Title Page

Missing Doses: A Performance Improvement Project

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Submitted to the Graduate Faculty of the

Department of Health Policy and Management

Graduate School of Public Health

in partial fulfillment of the requirements for the degree of

Master of Health Administration

University of Pittsburgh

2020

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UNIVERSITY OF PITTSBURGH

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Abstract

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**Missing Doses: A Performance Improvement Project**

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University of Pittsburgh, 2020

**Abstract**

Doses that are not available for administration to a patient at the time needed are known as missing doses. Missing doses affect the quality of patient care, staff satisfaction, and cause waste in manpower and in medications. This project was undertaken at a 363-bed acute care hospital in Pittsburgh, PA. The purpose of the project was to evaluate the extent and causes of missing doses and address processes to decrease missing doses. The project adds value to pharmacists and nurses due to the nature of their professional responsibilities. This project is also relevant to public health because the medications are not available when needed for patient care. Nursing staff from four inpatient care units and the Pharmacy staff participated. The project leader sent pre- and post-surveys to the Nursing and Pharmacy staff. After the pre-survey, missing dose documentation was collected and analyzed by the project leader for a period of two weeks. Subsequently, data were reviewed by the project team (nurses and pharmacists). Process changes were designed and implemented. The second phase of the study began with a second survey. Following that survey, missing doses were collected and analyzed a second time. As in the first phase, data were evaluated by the project team. During both phases, the survey and missing dose data were congruent in many of the issues noted. As a result of this project, there were noted improvements in 1) dispensing automation issues; 2) transfer issues; 3) the ability to locate medications on the patient care unit; 4) pharmacy turnaround time; and 5) nursing requests prior to Pharmacy’s ability to dispense and deliver. There are still opportunities for improvement. Such opportunities include the need for refined processes for the use of the pneumatic tube system, patient medication transfers, and the ability to locate medications on the patient care unit. Future endeavors of this project will include additional patient care areas. Also, a separate project will differentiate small and large volume admixed parenteral medications from ready-to-use products and non-sterile products. This project highlighted the complexity of the dispensing and administration of medications, both of which, are a part of the medication use process.

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Preface

My thanks to Assistant Professor Samuel A. Friede and Professor Susan J. Skledar. Their guidance, expertise, and time in this project are appreciated.

Thank you to Rosella Hoffmann, RPh, MBA for her support and participation and to all the project team members:

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Finally, thank you to staff on project Patient Care Units and to the Pharmacy leadership and staff. Without their insight and contributions, this project would not have the outcomes that it achieved.

# Introduction

Missing medications, also called missing doses, are doses of medication that are not available for timely administration to a patient. There are multiple reasons for missing doses, and more than one reason may contribute to each missing dose. To name only a few, reasons include 1) medication administration time changes; 2) medication not delivered to the patient care area (or not delivered in a timely manner); 3) pilfering; 4) borrowing from a different patient drawer; and 5) storage in an incorrect location (or storage of medications in multiple locations in the patient care area). ([O'Neil et al., 2014](#_ENREF_2)) Missing medications are a long-standing issue in hospitals.([O'Neil et al., 2014](#_ENREF_2)) Regardless of reason, the end result is that the right dose is not present for the right patient at the right time. This is a quality and safety issue and is relevant to public health because the medication is not present when needed for the patient’s care. A missing antibiotic in an immune-compromised patient can be lethal. Also, missing doses are a cause of frustration on the part of patients, nurses, and pharmacists. They also represent a waste of manpower due to the time used in searching for the medication, requesting a missing dose replacement, re-issuing the medication, and delivering the medication. Once received, or located, the nurse administering the medication needs to return to the patient to administer the medication. Finally, the patient may be waiting for a medication such as insulin, for example, before they can eat, or an analgesic medication before they can complete their physical therapy. In addition to the few reasons mentioned, another contributing factor to missing doses is that there are many dosage forms and types of medications that must be stored, dispensed, and administered in many different manners. This adds to the complexity of the medication use process. Hospitals strive to provide safe and effective therapy and use continuous quality improvement principles to try to refine their processes and care. The project was initiated and conducted by the author at a 363-bed acute care hospital in Pittsburgh, PA. Nursing and Pharmacy staff undertook the missing medication quality improvement program to improve the quality and safety of the medication use process with a secondary goal of increasing Nursing and Pharmacy staff satisfaction.

# Literature Review

A literature review was conducted by the author prior to the initiation of this project. A validated survey, to measure the satisfaction of nurses and pharmacists with the missing dose process, was not found. Therefore, the survey used for project purposes was created by the author.

A general literature search regarding missing doses was conducted using PubMed. The search was limited to the last twenty years. A bibliography of the most relevant publications for the intent of the author’s use are listed at the end of this essay

The literature review found scholarly articles with recommendations for decreasing missing doses and research conducted by others in the field of missing doses. Much of the recent research was regarding the results of implementation of medication tracking systems. Many of the issues and recommendations discussed in current literature were congruent with the results of this project. However, there was not a recent, systematic data collection and analysis of missing doses, such as undertaken in this project, discovered during the literature review. The missing dose project was initiated for this hospital to understand the specific issues and frequency of missing doses encountered by hospital staff during the delivery of their care and to determine the processes to decrease that frequency.

# Methods

The setting of the pilot project was four inpatient nursing care units. The patient care units were selected to allow review of missing doses in a variety in patient populations with differing care needs. The patient care units included General Medicine, Antepartum, Postpartum Mother Baby, and Oncology.

Prior to the project, the project team met, reviewed the survey questions, and discussed the methods of the project. The project team consisted of nurses and pharmacists.

This project was approved by Hospital Senior Leadership, Nursing, and Pharmacy. The project was approved as a quality improvement project by the health-system Quality Improvement Review Committee, as well as the University of Pittsburgh, Human Research Protection Office. After the project completion, data are to be secured in storage with a destruction date of five years. The author’s role was to develop and conduct the surveys, to analyze missing dose documentation within 24-36 hours, to analyze the results, to review those results with the project team, to implement or initiate process changes as developed by the team, and to conduct the second phase of the project utilizing the same methods as during the first phase.

The project graphic is outlined in Figure 1.

Figure 1: Project Outline

A voluntary, pre-project survey (Table 1) was made available to each member of the nursing staff on the pilot patient care units (approximately 100 nurses) and to each member of the inpatient Pharmacy staff (approximately 82 staff members). The survey was not given to nurses on Unit One during the project. This was due to a misunderstanding during distribution of the surveys. This survey was developed on-site for this project and created using “Forms” in Microsoft Office 365. A literature search demonstrated lack of a standardized and validated survey with a focus on missing doses. The goal of the survey developed for this project was to obtain descriptive statistics. The survey results provided insight into the thoughts and ideas of staff. The survey was open for staff response for twenty days during each survey period.

Table 1: Baseline Survey Questions and Responses

|  |
| --- |
| Satisfaction with the level of missing doses encountered daily on a scale from 1-5 (5 being the highest satisfaction): |
|  |
| Unit (Unit One, Unit Two, Unit Three, Unit Four): |
|  |
| Examples of frequent types and scenarios of missing doses (no patient specific data please, only general examples): |
|  |
| Biggest concern and/or barrier to decreasing missing doses: |
|  |
| Suggestions for improvement: |

After the initial survey, data were collected for a period of two weeks. Nursing and Pharmacy staff in the project areas were asked to manually document each missing dose on a missing dose log during the data collection period. Every missing dose documented was reviewed by the author for consistency within 24-36 hours. Each dose was tracked from the request for a missing dose until it was re-dispensed and administered to the patient. Data were collected and secured within the Pharmacy each day. Other data collected included: census for the units for each day, patient care unit, and person reporting the missing dose.

After the data were evaluated and categorized as to the reason for the missing dose, the interdisciplinary project team met and reviewed the results of the first survey and of the missing doses. Next project steps were identified. That is, based on the results of the data, recommended changes in process were developed.

The collated findings were shared with staff for review and comment to further refine the processes. The process changes were provided to the staff through training (e.g. staff meetings, training documents) and implemented after Phase One and prior to Phase Two.

During the process change period between the first and second phases of the project, an audit was performed on the patient medication cassette contents for each of the pilot patient care units. Patient medication cassettes are filled by Pharmacy and exchanged with the previous day’s cassettes every twenty-four hours. The audit was to determine if all the required medications were present in the patient medication cassette. If a medication was missing from the cassette prior to cassette exchange, that would be due to dispensing or automation issues. If the medication was missing after cassette exchange, that information would help clarify other reasons or scenarios of missing doses.

The second phase of the project began after allowing for the development and implementation of process changes. These changes are described in Section 4.4. As with the first phase of the project, the second phase began with project patient care area Nursing staff and Pharmacy staff participating in a survey. The survey was open for 19 days.

Missing dose data collection for the second phase began after completion of the survey. The data collection followed the same process as during the first phase.

After data analysis and collation of the information from the second phase, the missing doses results were presented to the interdisciplinary project team with final recommendations and project planning for any future phases.

# Results

## The Survey

The results of the first and second phase surveys are summarized in Table 2

Table 2: Results of First and Second Phase Surveys

|  |  |  |
| --- | --- | --- |
| **Survey Dates** | **Initial:** **12/20/18-1/8/19** | **Final:** **8/23/19-9/10/19** |
|  |  |  |
| **Total Respondents** | 64 | 45 |
|  |   |   |
| **Satisfaction Mean (Scale 1-5)** | 2.67 (Range: 1-4) | 3.3 (Range: 1-5) |
|   |   |   |
| **Locations responding:** |   |   |
|   |   |   |
| **Unit One** |   | 1 |
| **Unit Two** | 10 | 0 |
| **Unit Three** | 17 | 16 |
| **Unit Four** | 8 | 3 |
| **Pharmacy** | 29 | 25 |

The results give an indication of the level of satisfaction. Approximately 182 Nursing and Pharmacy staff members were given the opportunity to take the survey. The response rates were 35.2% in Phase One and 24.7% in Phase Two.

Categorized comments for each of the surveys are in the Appendix A. There are many themes running through the survey questions. Most of these themes appeared again during data collection.

For both project phases, the top four classifications for the frequent types and scenarios of missing doses were: 1) various examples of specific missing medication scenarios (e.g. missing AM medications, not enough daily doses in medication drawer, missing antibiotics, missing non-formulary medications), 2) nurse calls for medication that cannot be located, 3) nursing staff not waiting the appropriate time for medications from new orders, and 4) the patient transfer process.

For the survey question regarding biggest concern and/or barrier to decreasing missing doses, the top three reasons in both project phases were: 1) delayed doses causing rescheduling and interruption of care, 2) lack of awareness by Pharmacy and Nursing of the medication use process (communication also mentioned), and 3) nurses not checking all appropriate places and/or unaware of storage location.

For the final survey question regarding suggestions for improvement, the most frequent suggestions for the Phase One survey were: 1) need for a tube system process; 2) a uniform system for where medications are delivered; and 3) training and education (e.g. more Pharmacy electronic medical record training for pharmacy technicians). Phase Two highest responses were: 1) additional medications stocked in the Automated Dispensing Machine (ADM); 2) nurses to check available locations before phoning for a missing dose; and 3) a need for more frequent use of the pneumatic tube system.

## Missing Dose Data

The Phase One missing dose data were collected February 5 to February 17, 2019. After discussion of Phase One results with the project team and after making resulting process changes, Phase Two was initiated. Results are as noted in Tables 3 through 9. A total of 462 missing doses were reported in Phase One. The majority occurred on Unit Three, which is a general medicine patient care unit. The volumes of missing doses were also normalized to the census for the time period of missing dose data collection. Patient care Unit One was closed for construction during Phase Two.

Table 3: Volumes of Missing Doses

|  |  |  |
| --- | --- | --- |
| **Patient Care Unit** | **Phase One: Missing doses** | **Phase Two: Missing Doses** |
| **Unit One** | 51 |  |
| **Unit Two** | 22 | 44 |
| **Unit Three** | 234 | 130 |
| **Unit Four**  | 153 | 83 |
| **Location not recorded** | 1 |   |
| **Blank** | 1 |   |
| **Total** | **462** | **257** |

Table 4: Volumes of Missing Doses per Patient

|  |  |  |
| --- | --- | --- |
| **Patient Care Unit** | **Phase One: Missing Doses/Patient** | **Phase Two: Missing Doses/Patient** |
| **Unit One** | 0.44 |   |
| **Unit Two** | 0.08 | 0.4 |
| **Unit Three** | 0.69 | 0.36 |
| **Unit Four** | 0.48 | 0.24 |

The missing dose root causes, identified by the author, are listed in Table 5.

Table 5: Missing Dose Root Causes

|  |  |  |
| --- | --- | --- |
| **Missing dose root cause** | **Phase** **One** | **Phase Two** |
| Unknown | 98 | 97 |
| Potential automation issue | 50 | 8 |
| Request prior to time to dispense/deliver | 47 | 3 |
| Transfer issue | 40 | 17 |
| Potential process issue, not missing dose | 38 | 1 |
| On Unit  | 34 | 12 |
| In ADM\* | 26 | 30 |
| Not sent from Pharmacy-no manual pick | 22 | 2 |
| Not sent from Pharmacy | 17 | 24 |
| Potential Pharmacy turnaround time issue | 17 | 4 |
| Prn request-restock | 16 | 15 |
| Potential timing of cart delivery | 16 | 4 |
| On Unit-In Refrigerator | 9 | 3 |
| Bulk refill | 9 | 3 |
| Dropped or refused earlier | 7 | 0 |
| Call but on delivery | 4 | 4 |
| Naming | 2 | 0 |
| Missing dose prior and day supply not sent | 2 | 3 |
| Formulary issue | 2 | 0 |
| Oddity | 2 | 0 |
| Stock out | 1 | 0 |
| Not missing according to order start time | 1 | 4 |
| Delivery location or moved in patient cassette | 1 | 5 |
| Improper storage on Unit by Unit | 1 | 0 |
| Extra dose | 0 | 7 |
| Pharmacy removed dose too soon |   | 1 |
| IV room issues causing short date |   | 4 |
| Thrown up, destroyed, dropped on floor |   | 3 |
| Refrigerator issue; send every dose from Pharmacy |   | 1 |
| Expired on Unit; timing of doses |   | 2 |
| **Total:** | **462** | **257** |

\*ADM=Automated Dispensing Machine

Upon noting these root causes, with so many “unknown,” the team confirmed the need for the performance of an audit of the 24-hour patient cassette fill. The cart audit would allow further identification of potential automation issues and further delineate some of the unknown causes for missing doses. These causes included patient transfer issues, various examples of missing medications, delayed delivery of medications (e.g. pharmacy turnaround time), and nurse inability to locate medications that are stored in various locations. As can be noted, the reasons for missing doses were multifactorial~~,~~ supporting survey comments. Upon reviewing results, the project team agreed on several process changes in addition to the support for the cassette fill audit.

## Emergency Department and Labor and Delivery

Regarding transfer issues, it was noted that there are issues when a patient is moved between the Emergency Department (ED) to inpatient care units and with transfers from the Labor and Delivery Suite (LDR) to the Mother Baby Units. In the ED, many orders are auto-verified by the electronic medical record (eRecord) software through special medication selection and algorithms. When an ED order is auto-verified, one of two things happen: 1) the medication is either in the automated dispensing machine, or it needs to be dispensed from Pharmacy. Usually, on general patient units, when the medication is to be dispensed from Pharmacy, the dispensing label automatically prints on Pharmacy printers. The ED doses are not printed as labels for filling on an automated fill batch out of the pharmacy dispensing system. Pharmacy receives notification of doses through fill batches which list doses due in a specified time period during the day. This allows pharmacies to know which doses to prepare for impending patient medication needs. Therefore, when the patient is transferred out of the ED but before any scheduled fill batch prints, a missing dose can occur due to this timing issue between transfer and fill list. Along those lines, LDR doses are not on a dispensing fill batch due to the LDR being a procedure suite without, in general, running orders. Many doses are written as one time, versus continuous dosing, as are the ED orders. Doses can be missing on transfer for LDR patients if not monitored closely by the Pharmacy or communicated by Nursing.

## Training on Process Changes

There were several training points to assure Pharmacy staff were aware of the issues noted in the project. Through brainstorming, the project team had developed process improvement changes. These changes were communicated through staff meetings, email, and training procedures. These process improvement procedures included:

1. Send all doses needed for the patient until the next time patient cassettes will be exchanged. For example, if a dose is given twice daily, and the first dose of the day is missing, send both doses for a missing dose request.
2. Inform the Pharmacy Informatics Team of any repeated missing doses as one medication was not mapped in the dispensing automation, and the automation software did not recognize that the medication needed to be filled.
3. Deliveries should be made at the top of any designated delivery hour via a designated route. For example, the main patient medication administration times occur beginning at 7:30 AM and at 7:30 PM after nurses report for the new shifts. If a medication is due at 9 AM, for example, and was to be delivered at 8 AM, but the delivery did not leave on-time, the nurse will request a missing dose. Another example is that if a new order is verified, dispensed, and ready for delivery, a nurse will begin requesting that dose via a phone call or electronically if awaiting that dose for patient comfort or due to order status (e.g. an order start time of “Now”). Timely deliveries on a routine basis/route will allow nurses to know a pharmacy staff member will arrive on their unit at an approximate time each hour versus having uncertainty of deliveries.
4. A 7:30 AM “quick run” was initiated. Prior to the initiation of this “quick run”, an 8 AM run was performed by a Pharmacy technician and included medication refills for the automated dispensing machines, as well as any medications awaiting delivery to patient care units. After reviewing the data from Phase One, a “quick run” was implemented, and this occurs at 7:30 AM to deliver the medications awaiting delivery to patient care areas. This will allow those medications to be delivered in time for nursing to start administering after their morning shift report. After that “quick run”, the medication refill of the automated dispensing machine occurs. That refill was slowing the delivery of needed patient medications. The dispensing automation system alerts the pharmacy staff before the inventory of the medications in the automated dispensing machines reaches zero. So, there is time to delay the refills of the automated dispensing machines, instead of combining the deliveries and delaying medications for the morning medication pass for patients.
5. Make nurses aware that medications have been sent by the pneumatic tube system. Most Pharmacy staff sending a “Stat” or “Now” initial dose via pneumatic tube notify Nursing staff. However, when “tubing” an initial dose, for example, during the night, it is good to make the nurse aware. Doses may sit in a tube container in the tube station. Also, a few patient care units do not have tube stations, and nurses need to go to another close-by unit to obtain the medications from the tube system.
6. Stock key medications in the automated dispensing machine on the patient care unit. (ADM’s have software logic to allow pharmacist review of any medication order before non-emergent medications can be given to a patient.) For example, every year, influenza vaccine needs to be made available through the inpatient care units’ automated dispensing machines, especially due to the patient care goal of assuring vaccine administration while the patient is cared for in the hospital. Also, many orders are “as needed” (a.k.a “prn doses”) and are not scheduled to be administered but are administered to the patient when needed or requested by the patient. More medications that are typically prn were added to the automated dispensing machines on each patient care unit. For example, many pain and anti-nausea medication orders are “as needed”. Non-controlled substance prn medications are dispensed in bulk and refilled when needed as many times they are not used. This bulk process allows decreased Pharmacy inventory and decreases daily re-dispensing of medications that may not be administered (i.e. decreased workload). Prn refills are not true missing doses, but they are medication refill requests. Many missing dose requests or requests for medications that occur before pharmacy can dispense and deliver are due to prn initial doses or refills. Nurses request urgent fills due to wanting to assure patient comfort is met. So, adding common medications to the automated dispensing systems assures the pharmacist reviews and verifies the order, yet decreases the time for the dose to be administered to the patient.
7. Technicians should know all the possible storage locations for medications outside of the medication carousel. Several pharmacy technicians were throwing away manual fill labels if the medication was not in our automated inventory carousel. Re-education occurred to assure all Pharmacy technicians know where to look for medications not stocked in the automated carousel (e.g. non-formulary stock) or know to ask the pharmacist present to help to assure the medication is dispensed and delivered.
8. Pharmacy staff should leave non-administered intravenous medications on the units, until they expire, are discontinued, or the patient is discharged, as nursing administration times for medications can vary. The pharmacy technicians return medications from the patient care units that are expired or discontinued. Many technicians were returning doses to the Pharmacy, for example, of antibiotics that were past their due time of administration. It is appropriate to bring medications back to the pharmacy if the medication is expired due to stability of product. Technicians were made aware that nurses do not administer antibiotics by looking at the due time on the label. They may give a dose that is due at 6pm as the 12am dose, if it is the right dose for the right patient. Nurses do review and barcode scan patient bracelet barcodes and do review and scan doses to assure the “five rights of medication administration” (e.g. right patient, right drug, right dose, right route, right time).([Federico, 2010](#_ENREF_1)) They also look at the expiration date and time; however, they traditionally do not pay attention to the pharmacy batch generated dose due time. If the medication order is not discontinued and, if the dose will not expire, the Pharmacy Technicians are to keep doses on a unit for 24 hours past due time. It was thought that a change in process for nurses to use the dose prepared for a specific due time would not be possible. There is a risk of waste due to a medication expiring before it can be administered. However, medications are checked during Pharmacy medication deliveries for the potential of expiration. Also, Pharmacy fill batches control dose preparation, so a large supply of a medication for a patient is not in the patient care area at one time. These activities decrease the potential for expired medication being present and decrease the potential for medication wastage due to expiration before administration.
9. Staff should know that for each Unit, there are different models of patient medication cassette locations. On Unit One and Unit Two, the medications for each patient are stored in the medication towers of the automated dispensing machine. On Unit Three, the cassettes are in each nurse’s workstation-on-wheels. On Unit Four, patient medications are placed in a locked drawer built into cabinetry outside of the patient rooms. There are different models and different locations on each unit for these cassettes. On Unit Three, the medication packaging is bulky and large compared to the size of the workstation drawer for each patient’s medications. On Unit Four, the nurses do not have workstations-on-wheels, so their supplies such as syringes, alcohol wipes, cups are kept in the same drawer as medications. The design of Unit Three and Unit Four medication drawers make finding medications difficult. There were several examples of medications being present but unable to be found within the drawer due to size of drawer or the presence of other non-medication items. While this is still in-process at the time of this paper, a pilot matrix insert was installed on Unit Four medication drawers with plans to install these matrices in all Unit Four medication drawers. This matrix insert is labeled to locate medications and the supplies. Nursing and Pharmacy staff have accepted this solution and would like to pursue further in the future on other patient care units. Also, a search for new workstations-on-wheels is being conducted for Nursing. Pharmacy requested larger medication cassettes for Unit Three. For Unit Four, Pharmacy input was to assure nursing supplies could be stored separately in the workstation-on-wheels, as opposed to being mixed with medications.
10. A one-page inventory listing for the contents of each automated dispensing machine was created for and distributed to each unit. Missing doses were noted to occur because the nurse was unaware the medication was in the automated dispensing machine. The inventory in each automated dispensing machine is not uniform across the hospital. This is due to the different types of medications needed for each patient care unit. Only the most frequently vended medications from the automated dispensing machine were listed. The list did not include controlled substances as most nurses knew controlled substances are in the automated dispensing machines due the need for secure storage. The list was requested as one-page, cross-listed between generic and brand medication name, for easy reference. One side of the paper has an alphabetical listing by brand names. The other side of the paper has an alphabetical listing by generic name. The list included the generic name of the medication and the brand name of a medication to provide a reference for nurses. The thought was that each nurse workstation-on-wheels could have a copy. This one-page paper was deemed more helpful by the project team than the many page inventory report generated by the automated dispensing machine. Nursing noted this would be a help to nurses who typically worked in different patient care areas due to the need of staffing coverage. Finally, the team investigated whether integration between the eRecord (electronic medical record) and the automated dispensing machines would allow nurses, working within the eRecord, more visibility as to the contents of the automated dispensing machine. While not possible on the current automated machine platform, there is a potential for improved function in moving from the legacy platform to the updated automated machine platform. This function has been approved for further review during a future platform change.
11. Utilize a transfer report for medications between patient locations. At this institution, the process is that nurses transfer medications on patient transfer. Medication orders are not discontinued and re-entered, so medications are to be transferred with the patient. Any order changes or updates are performed by the receiving provider team, if a different team. Instances of medication transfers not occurring was documented during this project. It is also process that a transfer report within the electronic medical record is to be completed by nurses even after transfers to the intensive care unit. A field on this transfer report details whether medications were transferred and has reminders to check such areas as refrigerators or respiratory medication storage areas. The request was that this field become mandatory to help remind staff that medications need to be transferred with patients. Also, this report can be used for quality improvement and educational processes. The Directors of Clinical Informatics agreed. This group of directors is the approving body for nursing informatics builds or changes in the electronic medical record. This request was implemented as a result of this project and their agreement and support.
12. Implement a cassette fill update: The hospital’s automated robot patient cassette fill is performed by another hospital’s pharmacy robot. Patient medication cassettes are delivered to our pharmacy prior to our 24-hour patient medication cassette exchange. There was not an automated or manual update to the medication cassettes after the fill was sent to the robot for orders verified, modified, or discontinued in the time period between the cassette fill and cassette exchange. Additionally, no doses were set aside for later addition to the cart before cassette exchange. While there was a process to mitigate this issue, it was not effective. So, any new doses from that time period were sent up and then at risk for being returned in the exchanged cassette. Those doses would be missing the next day. Between phases of the project, Pharmacy instituted a cassette fill update which was tested and built within the electronic pharmacy dispensing system. That updated fill list contains order changes that occurred between the initial robot fill list and cassette exchange. Finally, Pharmacy narrowed the time between completion of the cassette fill and the 24-hour time range of doses in the patient cassette. Therefore, Pharmacy is delivering the medications needed right before the doses in the 24-hour cassette are due.

## Staff Position and Reporting Methods

Table 6 details the employee position of the staff reporting the missing doses during both phases of the project. Pharmacy staff logged the most missing doses during data collection. Pharmacy staff recorded doses on a missing dose log when a missing dose request was received. Nurses recorded missing doses on an identical log located in a convenient, monitored area for their use on each Unit.

Table 6: Position of Staff Reporting Missing Dose

|  |  |  |  |
| --- | --- | --- | --- |
| **Phase One** |   | **Phase Two** |   |
| **RN** | 50 | **RN** | 21 |
| **RN/Rx** | 45 | **RN/Rx** | 25 |
| **Rx** | 364 | **Rx** | 202 |
| **Rx/Rx** | 1 | **Rx/Rx** | 6 |
|   |   | **RN/RN** | 1 |
|   |   | **Rx/RN/Rx** | 2 |
| **Blank** | 2 |   |   |
| **Totals** | **462** |  | **257** |

Most missing doses were requested via electronic request from the electronic medical record as denoted in Table 7, which includes data from both project phases. Phone calls were the next highest in frequency. Anecdotally, several pharmacy staff commented that there were less phone calls and requests made both by phone and electronically. This is thought to be due to a “Hawthorne Effect” due to the immediate timing with project data collection.([Stand, 2000](#_ENREF_4))

Table 7: Missing Dose Notification Method

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Phase One** | **Phone** | **Phone &****eRecord** | **eRecord** | **In-Person** | **Unknown** | **Blank** |  |
|  |   |   |   |   |   |   |   |
| **Unit One** | 21 | 4 | 23 | 3 |   |   | **51** |
| **Unit Two** | 13 |   | 6 |   |   | 3 | **22** |
| **Unit Three** | 27 | 7 | 159 | 31 |   | 10 | **234** |
| **Unit Four** | 44 | 4 | 101 |   |   | 4 | **153** |
| **Blank** | 1 |   |   |   |   |   | **1** |
| **Unknown** |   |   | 1 |   |   |   | **1** |
| **Totals** | **106** |  **15** | **290** | **34** | **0** | **17** | **462** |
|   |   |   |   |   |   |   |   |
|   |   |   |   |   |   |   |   |
| **Phase Two** |   |   |   |   |   |   |   |
| **Unit One** |   |   |   |   |   |   |   |
| **Unit Two** | 20 | 1 | 22 |   |   | 1 | **44** |
| **Unit Three** | 28 | 7 | 89 |   | 2 | 4 | **130** |
| **Unit Four** | 31 | 1 | 50 |   | 1 |   | **83** |
| **Totals** | **79** | **9** | **161** |  | **3** | **5** | **257** |

## The Cart Fill Audit

In addition to the above actions and before Phase Two, an audit was performed on the 24-hour patient medication cassette fill.

The pharmacy dispensing software creates batches of medication lists needed for each patient. These batches can be run several times a day depending on the type of medication dosage form. In the case of non-parenteral dosage forms such as tablets or capsules, the batch patient cassette fill occurs every 24 hours at our hospital. The audit was performed on June 6, 2019. The purpose was to determine if there were any issues with patient medication cassette fills. These issues could be caused by the automation or by manual fills for items not stocked in the automated robot, which fills the patient cassette. Another goal of this audit was to help define causes of any missing doses during the cart fill audit period when doses were assured to be in the cart at 24-hour patient cassette exchange. This missing doses for this patient cassette fill are summarized in Table 8.

Table 8: Missing Dose Root Cause from Cart Fill Audit on June 6, 2019

|  |  |
| --- | --- |
| Doses were in patient cassette during the audit but missing before administration. (One dose may have been due nurse not knowing generic name.) |  3 |
| In cassette, but patient transferred. | 1 |
| In ADM, but patient transferred to another Unit without medication in ADM\* | 1 |
| Prn refills | 1 |
| Prn refill and no initial doses sent when order initially verified by pharmacist | 1 |
| Unknown (Doses should have been there from daily sterile compounding batches or from new orders but were not.) | 6 |
| Dose requested before pharmacist could verify and deliver. | 4 |
| IV fluid refill (not a missing dose) | 1 |
| **Total** | **18** |

\*ADM=Automated dispensing machine

It was noted during this cart audit that one cassette and its set of meds were missing for a patient. This patient had been hospitalized for a relatively long period of time. The robot that completes the hospital cart fill is at the nearby hospital that fills our 24-hour patient cassettes. This patient had been automatically discharged due to an inactivity setting in that automation system. The custom code to allow the other hospital to fill the patient cassettes does not recognize order activity in their automatic discharge settings. So, in cooperation with the neighboring site, we increased the time on their automatic discharge setting. Thus, one reason for missing doses was corrected due to this audit. Once again, many of the same issues as noted in Phase One occurred. These missing doses were due to misunderstanding of generic vs. brand names, transfers, prn medication refills, and doses requests prior to pharmacy verification and delivery. (Pharmacy has a two-hour maximum turnaround time for non-STAT or non-NOW doses.)

## Phase Two

The Phase Two data collection period was August 26 to September 8, 2019. Table 4 summarizes the results number of doses normalized to census and is compared to Phase One. During round 2, some missing doses were not recorded on an evening shift due to staff reporting being too busy to document. Key findings from the project are Summarized in Table 9. Detailed discussion of these findings follows that table.

Table 9: Project Key Findings

|  |  |
| --- | --- |
| **At Conclusion of Phase Two** | **Further Resolutions Pending** |
| Improved Automation Dispensing Issues | Refinement of Pneumatic Tube Processes |
| Improved Patient Medication Transfers | Patient Medication Transfer Process |
| Improved Ability to Locate a Medication on a Patient Care Unit | Ability to Locate a Medication on a Patient Care Unit |
| Improved Pharmacy Turnaround Time | Implementation of a Medication Tracking System |
| Decreased Requests Prior to Ability to Dispense and Deliver |   |
| Decreased number of doses not sent by Pharmacy due to technicians now performing manual picks |   |
| Overall doses not sent from Pharmacy increased due to various reasons |   |
| No change for "In ADM" missing doses |   |

1. While not statistically analyzed, there was noted to be a decrease in potential automation issues, as noted in Table 5. This seems due to the cart fill update that was instituted between Phase One and Phase Two. Also, the increase in time before a patient is discharged from the robot software due to inactivity has most likely contributed to a smaller number of missing doses. Along these lines, the category of “Timing of Cart Delivery?” also had fewer missing doses.
2. Nursing requesting doses prior to the ability of pharmacy to verify and dispense decreased. This may be due to improved deliveries, increased prn medications stocked in the automated dispensing machine, phone calls to the nurse when tubing medications, and other changes made due to information gleaned from the first phase of the project. It cannot be ruled out that there was a change in behavior during data collection; however, depending in the urgency of the need, nurses would not wait to request a medication if needed for a patient. So, the odds of this reason seem lower.
3. While the transfer report data field change regarding the status of whether medications were transferred with a patient was pending, there was a drop in the number of transfer issues. This may have been due in part to the discussion and education, and focused training, on transfer issues. There are still issues with assuring ED and LDR doses are not missing, so staff awareness and education for using transfer reports is ongoing along with determination of any potential automated reminder.
4. Another change noted during Phase Two was the decreased report of missing doses that already have been delivered to the patient care unit and not located by the nurse. That is, it is surmised that during the project and after sharing of results, nurses were looking for medications in the various potential locations before reporting a missing dose. Of note, a reality that nurses have many and different places to look for medications was noted during both project phases. Medications can be in patient cassettes or drawers, refrigerators, bulk storage areas, and in automated dispensing machines. Also, for several years, there have been ongoing medication shortages.([Practices, 2010](#_ENREF_3)) In order to assure a supply of medications for patients, dosage forms may change according to what is available for purchase by the Pharmacy. For example, an antibiotic may be in one of three different types of premixed bags, available in syringes, and may be refrigerated or not refrigerated. Finally, unless manually added during order verification by the Pharmacy, there is no note to direct the nurse to the correct storage locations. So, objectively, nurses have different places to look that may not be the same location on each unit, for example, if covering another area. That dosage form and its storage may change. The nurse must look rather than be directed to its location by some electronic means such as the medication order on the medication administration record. This is all done while they are trying to deliver timely and accurate medication to the correct patient. Another variable is assuring that the pharmacy technician delivering the medications remembers to which location to deliver these medications. As mentioned, that changes based according to each patient care unit.
5. The number of manual pick doses not sent from the Pharmacy decreased due to specific procedure training for the pharmacy technicians.
6. As Table 5 details, doses not sent from pharmacy increased slightly. A few examples of missing doses in this category:
	* A dose was administered in ED, but doses were not sent after patient transfer and before the pharmacy fill list was generated.
	* No initial doses were sent on a prn order.
	* A dose was sent at 11 AM for a 10 AM dose.
	* An order was entered as a “Patient Take Own Medication” dispense category, for which a dose is not generated on the pharmacy fill batches.
	* The dose was in the sterile compounding room and was in process of being admixed.
	* The medication needed to be pre-packaged into unit dose packaging as it was available in bulk quantity.
7. Of note, for the category of “In ADM”, there was essentially no change. However, the one-page listing of medications stocked within the automated dispensing machine had been distributed just three days prior to Phase Two data collection.
8. As a result of reviewing comments made by Pharmacy staff during data collection, more detailed training for current staff and for orienting staff needs to occur regarding the pharmacy dispensing system logic that works in the background of the Pharmacy dispensing application. For example, even though the electronic pharmacy dispensing system generates a dose request for dispensing, that does not mean the dose was dispensed. As can be seen from the data in this project, doses were generated but, for various reasons, they were not filled, dispensed, delivered, or located at the time of need. A more thorough understanding of the system would help prevent some of the misunderstandings of a complex system that involves manual, automated, and communication processes. For example, a dose may be generated by the pharmacy system. Depending on the time due, the pharmacy fill lists may generate the label for the time that dose is due. Fill lists need to run well before the dose is due to allow time for dispensing and delivery to the patient care area. So, an understanding of how and when doses will be generated needs to be understood in order to troubleshoot and understand why a dose is missing and to prevent missing doses. Also, the electronic pharmacy dispensing system may generate a dose, but the automation may not fill that dose request due to a variety of reasons. The order for the medication or the dose request may not have been sent on the interface to the automation. It was noted that some Pharmacy staff misunderstood that a dose was dispensed because the dispensing system requested a dose. The automation needs to be checked to assure a dose was dispensed. New and more detailed training development is in process regarding the use and the logic of the pharmacy dispensing system. The interplay between that system and the overall electronic health record and the dispensing automation is also being detailed. The pharmacy dispensing system, as part of the electronic health record, and the automation are designed to work together to allow preparation and dispensing of the variety of dosage forms needed and to accommodate the methods the pharmacy uses to prepare and dispense these doses. It seems that one of the biggest improvements on this project came from a correction to the automation, which does not require human or manual touches.
9. The author, who evaluated each missing dose in this project, changed her judgement during the second phase regarding a specific type of missing dose. For example, a process of nurses ordering intravenous drips when needed was misunderstood, and those drips should have been graded as missing doses in Phase One. Instead, they had been graded “process, not missing dose”. Also, regarding differences in data compared with Phase One, there were seventeen doses recorded as missing due to what was determined to be an inactivity discharge setting during the cart fill audit. These were not recognized as an automation issue during the first phase. A few missing doses from Phase Two were due to a short stability due to a sterile compounding room issue that occurred briefly during data collection.

# Discussion

The phases of this project were designed to collect and evaluate missing doses to improve the quality and safety of the medication use process and to increase Nursing and Pharmacy staff satisfaction.

The survey comments demonstrate the varied reasons for which a missing dose can occur. This makes the procedure for correcting multi-faceted and increasingly complex. While the survey was not standardized or validated and solely for this project, there is still information to be gleaned from staff comments. A desire to improve the system or frustration may have influenced the responses that were obtained.

Many of the issues addressed on the surveys were congruent with the data collection results. Examples are nurses not being able to find medications due to many storage locations; changing dosage forms and storage locations; a problematic transfer process; the need for a better tube system use process; and pharmacy turnaround time.

The author, survey results, and the project team offered solutions. Some of these potential solutions were instituted by the author and the project team. These solutions included training regarding sending enough doses for the entire day, not removing medications after their due time but before they expire, stocking additional medications in automated dispensing machines, and listing medications in the automated dispensing machine.

As a result of the data, changes were made, and improvements were realized. Improvements occurred regarding 1) automation issues, 2) requests made prior to pharmacy being able to dispense and deliver, 3) transfer issues, 4) medications on the unit and not located by the nurse, and 5) pharmacy turnaround time. The decrease in pharmacy turnaround time did not seem to be due to order verification and review by pharmacists. The delay in pharmacy turnaround seems more often due to deliveries not being made in a timely manner.

While there has been improvement in some areas, there is a potential that these improvements will not be sustained without continued monitoring of such items as timely deliveries or training. The training content is summarized in Table 10 and described in further detail below that table.

Table 10: Pharmacy Education/Training Points

|  |
| --- |
| Deliveries should be made at the top of any designated delivery hour via a designated route. |
| Send all doses needed for the patient until the next time patient cassettes will be exchanged.  |
| Leave non-administered intravenous medications on the units, until they expire, are discontinued, or the patient is discharged. |
| Make nurses aware that medications have been sent by the pneumatic tube system. |
| Staff should know that for each Unit, there are different models of patient medication cassette locations.  |
| Utilize a transfer report for medications between patient locations. |
| Inform the Pharmacy IT group of any repeated missing doses |
| Technicians should know all the possible storage locations for medications in the Pharmacy outside of the medication carousel. |
| Perform detailed training for current staff and for orienting staff regarding the pharmacy dispensing system logic, as well as, its interaction with the dispensing automation. |

Based on the work by this author, orientation and ongoing training will specifically detail:

1. Timely deliveries at the top of the hour via a designated route need to occur with no delays in the delivery run.
2. If a dose is missing, assure enough doses are sent to care for the patient until the next 24-hour patient cassette exchange.
3. Do not remove a parenteral medication based on the medication label due time if that medication order has not been discontinued or if the medication has not reached its expiration date and time.
4. The rationale and need for a “quick run” at 7:30 AM need to be communicated to all Pharmacy staff with accountability for all.
5. Standardized delivery locations need to be developed for patient care units.
6. Admission, discharge, and transfer (ADT) notifications and daily reports are to be used to help monitor patient transfers and assure medications for a specific patient, and not the prior patient, are in the appropriate patient medication location. This will also help with ED and LDR transfers to assure medication doses are available when needed.

Hospitals are busy places, and during the workday, detailed review of why each dose is missing does not occur. There can be longstanding issues that remain unresolved without scrutiny. While needing to keep automation processes simple to troubleshoot, there does need to be an understanding of the basic framework and pathways of the dispensing systems. This training needs to be consistent and formatted to prevent having to learn while using the system or not understanding the system at all.

It must be noted that the physical dispensing and delivery of the dose is only one part of the pharmacists’ thought processes. All these issues are in addition to the clinical focus needed during the dispensing process. A system that is fraught with dispensing issues affects the ability to focus on the clinical care.

Missing doses affect Nursing. The provision of their care can be delayed resulting in poor patient experience and quality of care. Nursing time is also taken to try to locate medications. Also, missing doses cause more time being spent on medication administration. This is due to the need for the nurse to return to the patient’s room additional time(s) to complete the medication administration process.

Follow-up is ongoing for several items that take longer to implement. The matrix inserts for the patient medication drawers on Unit Four are in process. Process refinement needs to occur for medication transfers during patient transfers, as well as, for using the pneumonic tube for delivery of medications.

Also, as a result of this project, the health-system will pursue the listing of ADM medication queues on the electronic medication administration record (eMAR) to help nursing staff know if the medication is in the automated dispensing machine

 For any future phases of this project, we would conduct this analysis in our other patient care units. The units selected had varied types of care, but a review of all patient care units might provide additional insight and value. We would also assure that all staff had an opportunity to complete the surveys. Additionally, we would delineate whether doses were parenteral products admixed in our cleanroom or not. This would be important due to the different dispensing processes for our sterile compounding cleanroom. While those doses were included in this project, delineating them may have given us more information.

Finally, a discussion item that arose from this project involves the idea of a medication tracking system, which will be implemented after a successful pilot program at another hospital. A tracking system would help Pharmacy monitor where medications are being delayed for dispensing and delivery. Also, it would allow Nursing to determine the status and locations of medications for which they are waiting or cannot locate. This would provide an aid to communication for the ordering, dispensing, and administration pieces of the medication use process.

The positive impact on quality, safety, time, patient experience, and staff experience involved with missing doses are noted results of this project.

# Conclusion

This project was undertaken to improve the quality of our patient care as part of our continuous quality improvement efforts. Staff seemed motivated to participate in this issue as it affects their ability to provide care to patients and causes increased workload. The surveys and the data were congruent in their findings. These findings allowed this hospital to refine processes with improved results. While there are short-term improvements which were able to be implemented, there are also longer-term projects to be pursued. As a result of this project, information is now available that can be used to continue to make improvements to minimize the number if missing medications.

Appendix A: Tables of Results from the Surveys

Table 11: Phase One: Survey Question: Examples of frequent types and scenarios of missing doses

|  |  |
| --- | --- |
| **Classification** |   |
| Missing medications (various example: antibiotics and AM medications) | 25 |
| Nurse: Phone call and cannot locate medication | 12 |
| Nursing staff not waiting appropriate time for new orders | 10 |
| Transfer process | 9 |
| Pharmacy turnaround time | 4 |
| Tube system usage: process issues | 4 |
| Patient admission >24 hrs. and missing medications | 3 |
| Nurse and/or Pharmacy staff store in wrong location | 3 |
| Lack of familiarity with ADM contents/floor stock\*  | 3 |
| Medications in many different storage locations | 3 |
| Medications are there and then removed (e.g. refrigerated IV's) | 3 |
| Phone and electronic requests for same missing dose | 3 |
| Medications showing filled on cart fill are missing | 2 |
| Many self-medication kits\*\* | 2 |
| Medication dropped on floor or wasted | 2 |
| Dose missing due to 24 hr. medication cassette exchange | 1 |
| Multiple phone calls for same medication after dose sent | 1 |
| Pharmacy staff not sending enough doses for the day when a dose is missing | 1 |
| Same medication in different dosage forms with different storage (e.g. IV admix vs. premix) | 1 |
| New admission medications missing the next day | 1 |
| Lack of understanding of medication use process | 1 |
| Nurses calling and not looking for medications | 1 |
| Nursing staff not using items at scheduled time that are short-dated and thus expire before administration | 1 |
| Auto-verify in Emergency Department | 1 |
| Too many items in refrigerators and drawers (clutter) | 1 |
| Wrong dosage form | 1 |

\*ADM=Automated dispensing machine in a patient care area

 \*\*Self-medication kits are for Labor and Delivery and consist of

 acetaminophen and ibuprofen oral dosage forms.

Table 12: Phase Two: Survey Question: Examples of Frequent Types and Scenarios of Missing Doses

|  |  |
| --- | --- |
| **Classification** |   |
| Missing medications (various examples: antibiotics, AM medications, IV medications, non-formulary meds, new orders, and not enough daily doses) | 18 |
| Nursing staff not waiting appropriate time for new orders | 7 |
| Nurse: Phone call and cannot locate medication | 7 |
| Transfer process | 3 |
| Pharmacy turnaround time | 3 |
| Nurses calling and not looking for medications | 2 |
| Tube system usage: process issues | 1 |
| Same medication in different dosage forms with different storage (e.g. IV admix vs. premix) | 1 |
| Nurse trying to locate incorrect medication on incorrect patient | 1 |
| Nurse lack of familiarity with generic name of a product | 1 |
| Nurse phone call for medication before administration time | 1 |
| Many times, first dose missing | 1 |
| Temporary locations ("virtual beds"): Doses not sent | 1 |
| Medication on delivery when missing dose requested | 1 |
| "As needed medications" not stocked in ADM and Pharmacy system dispense qty = 0\*\* | 1 |
| Dose requests left on Pharmacy printer | 1 |
| Medications not removed after discharge/transfer | 1 |
| Non-standardized ADM stock between patient care areas | 1 |
| "As needed" doses removed during 24 hr. cart medication cassette exchange | 1 |
| “As needed” orders with no initial doses sent | 1 |
| Medication delivered to incorrect location on Nursing Unit | 1 |

 \* "As needed" medications are not scheduled, only given as needed

 within prescribed parameters.

 \*\*ADM= automated dispensing machine in patient care area

Table 13: Phase One: Survey Question: Biggest Concern and/or Barrier to Decreasing Missing Doses

|  |  |
| --- | --- |
| **Classification** |   |
| Delayed doses causing rescheduling and interruption of care | 10 |
| Lack of awareness by both Pharmacy and Nursing-understanding of medication use process (communication also mentioned) | 8 |
| Nurses not checking all appropriate places and/or unaware of storage location | 7 |
| Pharmacy turnaround of missing doses | 5 |
| Multiple locations for medication storage in patient care areas | 4 |
| Multiple calls for same item (e.g. tubed and not taken out of tube) | 3 |
| Tracking system needed for medications | 3 |
| Frequent phone calls  | 3 |
| Lack of understanding of why medications are missing | 1 |
| Confusion of how to address the missing dose issue | 2 |
| Lack of a tube station | 2 |
| Lack of a method to keep nurses aware of changing storage locations due to different products | 1 |
| Pharmacy call offs or understaffing | 1 |
| Pharmacy assuring correct medication is sent to the Unit | 1 |
| A better process is needed for Labor and Delivery patients and Emergency Department patients transferred to different patient care areas | 1 |
| Confirmation of medication request through electronic health record (e.g. two-way communication) is needed | 1 |
| Inventory levels | 1 |
| Misplaced medications | 1 |
| Pharmacy not checking medication fill history of an order to determine missing dose cause | 1 |
| New order with requests prior to Pharmacy being able to verify | 1 |
| Self-medication kits being ordered ASAP\* | 1 |
| A curiosity-some nurses are frequent callers while others are not | 1 |
| Patient satisfaction | 1 |
| Pharmacy questioning the medication not being on Unit and asking if nurse looked in different locations | 1 |
| Time taken to retrieve medications from the Pharmacy medication inventory carousel or the sterile compounding room | 1 |
| Lack of policy and procedure enforcement | 1 |
| Lack of implementation of new technology | 1 |
| Medications removed by Pharmacy prematurely from patient care area | 1 |
| Patient refusal of medications and extra doses in the drawer | 1 |

\*Self-medication kits are for Labor and Delivery and consist of acetaminophen

 and ibuprofen oral dosage forms

Table 14: Phase Two: Survey Question: Biggest concern and/or Barrier to Decreasing Missing Doses

|  |  |
| --- | --- |
| **Classification** |   |
| Nurses not checking all appropriate places and/or unaware of storage location | 4 |
| Lack of awareness by both Pharmacy and Nursing-understanding of medication use process (communication also mentioned) | 3 |
| Delay in patient care | 3 |
| Need a functional IV room for longer medication stability and decreased wasted IV compounding time | 2 |
| Medications not transferred with patient | 2 |
| No one will answer phone in Pharmacy | 2 |
| Multiple locations for medication storage in patient care areas | 1 |
| Pharmacy turnaround of missing doses | 1 |
| New order with requests prior to Pharmacy being able to verify | 1 |
| Staff not accountable for missing doses | 1 |
| Volume of phone calls, use electronic requests | 1 |
| Lack of assistance from other groups in the health system and hospital | 1 |
| No concerns | 1 |
| Pharmacy questioning the medication not being on Unit and asking if nurse looked in different locations | 1 |
| Lack of knowledge of drug storage requirements | 1 |
| Staff frustration | 1 |
| Workflow | 1 |
| Too many people involved in the medication use process | 1 |
| Volume of missing meds | 1 |
| Medications removed by Pharmacy prematurely from patient care area | 1 |
| Pharmacy turnaround of STAT meds | 1 |
| Missing dose project information not being shared | 1 |
| Waste of caregiver time in administration of missing medications after the medication pass | 1 |
| Nurses continuing their strong effort after missing dose project over | 1 |
| Time | 1 |
| Tube process | 1 |
| Med Availability in ADM\* | 1 |

\*ADM=Automated dispensing machine in patient care area

Table 15: Phase One: Survey Question: Suggestions for Improvement

|  |  |
| --- | --- |
| Process for usage of the tube system (e.g. STAT, evenings, or night shifts) | 5 |
| Uniform system of where medications are delivered (ADM inventory mentioned) | 4 |
| Training and education (e.g. more Pharmacy eRecord training for technicians) \* | 4 |
| Workflow/Check list for nurses with medication locations (or other process) | 3 |
| Use pneumatic tube for medications requested as missing doses | 3 |
| Send enough missing doses for the entire day (e.g. not just AM dose) | 2 |
| A medication tracking system | 2 |
| Methods to notify on the medication order where the medication is located (e.g. refrigerator) | 2 |
| Certain medications are not in ADM's\*\* | 2 |
| More deliveries to patient care areas by Pharmacy | 2 |
| Pharmacy should not remove meds after their due time if they have not expired or been discontinued | 2 |
| Address medications stocked on the Units (e.g. stock more general use medications) | 2 |
| Central Drop Delivery | 1 |
| Nurse education on Pharmacy delivery processes | 1 |
| "As needed" meds need to stay in patient medication cassette\*\*\* | 1 |
| Nurse should be made aware of where to look for medications | 1 |
| Pharmacy delivery technician needs to carry a phone | 1 |
| Work shadowing between Nursing and Pharmacy | 1 |
| A method to let nurses know where medications are located | 1 |
| Missing med requests should only be sent for meds that are missing, not new orders | 1 |
| Pharmacy technician use of ADT sheets\*\*\*\* | 1 |
| Determine why missing doses are occurring when receive a missing dose | 1 |
| Improved process of medications transferred with a patient location transfer | 1 |
| Increase Pharmacy staffing levels | 1 |
| More timely deliveries by Pharmacy | 1 |
| More consistency in a medication’s dosage forms (e.g. syringe vs. bag) | 1 |
| Denoting urgent versus non-urgent on medication requests | 1 |
| Specific printer for missing doses, separate pharmacy bin for missing doses, and specific location on unit for missing dose delivery | 1 |
| Decrease the amount locations in patient care areas for medication storage | 1 |
| Designated technician for Unit Two | 1 |
| Staff need to be held accountable | 1 |
| Better communication between Nursing and Pharmacy | 1 |
| Technician "missing dose" run | 1 |
| More frequent patient medication cassette exchange | 1 |
| Better notification for nurse that a medication will be delayed (e.g. stocking issue) | 1 |
| New dose request if a medication is dropped or wasted to prevent a missing dose for the next dose | 1 |
| Use one ADM medication tower for deliveries when more than one ADM tower is on a Unit, and use correct tower\*\* | 1 |
| Better quality assurance that all medications are in the drawer | 1 |
| Change the medication use system; collaborate with other hospital systems | 1 |

 \*eRecord=Electronic Health Record

 \*\*ADM=Automated dispensing machine in patient care area

 \*\*\* "As needed" medications are not scheduled, only given as needed within prescribed parameters.

 \*\*\*\*ADT=Admission, discharge, and transfer notifications

Table 16: Phase Two: Survey Question: Suggestions for Improvement

|  |  |
| --- | --- |
| Additional meds stocked in ADM\* | 6 |
| Check available locations before phoning for a missing dose (one example: checklist) | 4 |
| More frequent use of the pneumatic tube system | 4 |
| Embed storage locations into the medication order to display on the electronic medication administration record (eMAR)\*\* | 3 |
| Communication | 2 |
| More realistic expectations of pharmacy medication turnaround time | 2 |
| The number of missing meds has decreased | 2 |
| Standardize ADM contents\* | 2 |
| Notify nurses when medication is delivered | 2 |
| Missing med requests should only be sent for meds that are missing, not new orders | 1 |
| Work with Nursing during a weekly meeting | 1 |
| Work together and realize each other's perspective | 1 |
| Scan meds that are sent via pneumatic tube (e.g. use automated dispensing software) | 1 |
| Something to help Pharmacy as Nursing process probably will not change | 1 |
| Assure Pharmacy staff know non-formulary locations in Pharmacy | 1 |
| Unsure | 1 |
| Restart use of yellow sticky notes on nurse's medication cart to communicate that medication was delivered and where it is located | 1 |
| Check missing dose printer | 1 |
| Improve transfer process of moving medications | 1 |
| More deliveries to patient care areas by Pharmacy | 1 |
| Sign-off process when patient transferred | 1 |
| Pneumatic tube station for all units | 1 |
| Medication drawers in all patient rooms | 1 |
| Longitudinal missing dose project | 1 |
| List all medications in ADM\* | 1  |

\*ADM= Automated dispensing machine in patient care area

\*\*eMAR=Electronic Medication Administration Record

Appendix B: Glossary of Terms

**ADM**: An automated dispensing machine from which nurses can vend medications on their respective patient care unit.

**ADT**: Patient admission discharge and transfer notifications

**Auto-verify:** The provider medication ordering software logic that allows provider medication orders to be verified by the ordering system. These orders do not require pharmacist verification prior to medication administration to the patient. Certain criteria must be met such as the medication type, the presence of physician, and the location of the patient.

**Cart Audit:** An accounting that each medication in the cassette is present by comparing to medications listed on the fill batch list.

**eRecord**: Electronic Medical Record

**Fill Batch List (also called Fill Batch):** A report that prints medication doses that are due for each patient for a specified period. The fill batch lists are created in advance of the dose administration due times. This allows the pharmacy time to prepare doses due during that fill batch time range.

**Matrix:** A plastic divider system inserted into the medication drawer

**Medication Carousel:** An automated inventory storage machine located in pharmacies. This machine has shelves that rotate according to the medication that is requested through the software.

**Non-Formulary Medications:** Medications that are not normally stocked in the Pharmacy inventory for patient care.

**Non-Parenteral:** A dosage form not to be used for an injection or an infusion.

**Patient Medication Cassette**: A drawer or envelope that contains a patient’s medication(s). These cassettes are filled with medications that are required by each patient during a twenty-four-hour time period. Pharmacy exchanges those cassettes every twenty-four hours.

**Parenteral:** A dosage form for injection or infusion, such as an intravenous infusion.

**PRN:** These are orders that are given only when needed by the patient and not on a scheduled, routine basis. PRN means “as needed”.

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