

# Nursing Time Study for the Administration of a PRN Oral Analgesic on an Orthopedic Postoperative Unit

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## ■ ABSTRACT:

As needed (PRN) oral opioid analgesics are an integral part of many orthopedic postoperative multimodal pain management regimens. However, the unpredictable nature of this dosing method can lead to disruptions in the process of administering the medication, as well as be an interruption to regular nursing activities. This IRB approved quantitative time study tested the hypothesis that a significant amount of nursing time is required in the administration of PRN oral opioid analgesics on a postoperative orthopedic nursing unit. The purpose of this study is to evaluate the time necessary to complete the required steps related to the administration of PRN oral analgesics. Nurses from 28 nursing shifts used a personal digital assistant (PDA) to record the time needed to complete these steps. We determined that 10.9 minutes is the mean time required to administer PRN oral analgesics on this unit. Other time studies have evaluated the medication administration process as a whole. No time studies related to PRN oral analgesic administration have been reported. In phase I of our project, the data were summarized and will be used as a baseline comparison for phase II, in which we will evaluate an oral PCA medication administration system.

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After surgery, orthopedic patients experience pain due to preoperative pain conditions, tissue damage related to surgery, and physical activity related to functional recovery activities (Pasero & McCaffery, 2007). Combining opioids, non-opioids, and local anesthetics in a multimodal treatment approach has been shown to provide optimum pain management in patients undergoing an orthopedic procedure. In this patient population, pain is typically moderate to severe (Parvizi, Miller, & Gandhi, 2011; Peters, Brayton, & Ericson, 2006). In this regard, our orthopedic patients undergoing primary total joint replacement receive an oral opioid before (scheduled) and after surgery (as needed). These patients

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also benefit from perineural infusions of local anesthetics as well as adjuvant medications. We have eliminated intravenous patient controlled analgesia (PCA) for these patients.

PRN dosing is most effective when the patient understands to request a dose of medication before activity or before pain becomes severe. The patient must be educated to call the nurse to get the medication at the appropriate time. Disadvantages to this dosing method occur when a patient is reluctant to call so as not to be viewed as a frequent requester, or a patient may experience a delay in receiving medication when the call occurs randomly during other structured nursing activities. These factors can lead to less than ideal pain control. Also, there can be a decrease in patient satisfaction despite the nurse's efforts to keep up with the demands of PRN oral medication requests and administration (Pasero & McCaffery, 2007; Pasero, Quinn, Portenoy, McCaffery & Rizos, 2011).

This time and motion research study was designed to evaluate the time required to complete the necessary steps in the administration of a single PRN dose of oral analgesic on 5 West, one of our postoperative orthopedic units. This is a 30 bed unit located at UPMC Shadyside Hospital in Pittsburgh, PA. The unit is designed as a linear hallway of patient rooms in a square configuration surrounding the nursing station. Rooms at each corner of the unit are designed in a pod-like architecture with nursing work areas at each corner and computer workstations on wheels throughout the unit. An automated medication dispensing cabinet (AcuDose, McKesson, San Francisco, CA) is located in the central nursing station. This is where the nurse accesses all opioid medications for patients.

The hypothesis of this study is that the frequent delivery of PRN oral pain medications on this unit requires a significant amount of nursing time. The purpose of this project is to measure how much nursing time is required for this method of medication administration. The outcomes of phase I of this study will be considered a prerequisite to a phase II time and motion research study. Phase II will evaluate the effect on nursing time by introducing an oral PCA device so that a patient may self-administer oral PRN analgesics. Nursing time used to implement the device and assess patients will be evaluated as it relates to PRN medication administration, pain management effectiveness, and patient/nurse satisfaction related to using the device.

## BACKGROUND

In 2008, a time and motion study done across 36 hospitals by Hendrich, Chow, Sjuerczynski, and Lu defined

routine medication administration as a nursing practice that consumed a large part of nursing time. It was concluded that changes in work processes could offer a solution and save nursing time. Medication administration was identified as one of the top three targets needing improvement to increase the efficiency of nursing care delivery. This study was done in medical-surgical units with mixed patient populations (Hendrich, Chow, Sjuerczynski, & Lu, 2008).

The Medication Administration Time Study (MATS) by Elganzouri, Standish, and Androwich evaluated nursing performance around routine medication administration in three medical-surgical units before implementing a bar-coded medication scanning system. This study found that nurses averaged more than 15 minutes on each medication pass, were at risk for interruption or distraction 1.21 times per medication pass, and walked an average of five miles per 12 hour shift (Elganzouri, Standish, & Androwich, 2009). This study evaluated medication administration as a whole and did not evaluate the time needed to administer PRN oral analgesics alone.

In 1994, Ferrell and Griffith reported a unit based project done to address the nursing staff time associated with giving PRN analgesics before implementing an electronic medication dispensing system. The goal was to determine the nursing time used to administer oral PRN analgesics. In this project, data was collected by research assistants and nursing students using a stop watch. The goal was to determine the number of minutes that elapsed from when a patient requested pain medicine until the nurse responded and the medication was given. They found that the amount of nursing time used for the administration of a PRN oral opioid analgesic was 18.42 minutes per dose. This work was done as a unit based quality improvement project. However, this data was not published separately and was only cited in other publications (Ferrell & Griffith, 1994; B. Ferrell, personal communication, December 15, 2010).

In 2010, part one of a study by Cornell, Herrin-Griffith, Keim, Petschonek, Sanders, D'Mello, Golden, and Shepard studied the activities of 27 medical-surgical RN's through 98 hours of direct observation of workflow and computer use related to assessment, charting and communicating. It was concluded that nurses stop and start many times when trying to complete one task. Forty percent of the assessment, charting, and communication tasks that were observed were less than 10 seconds in duration. This demonstrates that nurses constantly switch activities in a random pattern leading to a chaotic pattern of work (Cornell et al., 2010). Additionally in 2011, Cornell, Rordan, Townsend-Gervis, and Mobley demonstrated that

this chaotic work pattern for nurses does not allow time for critical thinking. It was concluded that nursing workflow is disorganized, and tasks are rarely completed from start to finish, mainly due to interruptions (Cornell, Riordan, Townsend-Gervis & Mobley, 2011). The administration of PRN oral analgesics is a part of nursing workflow that can be affected by these factors.

Our time study evaluated total nursing time related to the tasks required in our process of PRN oral opioid analgesic administration. We included interruptions, task switching, documentation, and information retrieval from the electronic health record in our timing process. While previous time studies focused on medication administration and related nursing activities, no formal time measurement studies exist related to the nursing time required for the administration of PRN oral analgesics alone by nurses on an inpatient postoperative unit.

## METHODS

This IRB-approved qualitative time study was conducted to measure the time intervals of the tasks required for the usual administration of an oral PRN pain medication to postsurgical orthopedic patients using an electronic health record, bar code scanning, and a central electronic medication dispensing system. Medications used for PRN dosing on this unit are driven by pain intensity and pain score using 0-10 on a numeric pain scale: acetaminophen 650 mg every 6 hours PRN for mild pain (1-3); oxycodone (IR) 5 mg, or oxycodone 5mg and acetaminophen 5/325 mg, or hydrocodone/acetaminophen 5/500 mg every 4 hours for moderate pain (4-6); and 10 mg oxycodone (IR), 15 mg oxycodone (IR), hydrocodone/acetaminophen 7.5/750 mg, or 10/660 mg every 4 hours for severe pain (7-10). One medication is ordered per pain

intensity level. A breakdown of commonly used PRN oral analgesics used on this unit is presented in Table 1. This table shows that for a 6-month period (January 2012 to June 2012) approximately 54 doses in a 24-hour period were administered to patients on this unit.

The administration of a single oral PRN opioid pain medication was divided into five separate tasks. The time to accomplish each task was measured using personal data assistant (PDA) devices. Tasks were measured individually, since it is not possible to go from “start to finish” completely in one period of time. The data were collected utilizing the programmed PDA devices and consisted of tasks related to nursing practices, interruptions, and computer access or documentation during the administration of the medication.

The nursing staff received instruction on the PDA device, and the nurses were required to provide return demonstration as part of the training before the start of the data collection. Trial runs of data collection using the PDA were done and not submitted. This allowed the nurses to become comfortable and proficient using the PDA before the actual data collection began.

The PDA devices were programmed using the WorkStudy+4 Program from Quetech Ltd (Waterloo, Ontario). A touch screen was created for each step of the process. Nurses carried the devices throughout their shift and touched the screen for each task, including interruptions, at the beginning, and at the end of the task. The program recorded the amount of time elapsed during each task. Although nurses were encouraged to capture as many tasks as possible, there was no expectation that all the tasks could be captured during the shift because of multiple ongoing demands on nursing time. Devices were collected at the end of each shift, and the data were uploaded into a central database by the research assistant. The device was

**TABLE 1.**  
**Total ADC Transaction Dispensing Quantity for 5 West—January 2012 to June 2012**

Full Site Drug Description	Shift		
	Day	Evening	Night
Hydrocodone/acetaminophen (vicodin es) 7.5/750 tab	34	32	29
Hydrocodone/acetaminophen (vicodin hp) 10/660 tab	56	50	35
Hydrocodone/acetaminophen (vicodin) 5/500 tab	284	284	159
Oxycodone (immediate release) 15 mg tab	404	399	290
Oxycodone (immediate release) 5 mg tab	2,833	2,625	1,816
Oxycodone 5 mg & acetaminophen 325 mg 5 mg tab	2,833	2,625	1,816
Total	3,751	3,522	2,427
Grand total			9,700

Approximately 54 doses per day dispensed.

then cleared of previously entered data and stored in the central dispensing cabinet on the unit for security until it was retrieved for use by the next shift's nurse.

Accordingly, the following times were recorded after the patient requested medication: the time necessary for the nurse to answer the patient's request (Task #1); the time necessary to get the pain medication (Task #2); the time necessary to "Bar Code + Pain Score + Give Med" (Task #3); the time necessary to "Reassess Pain" (Task #4), and finally, the time necessary to "Return Next Task (Task #5). These tasks are further detailed below.

Task #1, "Answer Patient Call", began by timing when the patient called for medication. It was based on whether the patient informed the nurse directly of the need for pain medication or if the patient used the call light system on the nursing unit. If the nursing assistant informed the nurse for the patient, the task was initiated at the time the nurse was informed of the request. Patient wait times were not measured.

Task #2, "Get Pain Medication", was recorded on the PDA as a two-step sequential process. First the nurse would access the patient electronic record to verify that it was time for the medication to be administered. We determined that 3.5% of the time it was too early for the PRN medication to be administered. However, if it was determined that the patient could receive a dose, the next step was to access the automated dispensing cabinet. The cabinet uses password access and the nurse removes the ordered medication. In some instances, nurses had to wait for the previous user to complete their task before being able to gain access to the cabinet.

Task #3, "Bar Code + Pain Score + Give Med", required the nurse to use barcode validation, acquire a pain score/assessment, and administer the medication. Pain assessments include obtaining pain scores using a Numeric Pain Scale zero ("no pain") to ten ("the worst pain imaginable") along with quality descriptors. Sedation assessments are measured using the numbers zero ("none") to three ("unable to arouse"), or S ("normal sleep").

Task #4, "Reassess Pain", required the nurse to return to the patient to reassess the effectiveness of the medication using the same scales to evaluate the pain score and sedation score. Reassessment time was based on the route used to administer the medication. Oral (PO) medication is reassessed in 60 minutes. The nurse also described the outcome by evaluating if the pain was improved, not changed by the medication, worse, or if the patient was unable to report.

Task #5, "Return Next Task", was intended to measure the amount of time that was required to return to the next task after either giving the medication or

traveling to the patient room to do the pain reassessment. The "Return Next Task" time was counted twice because two trips to the patient room were required to complete the entire work process. Travel times were variable depending upon interruptions or delays that occurred while proceeding to the next intended task. Task #5 did not have enough data to do a 2.5% data trim at each end, so the data shown is from removing outliers only.

Nurses across 28 shifts participated in the data collection. Observations were made on the day, evening, and night shifts with some nurses participating in more than one shift during the 6 weeks of the study. All of the nurses involved were volunteer participants and ranged from novice to expert in experience level. Information such as the specific shift and patient assignments of a given nurse, related interactions with a specific patient, or other methods of pain management were not identified. While waiver of documentation of consent was granted by the IRB, a written statement about the research study protocol was developed and reviewed during inservices for the nurses who wished to participate.

Collected data were reviewed and subjected to a 2.5% data trim, which is an averaging method designed to reduce the effects of statistical outliers. This process removes a small percentage of the shortest and longest time frames for each task that may have been collected. The data trim was done to account for the nurse forgetting to terminate a task on the touch screen or terminating a task prematurely. Removing these outliers also accounted for differences in nursing work patterns.

## RESULTS

By the summation of the task times previously described, we determined that the mean time to administer a single dose of PRN oral analgesic on this unit is 10.9 minutes per episode of medication administration. Our data is based on the usual dosing regimen of the commonly prescribed PRN oral analgesics administered on this unit and includes separate times for each task and the mean time from the sum of tasks. Table 2 depicts these data. Our time study does not measure patient wait times, but demonstrates the amount of time used for each task as well as delays in the medication administration work flow. The 2.5% data trim was done at both the low and high times, since wide standard deviations were expected due to the different nursing staff experience levels, potential interruptions and varying nurse to patient ratios that occur from shift to shift. The minimum and maximum values listed are given to appreciate the wide variation in the acquired data.

**TABLE 2.**  
**Recorded Times for Steps to Deliver a Single Dose of Oral Pain Medication**

Recorded Task	N	Mean Minutes	+/- STD	Minimum Value Minutes	Maximum Value Minutes
Answer Patient Call for Medication	101	0.45	0.48	0.10	2.07
Get Pain Medication	111	1.84	1.22	0.40	5.14
Give Med + Pain Assessment + Barcode Validation	112	4.08	2.02	1.43	12.0
Reassess Pain + Document	32	0.95	0.52	0.30	2.18
Return Next Task	33	1.81	1.48	0.27	5.78
Summation of Data		10.9		2.77	33.0

N = number of timed events; STD = standard deviation.

Return Next Task was counted as 2x for two trips to the patient room for the completed process.

## DISCUSSION

The usual PRN dosing interval of oxycodone on this unit is every 4 hours. This dosing time frame allows each patient to potentially receive three doses of oral PRN pain medication in a 12-hour shift. If each episode of PRN dosing uses a mean time of 10.9 minutes, this translates to ~32 minutes per patient per shift. Considering an average 5:1 patient ratio, the nurse could potentially spend 2 hours and 30 minutes, or approximately 20% of the 12 hour shift, dispensing oral PRN pain medications to patients. This is based on the premise that all of the patients had the same orders for PRN pain medications and were consistently requesting the medication.

The results of phase I will be used as a baseline for comparison in a phase II study. Phase II will implement an automated patient controlled delivery device for oral PRN pain medications on the same nursing unit. The nurses will use PDA technology to time tasks related to the use of the device. A comparison of nursing time used in phase I will be compared with the amount nursing time used in phase II to evaluate the effectiveness of implementing this type of device.

### Limitations on the Research Design and Material

The limitation of this study is that it was only conducted on one orthopedic unit. Therefore, data reported

may not directly apply to other types of units where nurses may take different steps to achieve the same goal. However, the intent was to measure the potential amount of time that may be used for the administration of PRN oral analgesics in a postsurgical unit.

## CONCLUSION

Our study demonstrated that the average or mean time for the delivery of an oral PRN pain medication is 10.9 minutes on a postoperative orthopedic unit. This demonstrates that a significant amount of time during a nursing shift may be dedicated to the administration of frequent PRN oral analgesics. Future approaches to improve workflow and shorten this time may allow more efficient use of nursing time, improve patient care, improve effectiveness of PRN analgesic dosing, and improve patient satisfaction related to pain management.

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