), see appendix four. This led to a statistical comparison of the sum of opioids with respect to hospital LOS greater than and equal to or less than one week for both cohorts ( $p=.533$  and  $.07$  respectfully). Though this outcome did not produce a statistical difference, one should note the individuals in the scheduled cohort staying less than one week had a mean opioid use of 15.6 while individuals in the non- scheduled cohort staying less than one week had a mean opioid use of 22.1. This could be of use on an individual consumption basis (15 opioid doses during hospital stay is better than 22) or on an individual cost basis (15 opioids cost less than 22), but also supports the need for more research involving postoperative opioid use associated with hospital length of stay especially among the cardiac surgery patient to determine statistical difference in a larger, more equal cohort sample size.

**Aim Three: Does scheduling acetaminophen and methocarbamol postoperatively impact the average amount of those discharged home on opioids among cohorts?**

The synthesis of evidence supports that even opioid naïve surgical patients are at risk for dependence (Brescia et al., 2019; Sun, Darnell, Baker, & Mackey, 2016; Brummett et al., 2017; Clarke et al., 2014; Calcaterra et al., 2015; Mechcatie, 2018) and this study theoretically included all opioid naïve patients as patients were excluded with chronic pain disorders like fibromyalgia/ chronic back pain (likely prescribed opioids) and patients with diagnosed opioid use disorder. Granted, unknown preoperative opioid abuse and prescribed opioid use could be confounding the sample results which might also be warranted to consider when developing future research.

This study did not produce a statistical difference when comparing scheduled and non-scheduled cohorts to those discharged home on opioids. One Canadian retrospective cohort study found among opioid naïve patients who had major elective surgery including cardiac procedures- 49 percent were discharged home with an opioid prescription (Clarke, Soneji, Ko, Yun, & Wijesundera, 2014). When comparing this research to this study's results, the scheduled cohort had a slightly lower percentage of being discharged on opioids (48.1 percent), but when considering the non- scheduled cohort's higher percentage of being discharged on opioids (54 percent) the scheduling may be warranted to reduce this hospital region's average percentage of cardiac surgery patients receiving opioids at discharge. Future research is warranted. The alteration of including a 24 hour (+ or - 4 hours) for the scheduled cohort, as previously stated, could also produce more significant results among the

discharged on opioid percentages between the two cohorts. One should also note 17.4 percent in the entire study were not known if they were discharged home on opioids.

**Aim Four: Does scheduling acetaminophen and methocarbamol postoperatively impact the average postoperative antiemetic use among cohorts?**

The literature states nausea is a side effect reported to occur in 25 percent of patients receiving opioids. No statistical difference was noted when comparing the sum of nausea medication means to the cohorts ( $p=.107$ ) which supports the first objective's finding of no significant difference between cohorts' sum of opioid means (23.5= scheduled cohort, 25.5= non-scheduled cohort). Indicating both cohorts consumed opioids similarly; therefore, had similar requirements for antiemetics postoperatively.

**IMPLICATIONS for PRACTICE and FUTURE RESEARCH**

Literature supports clinical guidelines from the American Pain Society (2016), Enhanced Recovery After Surgery Society and European Society of Thoracic Surgeons (2019) for scheduling acetaminophen postoperatively to reduce opioid consumption and should be a considered practice change for UK's cardiac surgery patients. Future research is warranted involving the scheduling of acetaminophen and methocarbamol postoperatively in cardiac surgery patients as no studies exist currently.

When developing these future studies, one could argue hospital LOS should be a considered factor due to this study's findings. LOS could be altered related to procedure as CABGs usually have a hospital LOS seven days while valves are 14 days at UK Chandler Hospital. LOS could also be altered related to common complications that should be considered. Future research is needed for cardiac surgery patients and those discharged home on opioids. It would be interesting to see this study's results with an altered "scheduling" definition to include patients receiving acetaminophen and methocarbamol greater than or equal to four times in a 24-hour period (+ or – four hours).

Another aspect for future research could include a more in-depth consultation with CCTS and the data collectors to address ways to mitigate the technological errors encountered with all the medication counts on the MARs and other technologically related issues in data collecting. Resolving these issues would give the primary investigator more time to address ways to increase reliability and validity within the study, and to disseminate future results among the disciplines.

In the future, an extensive cost analysis could be valuable in this study to determine which combinations of medications (acetaminophen/ methocarbamol or opioids) cost the hospital less. Obviously, the study could be strengthened if the acetaminophen/ methocarbamol combination was cheaper than opioids; however, if opioids were cheaper one could see why providers would want to

abstain from ordering acetaminophen/ methocarbamol due to the additional cost it would present the hospital.

Dissemination of the surgical guidelines published by the American Pain Society (2016) and The Enhanced Recovery After Surgery Society (2019) that promote scheduling acetaminophen postoperatively could occur in an educational in-person session to the providers and cardiac surgery service line of this study and serve as beneficial along with this study's clinically relevant findings that were previously discussed. A pre and post educational analysis among providers and nurses could be included to verify the educational efficacy. This postoperative educational dissemination session could also include a compilation of various complementary pain treatment regimens where various methods of aromatherapy, acupuncture, massage, music, etc. are presented. If Kolcaba's Comfort Theory Construct of Transcendence is ever attainable, alternative therapies should be discussed in order to overcome and rise above opioid dependence and associated side effects.

A more involved communicative approach between all disciplines in this study would also serve to be beneficial when tackling the technological obstacles encountered within the data collection process. This consistent communication could've decreased the time to validate data and could've also prevented technological errors.

### **LIMITATIONS**

This study was subject to several limitations. The first limitation was overall time. If more time were feasible for the data collection process, then the primary investigator could have included a less strict "scheduling" definition to involve more patients in the study which would eliminate the limitation of small sample size. Instead of the scheduling definition adhering to a strict time frame of receiving the scheduled medications greater than or equal to four times in a 24-hour period, a plus or minus fourhour window could've been used which would've included many more patients.

This small sample size limitation could have also been increased if other exclusion criteria was omitted. Many patients were excluded if they had opioid use disorder, fibromyalgia, or chronic back pain. Minimal diversity among the patient population was another limitation due to the hospital residing in a region where the majority of the population was Caucasian. Selection was not random, as strict inclusion and exclusion criteria was used among the cardiac surgery patient population.

Another limitation was this was a single-center study where multiple doses and routes of the medications were used. To increase the reliability of the study, one might suggest a multi-center approach where cardiac surgery patients are given the same doses of scheduled, non-scheduled, and opioid medications. The last limitation could include that one of the opioid medications examined in

both cohorts (hydrocodone) also contained acetaminophen 325 mg and was not counted towards the scheduled acetaminophen/ cohort which could threaten internal validity by confounding the results.

One ethical limitation is that the project author was employed as a registered nurse in the unit where the study took place. This means the study's author could have provided care for the study participants which could produce threats to internal validity; however, at the time the care was provided, the author would not have known about the patients' participation because of the retrospective nature of the study. The participants were not included until the care had already been provided and their discharge completed.

## **CONCLUSION**

In conclusion, limited research exists studying postoperative opioid consumption and opioid associated effects among cardiac surgical patients when scheduling acetaminophen and methocarbamol. This study produced no statistically significant differences among the objectives analyzed; however, various clinically significant objectives were discussed. Some of these clinically significant objectives involved the consideration of hospital LOS when scheduling acetaminophen and methocarbamol postoperatively with respect to reducing postoperative opioid use and scheduling acetaminophen and methocarbamol with respect to those being discharged home on opioids. Future research is needed regarding contributing factors towards hospital LOS and alternative modalities contributing towards hospital LOS. The study supports the need for altering the "scheduled" inclusion definition to include a grace period of receiving methocarbamol and acetaminophen greater than or equal to four times in 24 hours plus or minus four hours along with less strict exclusion preoperative diagnoses criteria. These adjustments in research would increase sample size and potentially produce a more reliable study. Literature supports clinical guidelines from the American Pain Society (2016) and Enhanced Recovery After Surgery Society (2019) for scheduling acetaminophen postoperatively to reduce opioid use and should be a considered practice change for UK's cardiac surgery patients based on findings produced by this study's review of literature and clinically significant results. In future research, hospital LOS and ways to mitigate those discharged home on opioids should be considered as well as a more in-depth multidisciplinary communicative approach among the disciplines involved. Limitations to this study included time constraints, strict inclusion and exclusion criteria, small sample size with minimal diversity, and a single-center study where multiple doses and routes of all the medications studied were utilized. This study contributes to the knowledge of the effects related to scheduling postoperative acetaminophen and methocarbamol among cardiac surgery patients and has the potential to offer insight on future study designs. Should Kolcaba's Comfort Theory Construct of Transcendence ever be attainable, consideration must be made towards alternative postoperative therapies such as scheduling acetaminophen and methocarbamol.

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## APPENDICES

### Appendix One- Kolcaba's Comfort Theory Conceptual Framework Experienced by Cardiac Surgical Patients Through Scheduling Acetaminophen and Methocarbamol



Appendix Two- Synthesis of Evidence Table

Objectives
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	Postoperative opioid use	Postoperative opioid dependence	Postoperative opioid related nausea	Postoperative Scheduling Acetaminophen	Postoperative Scheduling Methocarbamol
<b>Office of Drug Control Policy, 2018</b>	X				
<b>Sun et al., 2016</b>	X	X			
<b>Brummet et al., 2017</b>	X	X			
<b>Clarke et al., 2014</b>	X	X			
<b>Calceterra et al., 2015</b>	X	X			
<b>Mechcatie, 2018</b>	X	X			
<b>Clark &amp; Schumacher, 2017</b>	X	X			
<b>Hirjii et al., 2019</b>		X			
<b>Shah et al., 2017</b>		X			
<b>Kane-Gill et al., 2014</b>			X		
<b>Swegle &amp; Logemann, 2006</b>			X		
<b>American Pain Society, 2016</b>			X	X	

Supporting Sources

<b>Urman et al., 2014</b>			X		
<b>Engleman et al., 2019</b>	X			X	
<b>Looke &amp; Kluth, 2013</b>	X			X	X
<b>MicNicol et al., 2011</b>	X			X	
<b>Jelacic et al., 2016</b>	X			X	
<b>Toms et al., 2008</b>	X			X	
<b>Mamoun et al., 2016</b>	X			X	
<b>Hidalgo &amp; Pusic, 2005</b>	X				X
<b>Enhanced Recovery After Surgery Society and European Society of Thoracic Surgeons, 2019</b>	X			X	

Appendix Three-

**TABLE of STUDY MEASURES**

<b>Measures</b>	<b>Description</b>	<b>Level of Measurement</b>	<b>Data Source</b>
<b>OUTCOMES</b>			
<p>Number of occurrences of opioid administration (morphine, hydromorphone, oxycodone, hydrocodone) throughout hospital stay for cohort one and two.</p>	<p>The number of total occurrences of received opioids was based on the sum of total opioid medications being scanned into the patients' medication administration records (MARs) which is a required nursing practice at UK.</p>	<p>Continuous</p>	<p>CCTS provided the data and the primary researcher's analysis of the patients' electronic medical record MAR opioid administration included the following opioids: morphine, hydrocodone, oxycodone, hydromorphone. Measures of central tendency were used to compare the mean number of the sum of opioid occurrences between the two groups via SPSS.</p>
<p>Number of occurrences of opioid administration (as above) for cohort one and two based on length of stay (LOS) less than one week and more than one week</p>	<p>The number of total occurrences of received opioids was based on the sum of total opioid medications being scanned into the patients' MARs for both groups which is a required practice at UK.</p>	<p>Continuous</p>	<p>CCTS provided the data and the primary researcher's analysis of the patients' MARs opioid administrations included the following opioids: morphine, hydrocodone, oxycodone, hydromorphone with respect to their hospital LOS. Measures of central tendency were used to compare the mean number of total opioid</p>

			occurrences between the two cohorts based on a length of stay less than one week and more than one week via SPSS.
Nausea via documented number of occurrences of antiemetic administration (ondansetron, promethazine) throughout hospital stay for cohort one and two.	The number of total occurrences of antiemetic administration being scanned into the patients MARs . Scanning medication is a required nursing practice at UK.	Continuous	CCTS provided the data and the primary researcher’s analyzation of patients’ electronic medical record MAR antiemetic administration including ondansetron and promethazine. Measures of central tendency were used to compare the mean number of antiemetic administrations between the two cohorts via SPSS.
Cost Analysis	Consultation with UK Healthcare Pharmacy Office with the goals of obtaining the individual hospital purchasing cost of the following opioids: morphine, hydromorphone, oxycodone, and hydrocodone. Another goal was to obtain an individual hospital purchasing cost of acetaminophen and methocarbamol.	Continuous	UK Pharmacy
Percentage of opioid prescriptions at	Discharge medications were analyzed for the following opioids: oxycodone and	Nominal	CCTS collected data from the patients’ electronic medical record for those discharged

discharge between two cohorts	hydrocodone. Example: yes they were discharged on opioids, no they were not, or unknown.		home on opioids and those that were not. Percentages were calculated among the two cohorts via SPSS.
<b>DEMOGRAPHIC VARIABLES</b>			
Gender	Male vs Female	Nominal	CCTS provided the data and the primary researcher examined male vs female status in patients' electronic medical record for both cohorts. Percentages were calculated among the two cohorts with analysis in SPSS.
Age	Mean age in years	Continuous	CCTS provided the data and the primary researcher examined age in years among study participants' electronic medical record in both cohorts with analysis in SPSS.
Procedure Type	CABG, VALVE, CABG and VALVE	Nominal	CCTS provided the data and the primary researcher examined procedure type among study participants' electronic medical record in both cohorts. Percentages were calculated among the two cohorts with analysis in SPSS.
Hospital Length of Stay (LOS)	Less than one week vs more than one week	Nominal	CCTS provided the data and the primary researcher

			examined hospital LOS among study participants' electronic medical record for both cohorts and percentages were calculated with analysis in SPSS.
Race	White vs Non-White	Nominal	CCTS provided the data and the primary researcher examined race among study participants' electronic health record for both cohorts and percentages were calculated with analysis in SPSS.



Appendix Four- Demographic Variable Table

	Scheduled (n =27) Mean (SD) or n (%)	Not scheduled (n = 50) Mean (SD) or n (%)	<i>p</i>
Age	60.81 (9.6)	59.54 (12.1)	.639
Gender			.300
Male	14 (51.9%)	32 (64.0%)	
Female	13 (48.1%)	18 (36.0%)	
Procedure type			.144
CABG	14 (51.9%)	35 (70.0%)	
Valve	9 (33.3%)	13 (26.0%)	
CABG and Valve	4 (14.8%)	2 (4.0%)	
Hospital LOS			.057
Less than one week	9 (33.3%)	28 (56.0%)	
One week or more	18 (66.7%)	22 (44.0%)	
Race			.292
White	27 (100%)	48 (96%)	
Non-white	0 (0%)	2 (4%)	

Appendix Five- Objectives Variable Table

	Objectives	Scheduled (n =27) Mean (SD) or n (%)	Not scheduled (n = 50) Mean (SD) or n (%)	<i>P</i>
Objective 1	Sum of Opioids	23.5 (12.5)	25.5 (10.6)	.470
Objective 2	Sum of Opioids with hospital length of stay Less than one week Greater than one week	n=9, 15.6 (6.1) n=18, 27.5 (13.1)	n= 28, 22.1 (9.8) n= 22, 29.8 (10.2)	.070 .533
Objective 3	Discharged on Opioids Yes No Unknown	13 (48.1%) 12 (44.4%) 2 (7.4%)	27 (54%) 18 (36%) 5 (10%)	.753
Objective 4	Sum of Nausea Medication	3.22 (2.7)	2.08 (3.0)	.107