

Development of a System to Improve the Communication and Delivery System of Medications in a Hospital Setting

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ABSTRACT

Studies suggest lack of communication, lapses in judgement, and overall bad practice are common in healthcare and in hospitals [1]. Therefore, in order to combat these errors and ensure patients receive the best possible healthcare, I conducted research to develop a communication system that can be used by nurses, pharmacists, and doctors that ensures patient receives the correct medication and dosages at the appropriate time. Delays in medical settings can be attributed to pharmacy scheduling errors and backlogs; the development of communication/scheduling system that promotes efficient interacts between nurses and pharmacists can greatly reduce the number of errors and delays in healthcare settings [2]. Receiving timely medication is crucial for ensuring patients obtain healthy and effective treatment. Therefore, prioritizing efficient internal communication may alleviate some tensions that arise from errors, increase productivity, and create an overall better care for each patient. I conducted my research for how to develop this system to be the most effective by interviewing doctors, nurses, and pharmacists and analyzing previous studies done in order to understand the errors that occur and then propose a new system that can counter these issues. This new proposed system suggests improvisations to increase the quality of care for each patient and ensures significant reduction to errors and delays.

1 Introduction

Medication errors occur within a hospital at an alarming rate of at least one per day [3]. These errors can be attributed to several different factors including, lack of communication, simple lapses in judgement, errors in writing of the prescription, and countless more. Combined, these errors produce a more tiresome and stressful experience for patients [1]. Additionally, these medical errors serve as a measurement for each hospital to determine the effectiveness and efficiency of their patient care. As the number of medical errors increases, the quality of patient care decreases. These medical errors disrupt the

communication process between each member of the groups and leads to lots of confusion.

In section 4.1 I conducted interviews to understand challenges faced in the medical field. According to my interviews conducted, one of the biggest complaints that these systems have between nurses, doctors, and pharmacists, is the fact that the information and user interface available to each member is completely different and leads to lots of problems, confusion, and delays. Due to these differences in interfaces, individuals in the chain of patient care are not provided necessary information they need to ensure proper treatment. For example, when a medication is denied for some reason through the pharmacy, the nurse is unable to view the reason for denial. Furthermore, the nurses I interviewed explained how this process becomes a tedious and time-consuming task for the nurse to contact pharmacy, determine what went wrong with the medication order, then go back to the doctor to prescribe another prescription. Additionally, the interviewees mentioned that the system hospitals utilize for medicinal orders and management is through their emergency health records (EHR) system. Most hospitals in the US currently use Epic or Cerner as their EHR provider. The interviewees state that recording patient information into these two systems is extremely tedious and difficult to follow between the various professionals due to the differences in interfaces, lack of transparency, and lack of communication.

This project explores the possibility that a revised medical management system, one with greater emphasis on transparency and user interface design, could reduce miscommunication and increase useability for all stakeholder groups, ultimately reducing the rate of avoidable errors and delays.

2 Definitions

Medication error

According to the National Coordinating Council for Medication Error Reporting and Prevention, a medication error is defined as “any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient, or consumer.” Additionally, they state that medication errors (MAE) can occur throughout the medication-use system. These errors may occur when prescribing a drug, upon entering information into a computer system, when the drug is being prepared or dispensed, or when the drug is given to or taken by a patient [4]. In other words, medication errors can be made from any of the stakeholder groups along the process and is not a result of any single person but rather the system as a whole.

Stakeholder Group’s Roles and Responsibilities

The stakeholder groups refer to the three main components in the medication administration system. The three groups include doctors, nurses, and pharmacists.

Doctors are the beginning of the chain in medication because they are the individuals that will write the prescription that get sent to the pharmacy for each patient and then communicate this information with the nurse in charge. There are many issues that can occur while writing the prescription such as, incorrect spelling for the name of the patient, wrong dosage, or contradicting medications that could lead to further issues [5]. Generally, these issues will be caught by the pharmacist when they perform their checks on dosage and medication interactions however, because of the initial error caused by the doctor, this leads to an increase in delays and ultimately amplify the issue of patients not receiving their medications on time.

Pharmacists are the next group in the chain for medication administration. Pharmacists have a significant role and are vital for making sure that errors do not occur. The pharmacist is in charge of reviewing the order placed by the doctor and ensuring that the dosage is correct for the patient, the medication won’t interact with other medications the patient is taking and assessing the current health status of the patient to determine any other issues that might occur [6]. Once the pharmacist can ensure the medication will be safe for the patient, they need to fill the order and then send it back up to the department that requested the medication. The main issues that cause delays on the pharmacist side is dealing with incorrect prescriptions. This error then requires additional communication from the doctor to revise the prescription and restart the process from the top. This process causes many delays because the doctor is often preoccupied with other patients, therefore getting in contact

with them can be a timely process. Moreover, another major issue pharmacies face which causes delays is shortages in staff. Due to the lack of staff in the pharmacy, they will often struggle to stay on time with orders, fill them, and delivery them on time.

The last step to the medication administration process involves the nurse and providing the medication to the patient. Nurses are at the end of the line and they are the ones administering the medication. At this stage, errors should be limited however this is not the case. A 2013 study states that nearly 64.5% of nurses have made a medication error and the majority of errors in the process are caused by nurses due a lack of pharmacological knowledge [7]. A common source for errors occurs because nurses are not trained to understand certain abbreviations for medication. Additionally, nurses are sometimes required to make judgement calls which may lead to MAEs or delays because they must get clarification on unclear dosages, thus resulting in poor communication between doctors and nurses. Poor communication can lead to failures in treatment because, when doctors and nurses are under heavy workloads, there may be not enough time for nurses to talk with the doctor. In this case they are required to make a judgement call in order to start treatment on time, which can cause errors and ultimately lead to a failure in treatment.

3 Related Work

Technology that aims to assist the medication delivery process are EHR systems that are currently used in hospitals. For example, the most commonly EHRs are Epic or Cerner. However, both of these systems lack the ability to have good communication between the users and a method of tracking or updates. Furthermore, these systems utilize poor user interfaces, and have inadequate notification system to alert the users of problems that occurred with the order that was placed [2].

In their article, *Medical Errors; Causes, onsequences, Emotional Response and Resulting Behavioral Change*, researchers Bari, Khan, and Rathore aims to determine and solve reason for possible medication errors in the workplace. They conducted a systematic review of articles in order to determine why these problems exist and try to propose a possible solution [8].

4 System Design

4.1 Interviews

Before I could determine what exactly would be the most effective and beneficial to reduce delays for the individuals in medication delivery, I needed to interview individuals from each of the stakeholder groups. I conducted interviews with two doctors, two nurses, and one pharmacist in order to better understand the issues that arise every day and what these individuals want to see in order to better support the patients. I have kept the names of the individuals as just their initials for their privacy. For each interview conducted, my goal was to understand the issues that cause MAEs to occur; why they think the current system in place does not work properly; what are the most common issues that occur in their role in this system; and their opinions on how to improve the structure that is currently in place.

The first interview I conducted was with two doctors working in the internal medicine department in hospitals in Columbus, Ohio. They will be referred to as JS and SS in this paragraph. According to these doctors, the biggest complaint and issue they have is with their Epic system. SS states that Epic is very slow and inefficient as the system does not update properly when medication is either filled or gets rejected from the pharmacy. In other words, Epic lacks application transparency by failing to inform doctors what is happening to the medication. Both these doctors state that if medication gets rejected, the doctor needs to reapprove the prescription for the patient. However, Epic does not provide notifications or alerts when rejection occurs. Therefore, doctors are often unaware of an issue and won't find out until 30 minutes to an hour later. By that time, the medication is already been delayed. The other biggest issue that these doctors pointed out is how the prioritization system is flawed and needs the support of technology. They explained how in bigger hospitals, there might be 30 or more stat orders coming in within an hour but there is no system in place to determine which medication is more important to a patient's survival. For example, if Tylenol and insulin are both put in the system as stat then there needs to be a system in place for the insulin to be filled and delivered first as this can be potentially more life threatening for a patient than a painkiller. While all medications are essential and necessary, medical prioritization is crucial for reducing detrimental errors.

The next interview I conducted was with two different nurses one, referred to as SS, who works in the oncology department in DC and another nurse, RI, working in post anesthesia in Charlottesville, VA. According to both these nurses, the biggest cause of medication delays in their profession is due to two main factors. The first being that

they are helping another patient and cannot make it to the patient's room that needs the medication at that specific time. In a lot of cases, if a nurse is helping a patient and there is a problem that occurs, they must stay in the room and take care of that patient until the problem has been resolved before they can move to another patient's room. The second biggest issue that both nurses complained about was not being able to track or locate the medication. SS states that if a medication is not at the department when she need it then she has to call the pharmacy and track the medication down. This timely process causes delays because, many times, even the pharmacy isn't sure where the medication is. Sometimes the medication will get rejected from the pharmacist, but nobody realizes this until its time to give it to the patient and at that point having to restart the process from the doctor's order puts treatments very far behind. In other words, from these two nurses, the primary issue is not being able to track or locate the medication and when they have to spend time trying to find it, they fall even further behind with other patients.

The final interview I conducted was with a pharmacist, PK, who works in a hospital pharmacy in DC. The primary issues that came up from PK was difficulties in managing the number of orders that come in while being short staffed and difficulty keeping track of all the orders that are coming in with the current user interface in Epic. The main issue that pharmacies face is they are frequently understaffed and with the hundreds of orders that come in each hour for the whole hospital can be difficult to manage, especially with all the phone calls coming in to check on medications. In order to help alleviate this issue, the doctors and nurses should be able to receive updates on what stage the medication is in so that the pharmacist can focus on checking orders and filling medication. Additionally, a more user-friendly interface will make it easier to keep up with the orders that are constantly coming in.

4.2 System Features

The new system to place medication orders will be an add-on to the current system hospitals use (Epic, Cerner, etc) and consist of four main features in order to minimize the number of delays and medication errors that occur. These include, a tracking system for all individuals in the stakeholder group to see the status of a medication, a proper notification system that allows a doctor to go back and revise an order in a timely manner if needed, a priority system for determining which medications are more important than others, and automated checks which will read over an order before its sent to the pharmacy and determine if there are

errors which could result in it being rejected. By implementing these features into a medication ordering system, we can ease the pressure on each individual in the chain and ultimately lead to fewer errors and delays and provide a more positive experience for each patient.

First, and the most important feature, is the tracking system for everyone in the process. Tracking is one of the biggest complaints I received from each member of the hospital and in order to save time and reduce delays, each individual should be able to determine which stage the medication is in. When an order is first placed, the application will show the medication under that patient's name in a list, and it will have a status bar next to it. The different statuses will be ordered, seen by pharmacist, being filled, filled and ready for delivery, administered. By having these constant updates for a medication, this will reduce the time wasted by nurses and doctors to call the pharmacy and try to locate a medicine that was ordered. Additionally, this will ease the job for pharmacists and allow them to focus on reviewing orders and filling medications rather than constantly picking up the phone. This tracking system will be similar to how DoorDash or Dominos allows a customer to keep track of where the order is and what stage it's in.

The next key feature of the application is a proper notification system that will inform the appropriate individual when there is a problem with an order. For example, if an order is rejected from the pharmacy, both the nurse and the doctor will receive a notification that will continue to resend every 5 to 10 minutes in order to get the attention of the doctor as soon as possible and minimize further delays. This notification system will help reduce the time it takes to locate the doctor and revise the order if necessary. Additionally, it is important that the system does not send notifications for tasks that are not essential in order to reduce the amount of information that is sent to each member. If there are too many notifications being sent this will defeat the purpose and they may get neglected again.

Next, and one of the most challenging aspects of the new application, will be to create a priority algorithm to order the medications by most essential. Currently, there are 4 rankings to medication priority, low, medium, high, and stat. This algorithm would further sort the medications within each of the rankings to make sure the most lifesaving and time sensitive medications are filled first. In order to develop this algorithm, I will need the help of a doctor and pharmacist who can guide me through the process of which medications are more important than others. After gaining

this knowledge I will be able to sort the medications within each ranking which will allow the pharmacist to easily go from top to bottom on the list as well as reduce the stress of doctors and nurses to receive medications that are essential to a patient's survival.

The fourth feature, in order to reduce the work of a pharmacist and allow them to spend more time filling medication, is a check on the prescription through the system before it is sent to the pharmacy. The pharmacist will still need to ensure that all the information on the prescription is correct, but this check will reduce the number of rejections a pharmacist has to make due to simple human errors. This check will be done by an algorithm that will cross reference the other medications the patient is on or has taken, which will be stored in a central database, and calculate the dosage for the medication based on the basic information it has. If the system detects an error in the prescription, it will give a warning to the doctor before the order is placed and the doctor will be able to review it and correct it if needed. In order to account for the times where a higher-than-normal dose is needed based on a patient's condition, the system will only give a warning to the doctor and allow them to recheck the prescription they filled out. If, for some reason, a higher dose than recommended is required then the doctor will still be able to send the prescription after they provide a reasoning. This will help the pharmacist understand why there is a specific dosage rather than rejecting the order and the doctor having to explain later on. This system check can save lots of time for all individuals in the stakeholder group as one of the most common issues is from errors in the prescription.

The next feature that will be essential in improving the communication between each member in the medication administration process will be a secure chat. This will be a feature that is in the same application as the medication ordering system. If there are any problems along the way, the individuals will easily be able to communicate via chat. This chat will be available through each patient's individual tab. Nurses or pharmacists will not need to enter in the information of the patient they are discussing; information will be automatically filled in by the application. Additionally, this feature will require the use of cryptography in order to encrypt the chat between the doctors, nurses, and pharmacists. This information is all covered under HIPAA— Health Insurance Portability and Accountability Act. Ensuring that the messages are secure will be an important aspect for protecting patient confidentiality. Additionally, this chat feature will keep logs

of the messages that were sent under a protected file with secure encryption. Therefore, if there is an issue in the process, accountability can be traced back to the individual who made the error.

5 Procedure

This new system will support the stakeholder groups along every step of the way. First when a doctor places an order, they will select the name and medicine for the patient by using a drop-down menu to select from a database rather than typing it in each time. This will reduce the number of errors that occur when writing out a prescription. Once the doctor enters in the patient's name, medicine, dosage, and reason, they will submit the order and the system will perform a check and mathematically to determine if the dosage is correct based on the patient's age, gender, weight, and other factors necessary in order to ease the pressure for the pharmacist. Once the order is submitted, this will appear as a list on the pharmacists' screen sorted based on the priority algorithm within the system. The pharmacist will be able to click on each order and then perform their review and click a check mark to indicate when the order has begun being filled. Once the medication has been filled and is ready for delivery the pharmacist will scan the QR code that is printed on the label and that will alert the system that the medication is ready and being shipped out. Once a nurse is about to administer the medication, they will need to scan the QR code through this application again in order to keep track of when the medication was administered and then finally that medication order has been completed.

This process ensures that all the members are in constant communication with the medication that needs to be administered. Also, this application will make sure that accountability can be ensured throughout the administration process. If there is a medication error throughout this application, we will be able to locate a specific location where the process was interrupted and improve that specific aspect.

6 Conclusion

This application eased the process for ordering and administering medication for all members of the stakeholder group that I interviewed. The ability for the system to check

the order and for each member to have a tracker of where a medication is in the process and if there was any issue is an essential feature that is required for hospitals to minimize medication errors. Through my research and interviews I proposed a system that will improve communication, transparency, and effectiveness in the process of administering medications for each patient to have quality medical care. Additionally, this proposed application will ease the roles and responsibilities for doctors, pharmacists, and nurses and ensure that they can perform their responsibilities without the stress and pressure they receive from other departments within a hospital.

7 Future Work

In the future to improve this proposed system, I would need to implement this application and determine how it reduces medication errors with it in place. By implementing a system where individuals are able to track medications and see the current status will improve the delays that occur in patient care. Overall, by adding more technology into patient care will benefit and support both the medical industry as well as the individuals working in it.

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