Task Analysis for Medication Reconciliation by Pharmacists

By

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Certificate of Approval

This is to certify that the Master's Capstone Project of

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In the course of my studies at OHSU I have learned more than I thought was possible in such a short span of time. I have learned to have faith in my own ability; personal, professional and academic. I have also learned the value of having a strong support system of family and friends who never stopped believing in me. Their energy sustained me through many long nights of study. I learned the value of mentors, especially those who have provided me with an "insiders" view of the professional issues and challenges that still await me. I have also learned that I will need to seek out new environments with the same level of intellectual vibrancy I experienced at OHSU. I do not want to settle for less.

A special thank you -- to my mother Robbie, my sister Amanda, and to the Faculty and Staff of OHSU for having faith in me.

ABSTRACT

BACKGROUND:

Medication reconciliation is an essential process for patient safety, but can be time consuming and prone to error. A medication can have multiple trade names in addition to a generic name. Medication information may be stored on multiple clinical systems, and medication management processes are often isolated and fragmented across multiple disciplines and organizations. Aggregation of all medication information into a single data source could significantly decrease, if not completely eliminate, medication errors due to duplication or inadvertent drug reactions and allergies. This is the goal of *RxSafe*, a project to develop medication reconciliation software.

Medication administration is a clinical process; therefore the successful design and development of any automated system must support the roles and responsibilities of clinicians in order to ensure that they will ultimately use it. The first step in the development of software to support this or any other clinical process is a thorough task analysis in order to develop a clear understanding of the clinical information requirements and work processes involved. This task analysis is the purpose of this Capstone Project.

METHODS:

Information for this project was obtained through interviews of clinical experts and observation of their work processes. After first meeting with *RxSafe* project

personnel who provided the author with background information on the project scope, a summary of the previous work on the *RxSafe* project and specific goals for the task analysis. Subsequently, pharmacists employed in both community and long-term care settings were interviewed to establish an outline of their desired functionality for *RxSafe* with specific focus on support for day-to-day tasks and simplification of tasks that required referencing multiple data sources. Interviews were followed by guided observation of the medication administration process, with the pharmacists explaining each step of their work. The author analyzed field notes and interview transcripts to develop a series of work flow diagrams supported by use-case descriptions. This work was reviewed with and validated by domain experts, including pharmacists.

RESULTS:

Analysis of the pharmacists' work flow clearly revealed that they currently have no reliable source of accurate and complete information for any patient's medication history or his or her complete list of current medications. Community-based pharmacists are dispensing prescriptions without being able to assess the patient's complete medication history or current drug regimen. Long-term care pharmacies differ slightly from community pharmacies in that they have the advantage of a patient history if the patient is a resident of the Long Term Care facility, but that history is only as reliable as the source from which it was obtained. The end result of the task analysis clearly indicated that that the primary requirement to enhance safety in the practice of pharmacy is the development of a single data repository to house a complete and accurate list of medications for each patient.

CONCLUSION:

Based on the information gathered and examined, the requirements and information needed by community and long-term care pharmacists for medication reconciliation support could be considered as comparable. Therefore, a single set of use cases can be applied to both settings for the support of medication reconciliation.

INTRODUCTION

Background

Medication errors affect millions of patients each year. These errors contribute to significant harm, including adverse events, increased costs of care, and even deaths. The Institute of Medicines landmark report *To Err is Human: Building a Safer Health Care System (1999)*, estimates that between 44,000 to 98,000 people die each year as a result of medical errors, which includes medication errors. While this estimate only includes patients who die because of errors, it does not count the millions injured each year by preventable medication errors. One way to prevent medication errors that result in patient harm is to reconcile the many medication lists the patients have. Reasons for medication errors include the fact that a single medication can have multiple names, medication information is stored on various clinical systems, and medication management processes are often isolated and fragmented across multiple disciplines and organizations. Consolidation of disparate medication information in a central location or system can enables automation of background processes such as flagging duplicates and drug interactions, and improve the availability of information to human experts Automated medication reconciliation could significantly reduce the possibility of errors in the ordering and dispensing phases of medication administration, if not eliminate them entirely.

Recognizing the importance of this problem, the Joint Commission of Accreditation of Healthcare Organizations (JCAHO) lists Medication Reconciliation among their National Patient Safety Goals for 2007, as listed in the table below.

JCAHO 2007 Patient Safety Goals for Medication Reconciliation

Patient Goal	Goal Description
8	*Accurately and completely reconcile medications across the continuum of care.*
8A	*There is a process for comparing the patient's current medications with those ordered for the patient while under the care of the organization. [Ambulatory, Assisted Living, Behavioral Health Care, Critical Access Hospital, Disease-Specific Care, Home Care, Hospital, Long Term Care, Office-Based Surgery]*
8B	*A complete list of the patient's medications is communicated to the next provider of service when a patient is referred or transferred to another setting, service, practitioner or level of care within or outside the organization.* ***The complete list of medications is also provided to the patient on discharge from the facility.*** *[Ambulatory, Assisted Living, Behavioral Health Care, Critical Access Hospital, Disease-Specific Care, Home Care, Hospital, Long Term Care, Office-Based Surgery]*

http://www.jointcommission.org/PatientSafety/NationalPatientSafetyGoals/07_npsg_facts.htm?print=yes

Objective

The objective of this project was to obtain and analyze the stated and observed needs of pharmacists performing medication reconciliation in a typical long-term care

pharmacy and a typical community pharmacy. Once this information was available, it was used to identify functionality that is specifically tailored to the pharmacists who would be using the proposed medication reconciliation software.

Design

This project began by systematically gathering the pharmacists' needs related to the information needed for support in medication reconciliation. Once the information requirements were obtained, use cases were created to be submitted to the pharmacists for their review. Based on their feedback, these use cases will be iteratively modified to include any error handling or oversights that were not originally identified in the initial draft of the use cases.

METHODS

This project was accomplished by dividing the work into three distinct phases. The first phase encompassed interviewing and observing the pharmacists in their natural work setting. Structured interviews with the pharmacists were focused on the tools and artifacts currently used to reconcile medications and descriptions of processes involved. The pharmacists were also observed as they performed the work of medication reconciliation. By utilizing both of these methods, processes or activities not documented or mentioned in the interviews would be noted, thereby reducing the possibility of missing important steps or tools used in the reconciliation process.

The second phase was analysis of the information gathered from the pharmacists. Work flow diagrams produced in Visio Professional 2007 were developed which integrated existing workflow with the desired medication reconciliation functionality. The software supported both the development of use case diagrams as well as class diagrams. Use cases were then outlined based upon the workflow diagrams.

The final phase of the work involved presenting the results to the pharmacists and domain experts for review in order to determine whether the task descriptions and functionality specifications were accurate and likely to meet their needs for the medication reconciliation process. This step is only partially complete at the time of this writing. Subsequent recommendations will be used to modify the specifications to be turned in at the end of the project.

Subjects

The subjects for this project are pharmacists who work in pharmacies that have a demonstrated need for the ability to reconcile medication on a regular basis. The individual pharmacists were selected based on two specific criterions. The first criterion was that they were employed by a pharmacy involved in the *RxSafe* project. This was important because the pharmacies that are involved in this project have already been identified as benefiting from the ability to reconcile medication lists. The second criterion was that they were available for observation and interviews within the time allotted for this project.

Setting

The settings in which information was gathered for this project were two distinctly different pharmacies that serving different patient populations. The first was a typical community pharmacy that is part of a large supermarket chain. The second pharmacy was a specialized pharmacy that provides dispensing and other services to long term care facilities such as nursing homes and assisted living facilities. By interviewing the pharmacists at their place of work, it was possible to observe directly the processes and the information that is involved in filling a prescription along with the artifacts used.

Task Analysis

The following definitions are used by the US Department of Labor (1972; 1982), McCormick (1979) and Gael (1988) in relation to the dimensions of work:

- Job: a group of positions which are similar in their significant duties such as "clerk – level 2". Jobs may involve one or more positions, depending on the size of an organization.

- Position: one or more duties performed by an individual in a particular company at a given time. There can be as many positions as there are workers

- Duty: a large segment of the work that an individual performs, which may include many different tasks. For instance, a "clerk – level 2" may have duties that include generating business correspondence, tracking accounts receivable, maintaining sales records, etc.

- Task: a distinct work activity carried out for a very specific purpose such as typing a letter or validating an invoice.

- Element: is the smallest unit into which work can be divided without analyzing separate movements and mental processes involved. Configuring the format for a business letter would be an example of a job element.

Job analysis

Job analysis consists of defining a job in terms of its underlying components (duties, tasks, elements) and then discovering what the job calls for in terms of employee behaviors. This analysis must also take into account the essential *task requirements* and *worker requirements*. These requirements are the "givens" such as equipment needed (paper, pencil, computer, telephone, etc.) and underlying skills, knowledge and abilities (literacy, manual dexterity, reading comprehension, visual acuity, etc.). (Cascio, 1991).

Job Analysis Validity

Job specifications are valid to the extent that they accurately represent job content and work requirements (Cascio, 1991) and that workers who are provided with specified requirements do perform more effectively on the job. In terms of accuracy, research indicates that the amount of job descriptive information available to raters has a significant positive effect on job analysis accuracy (Harvey & Lozada-Larsen, 1988). In order to accurately test the validity of specific job requirements, a company would have to deliberately hire applicants who *did not* possess the requirements along with an equal number of people who *did* have the requirements. Then they would have to measure job performance after providing exactly the same amount of support and training to both groups. Obviously, this approach is not practical in today's world. Instead, "indirect validity" measures can be substituted (McCormick, 1959).

According to McCormick (1959) indirect validity can be extrapolated by identifying common denominators among similar jobs. Therefore, if a new job/task can be satisfactorily compared to an existing job/task that has already been determined to be valid, it can be validated indirectly. It has further been shown that the exact dimensions on which the jobs are compared is not as crucial as long as they have a close relationship to the ultimate purpose (e.g., training, improved accuracy, etc.) (McCormick, Jeanneret & Meacham, 1972).

Historically, procedures for job/task analysis have revolved around a descriptive approach with job elements described in a narrative format (Cascio, 1991). This information is not easy to put into quantifiable terms which are the foundation of indirect

validity analysis. Task checklists along with diagrams and flowcharts which indicate relative frequency or importance of discrete elements are much easier to compare. In this way, each element can be examined for congruence validity rather than trying to determine this level of information from a written description.

Obtaining job information

There are numerous methods for describing jobs/tasks. Some are job oriented and some are worker oriented. However, because jobs cannot be actually separated from the humans who perform them, Cascio (1991) recommends the practice of including at least two methods to ensure that both dimensions are better represented.

Direct Observation of Job Performance

For jobs or processes that are fairly static, observation of competent job incumbents and actual performance of the job/task by the analyst are two recommended methods of gathering job information (Cascio 1991). Data can then be recorded in a narrative or checklist/flowchart. These methods are particularly suited to jobs/tasks that do not change with each new incumbent or from situation to situation. They are appropriate for jobs/tasks that require a great deal of manual, standardized activities that the job analyst could learn to do readily. These methods would not be appropriate for jobs/tasks that require high levels of critical judgments or complex cognitive processing by job specialists. Observations should include a representative sampling of the job/task. If the job/task is performed infrequently, a complete analysis may be very lengthy in order to accumulate a requisite sample.

Furthermore, the analyst must be unobtrusive during the observation process in order not to distort what is being measured (Webb et al., 1981).

In order to organize the information gathered during an observation, a technique known as Functional Job Analysis (FJA) can be used (Fine, 1986). FJA attempts to identify exactly what the worker does in the task as well as the outcome of the action. In addition, it provides a system of coding information about the worker's functions that can be used to determine underlying worker requirements (see example). Each of the functional areas (Data, People, Things) include a list of terms with numbers indicating complexity (higher numbers= less complex).

Interview

Interviewing is the most common technique for establishing the tasks, duties and behaviors necessary for both standard and non-standardized activities for physical and mental work (Cascio, 1991). In this method, the worker acts as his or her own observer in the interview and he or she can report activities that would not often be caught by the observer as well as those that may occur over a longer time span to which an outside observer may not be privy. Also, the worker has an in-depth knowledge of the job and can report information that may not be available from any other source.

McCormick (1979) recommends that interviewer/analysts follow a patterned interview form in order to systematically cover all of the information that needs to be gathered. According to McCormick (1979, p. 36), questions should meet the following criteria:

- The question should be related to the purpose of the analysis
- The wording should be clear and unambiguous
- The questions should not "lead" the respondent; that is, they should not imply that a specific answer is desired
- The question should not be "loaded" in the sense that one form of response might be considered more socially desirable than another
- The question should not ask for knowledge or information that the worker does not have
- There should be no personal or intimate material that the interviewee might resent

The major obstacle with the interviewing technique is distortion of information. For instance, workers may believe that results of the job analysis could influence wages and therefore exaggerate the difficulty or responsibilities involved. In order to validate the information, multiple incumbents should be interviewed as well as immediate supervisors who know the job/task very well. Ideally, in the case of complex jobs/tasks both high- and low-performing incumbents should be interviewed (Conley & Sackett, 1987) as well as a range of workers from various demographic groups or functional areas.

In addition to individual interviews, panels of six to eight subject matter experts (SME) can be convened to obtain information for job/task analysis for complex jobs or to validate information received from individual interviews. High levels of agreement among the SME panel indicate that the analyst's conclusions are valid.

Task Inventories & Checklists

Task inventories and checklists are often used as a tool to collect information about a particular job/task. A list of the tasks is compiled by the analyst and used to check or rate each item as it pertains to the job (Cascio, 1991). The tool may be structured to record items in terms of the frequency which the task is performed, the perceived difficulty, relation to overall performance, or other criteria of interest. Although these data can be adapted to computer analysis, simple checklists tend to ignore the sequencing of activities or their relation to other jobs, tasks or activities. Therefore, an overall perspective of the job is very difficult to obtain with checklist information only.

Critical Incidents

This method involves the collection of a series of anecdotal job behaviors from supervisors, workers or others familiar with the job/task. They are asked to describe examples of especially good or especially poor job/task behaviors. This can result in information that is very valuable in terms of preventing potential errors due to on the job mistakes (Cascio 1991).

Each informant is asked to describe:

1. what led up to the incident and the context in which it occurred
2. exactly what the worker did that was effective or ineffective
3. the perceived consequences of the worker's actions, and
4. whether or not the consequences were actually within control of the worker.

Although this method can take a great deal of time to gather, abstract and categorize when working with complex job/tasks, it may provide information about overall 'system' or environmental issues that cannot be obtained in any other way (Page and Van De Voort, 1989). Critical Incident analysis may be particularly appropriate when designing automated processes so support tasks in order to ensure that the end result includes ways to prevent "worst case scenarios".

Data Collection

In this study, the observation and interview data collection methods were chosen. These two methods were selected based on their applicability to the project and the pre-existing time constraints. The critical incident method was deemed inappropriate because the author did not have adequate time to develop a trusting relationship with the informants that is required for the success of this method. The use of task inventories and checklists was not chosen because there was insufficient time to obtain and analyze the detailed background information required for this approach. If additional data collection is required in subsequent work with the pharmacists, the use of the critical incident method along with task inventories and checklists could be utilized to obtain more highly detailed information.

The data needed for this project was collected through interviewing and observing the participating pharmacists in their working environment. The initial step in collecting the data was to observe the pharmacists performing the task of filling prescriptions. This was done by observing the pharmacist going through the steps

required to fill a prescription. While observing the process, notes were taken and any questions about their actions and the process were written down to be asked later. The reason the subject was not asked the question immediately is that while directly observing job performance, the analyst must be unobtrusive during the observation process in order not to distort what is being sampled (Webb et al., 1981).

The final step was to interview the pharmacist utilizing the criteria for questions set forth by McCormick (1979, pg 36), about the task of filling prescriptions. It was during this time that the questions that arose during the observation portion were asked and answered by the pharmacist who was being observed. This method of data collection was utilized for both types of pharmacy settings.

Data Analysis

The analysis of the data collected for this project consisted of going through the notes taken during the observations and interviews of the pharmacists and staff at the participating pharmacies. The data was evaluated according to the US Department of Labor (1972;1982), McCormick (1979), and Gael (1988) definitions in regard to dimension of work .

The initial phase was to identify the elements or individual actions involved in filling a prescription at each of the pharmacies. An example of an element is obtaining the prescription from a patient. Once the individual elements were identified, they were grouped together to form tasks. This was done at both the community and long-term care pharmacy visited for this project. The task lists for both pharmacies were then compared and contrasted to one another.

Common themes emerged, and from these themes, a list of scenarios was created; each of which described a specific situation in which the pharmacist needed to act. These situations included actions such as "check drug interactions" in which the pharmacist must assess whether a new prescription would have any adverse interactions with an existing drug regimen. Each of these situations includes a series of steps and is a small sub-process in itself. For purposes of software development, each of these sub-processes was converted to a "use case" containing a specific sequence of steps. Use cases then serve as a template for development of the software needed to support the processes.

Validation

Validation of the use cases was accomplished through review with a practicing pharmacist from a community pharmacy and domain experts. Findings were discussed and the use cases were critiqued. In order to review the individual use cases, the pharmacist and the researchers methodically walked through the task it represented to distinguish if all possible scenarios were successful and exceptions were identified. The use case was considered successful and complete if it was able to meet all the needs of the pharmacists who would be performing the task it represented.

For this project, the use cases needed to be validated by a practicing pharmacist in a community or long term care setting because he or she performs the tasks on a daily basis and can most easily identify any discrepancy. An example of this would be a use case for sorting a patient's medication list. While an individual who is not a pharmacist, for example a software developer, may approve a use case because it is technically sound, the pharmacist is able to verify if the manner in which medication is sorted is logical to the pharmacists who will view the list.

RESULTS

This section will describe the findings of this task analysis study. It begins with an overview and description of the processes for the community pharmacy and then the long-term care pharmacies visited for this study. Then it is followed by the concerns of the pharmacists who took part in this study. Finally at the end of this section is the functionality that has been requested by the participating pharmacists.

Community Pharmacy: Overview

Community pharmacies must comply with retail pharmacy regulations. They can be found in a variety of stand-alone locations as well as within a larger entity such as grocery stores, wholesale stores, and "big box" discount chains. According to the pharmacists at the community pharmacy the patient population they serve is equally as diverse, driven primarily by whether the pharmacy participates in their insurance plan and geographic convenience.

As observed, the process for filling a prescription in a community pharmacy (see diagram Appendix 1) is initiated when a customer's prescription is presented to be filled. Prescriptions can arrive at the pharmacy by various means. The pharmacist revealed that the prescription may be faxed to the pharmacy from a physician's office, the physician may "call in" a prescription by phone, or the customer brings a traditional paper prescription to be filled. No matter how it is received, a prescription is processed in exactly the same way. According to the pharmacist, the first step is the verification

process. The pharmacist looks up the patient in the existing medication system and proceeds to:

1. locate the patient's record – verifying identity in cases of duplicate names
2. check the patient's allergies against the new prescription
3. review the appropriateness – in light of the patient's diagnosis and approved uses for the medication
4. check the dosage and quantity listed in the prescription
5. and look at the notes that may have been made for the patient (if any), including whether there are any formulary restrictions in the patient's insurance plan.

If there are any questions about the prescription, the pharmacist calls the prescribing physician. Once all of this verification is done and it is successful, the prescription can be filled and is ready to be picked up by the customer.

The information available at the vast majority of community pharmacies is limited to what the customer is able to provide. The only exceptions are major national pharmacy retailers that can have in some cases, a common database. During interviews, a community pharmacist pointed out that only having the information a patient provides could result in potentially serious situations that can have a major impact on patient safety. The first is that the patient can only provide information that they actually have. Not all patients understand or have knowledge of their health status and medication

regimen. This is more commonly found among elderly patients that may have several prescriptions to treat chronic and multi-system illnesses. Secondly, the pharmacist revealed that some patients might withhold information simply because they do not think it is important or because they do not want anyone to know about their illness. This creates a problem since the pharmacist will not be aware of potential drug interactions or contraindications. Thirdly, one pharmacist noted that the patient may actually be creating problems inadvertently by "shopping" several pharmacies to have prescriptions filled. According to the pharmacists, this is especially true for customers without prescription coverage who shop around for the best price on their various prescriptions. When customers shop around they have to give out their information at each of these pharmacies, and they may not give a complete list of their medications to each of the pharmacies that they use. This would not be problem if all the pharmacies systems communicated with each other, however the current the systems are completely independent; each with their own database of patient information. When a customer uses more than one community pharmacy, they must provide a complete medication list to each pharmacy they visit.

A final issue brought up by the pharmacists is that just because a prescription has been filled, it does not mean that the customer is going to take the medication. This becomes an issue when a customer comes in with a new prescription that interacts with a medication that is listed on the patient's current record. If the customer tells the pharmacist that they are no longer taking the medication, the pharmacist will fill the current prescription for the customer and provide a warning to ensure that they

understand the necessity of not taking the previous medication. If the patient does not clearly understand all the ramifications, this could be a dangerous situation, but not one that the pharmacist can control.

Long Term Care Pharmacy: Overview

Long-term care pharmacies are specialized pharmacies that serve long-term care facilities such as assisted living facilities and nursing homes. The regulations that they follow depend on the type of facility that they are serving. If they are filling prescriptions for an assisted living facility (ALF), the regulations are the same as for retail pharmacies. The prescriptions filled for a skilled nursing facility (SNF) are regulated by hospital pharmacy regulations. The reason for the different set of regulations as explained by a long-term care pharmacist is that different facilities have different services. An ALF can be thought of similar to a college dorm, in that the residents are free to go as they please and can use any pharmacy that they would like. Whereas a SNF operates similar to a hospital in the services that they offer, an example would be rehabilitation for patients not ill enough to stay in a hospital, but ill enough not to be at home alone.

An important difference between community and long-term care pharmacies is that the long-term care pharmacy maintains medical records. The medical records department maintains medical records for the customers in the various facilities that the long-term care pharmacy serves. This helps the long-term care pharmacy in that they are able to track what medications patients are actually taking. This service can also be used by physicians and health care providers to track medications that a patient is taking,

because often a patient can have several different heath care providers. Another difference, at least for the community pharmacy that was interviewed, is that the medications are dispensed in a "unit dose" method rather than in a bottle. Each dose of the medication is sealed into an individual plastic "blister pack" on a card that may contain many doses.

The process for long-term care pharmacy is depicted in Appendix 2. According to information provided by the pharmacy interviews, prescriptions are normally received at the long-term care pharmacy by fax from the SNF or ALF, but they may also be called in by the physician or sent electronically. Once the pharmacy receives the prescription, a pharmacist:

1. evaluates the prescription to make sure the mediation and dosage is appropriate for the patient's condition
2. checks the quantity requested – most prescriptions are filled monthly or bi-monthly
3. reviews the patient's record for any allergies
4. reviews any additional notes that they might have for the patient – e.g., some patients have difficulty swallowing and need a liquid instead of a pill

If any questions arise, the pharmacist will call the facility where the patient is staying or the prescribing physician to obtain clarification. It was revealed in interviewing the pharmacists at the long-term care pharmacy that occasionally a prescription that is faxed

in is not legible and will have to be re-faxed to the pharmacy. If questions arise, the dispensing process is put on hold until clarification is received. After the pharmacist has approved the prescription, it is entered into the pharmacy's system by a pharmacy tech. This action triggers the printing of documents needed to dispense the medication: a) a prescription information card that is used by the tech to prepare the medication; b) drug information and; c) the shipping documents that must accompany the prescription. The tech then uses the prescription information card to select the right drug, prepare the prescription and pack it for shipping. The prescription is shipped to the facility where it was ordered. At any stage in the process, if a question arises, the entire process is halted until the question is answered.

The issues that long-term care pharmacies have are similar to the community pharmacies. According to pharmacy interviews, the main problem is a lack of comprehensive integration of all relevant information. Regulations do not require each patient to use only one pharmacy; therefore, several pharmacies may be involved in the care of the patient. Lack of data integration can result in dangerous interactions or even overdoses in the case of duplicate prescriptions with different trade names. The other main issue essentially stems from the fact that their primary patient population consists of elderly people. Many have multiple system illnesses and take many types of medications prescribed by multiple "specialists". According to the pharmacists, elderly people may have low levels of interaction with family or other caregivers so the initial information that is provided to the long-term care pharmacy may be inaccurate or incomplete. If the family is not aware of all the medication a patient is taking, then they are not able to

provide a complete listing to the pharmacy. A long-term care pharmacist mentioned that often, the patient is the only person who is aware of all the prescriptions that they are taking, but they do not 'know' all of the prescriptions they are taking. According to an individual working in medical records at the long-term care pharmacy, their pharmacies do have one advantage. Since they work with a medical records department, they have access to all of the supplements that have been ordered for a patient. By having a record of supplements, interactions and adverse effects that they will cause in a medication can be identified before they can occur.

Concerns

Pharmacy interviews produced some themes that were common to both community and long-term care operations. According to all of the interviewees, the most important function of a pharmacy information system is the ability to aggregate all of a patient's medications into a single database. Currently if a patient has their prescriptions filled at more than one pharmacy, the pharmacist divulged in interviews that they are unable to accurately determine all the medications that the patient is taking. This is especially a concern for community pharmacists, who reiterated this concern throughout the course of the interview, since their patients can be highly mobile and have the ability to shop around different pharmacies to get the best price. If a single list of all a patients' medication were available to pharmacists, they would be able to identify dangerous drug interactions easier.

These concerns were also voiced at the long-term care pharmacy. In the long-term care pharmacy, there is a need for collecting pertinent information in the medical records department allergies, medication history, special dosage or administration considerations, lab results, etc. because these all can have an impact on the safety and efficacy of medication administration. Medical Records professionals in the long-term care facilities stressed the need to have a repository of this information that is easily accessible. This would not only facilitate their own internal operations, but also provide significant improvements to the process of communicating the information to with acute care hospitals. Medical records stated that when a patient is admitted to hospitals for treatment, all of this information must be provided and this can cause delays in treatment. Likewise, when the patient is transferred back from the hospital to the long-term care facility, the pharmacists stated that there must be an easy way to update the medical records information in the central repository.

Both community and long-term care pharmacies would also like the ability to see a patient's pertinent lab results in order to monitor a patient's well-being. Many benign medications can become toxic if liver or renal function is abnormal. Some medications can also have negative effects on various organs, such as cholesterol-lowering drugs have on liver function. If pharmacists have the ability to view lab results it would provide an extra "safety net" for patients. The pharmacist could alert a physician when patients should have drug therapies altered.

Functionality Requested

The functionality requested (see Appendix 5) by both community pharmacists and long-term care pharmacists are comparable. The ability to generate a single and complete list of medications for an individual patient is paramount. While interviewing the pharmacists, it was evident that currently they have to rely heavily on the patient and his/her family or caregivers for a complete list of medication. This proves to be an issue; because when a patient is visiting a community pharmacy to have a prescription filled, they might not remember all their medication when asked. This is especially true if a patient is on numerous prescriptions and over the counter medications.

The other major functionality requested is the ability to check for drug interactions. A recurring theme in interviews with the pharmacists is the ability to check for drug interactions both automatically when a complete medication list is being built to be displayed and when filling a new prescription for an existing patient. This is a significant piece of functionality because it could potentially be life saving. One long-term care pharmacist who has also worked in a community pharmacy remarked that is would be helpful if the medications that have an adverse reaction would be displayed prominently on the medication list when it is first displayed on the screen. She said that not only does she need potential interactions to display for a prescription that is being filled, but also current medications that the patient is taking.

The ability to sort the patient's medication list by various criteria, depending on the type of report needed or information sought by the pharmacist is another function that

was requested by the pharmacists at both of the facilities. The pharmacists requested that the list be able to be sorted alphabetically, by medication group, medication family, and fill date. A long-term care pharmacist that was interviewed stressed the importance of fill dates in order to quickly determine which medications are current when the patient has a long list in his/her record.

The capacity to obtain reference information on a medication directly from a medication list is another functionality requested. There is an abundance of medication reference material available, however in order to use it, the pharmacist must interrupt what she is doing and locate the appropriate information, then resume the original task. This can cause a lapse of attention and could contribute to human error. By integrating the reference material into the application, a lookup button or double clicking the medication on a list could launch a separate window that contains information about the medication selected. A feature such as this would reduce the amount of time it takes to reference a medication and help streamline the process. In addition, it would cut down the chance of an error occurring when attempting to locate further information on a medication because of a spelling error, or mistyped dosage.

The last request for functionality is the ability to print reports for use by either patients or providers. The reports could potentially be used outside the pharmacy for other departments; such as medical records. The report would contain patient information, medication and instructions for the medication listed on the report. One version of a report that would be helpful for a community pharmacy would be one that is created dynamically. This would be done by letting the pharmacist select which

medications are to appear on the list, and when they print the report, the directions are pulled from the database and printed similar to an instruction sheet. This report might also contain a time line on when what medication should be taken. If a patient is currently taking several medications, a graphic display showing each medication superimposed on a specific time (e.g., "before bedtime") timetable would be helpful to make sure that mediations are taken accordingly. Another version of a report would be one that could be used by medical records. By having all the medication information located in a single application, medical records would be able to retrieve valuable information for providers in a timely manner.

DISCUSSION

Summary

Pharmacists in both community pharmacy and long-term care pharmacies need the ability for medication reconciliation support. This project, through observations and interviews with pharmacist, gathered the data to identify the functionality needed for medication reconciliation support. In both the settings visited for data collection, the individual elements for filling a prescription varied slightly, but the task itself was primarily the same. Both of the pharmacies that were observed and their respective pharmacists who were interviewed, identified the main steps in filling a prescription. The basic steps are confirm the identity of the patient, examine and validate the prescription and finally fill the prescription.

Once these steps were acknowledged, use cases were created to assist in the tasks of identifying the patient and validating the prescription to be filled. The two paramount items of functionality that were requested by the pharmacists in both settings is the ability to have all the medication on a single list, and the ability to identify medication interactions. Use cases for these two items of functionality, along with some other minor functionality requests were then written up in use cases. A pharmacist from a community pharmacy and two domain experts then evaluated the use cases. Once this review was completed, the next step was to revise the use cases with the feedback gained during the review and present my findings. The final products of this study are the use cases, which will be submitted for use in the *RxSafe* project.

Limitations

While this study did reveal the importance of having a complete medication list for the dispensing pharmacist, it does have several limitations. The first threat to the validity of this study is the limited sample size and settings used to gather the information. The second limitation of this study is that the subjects knew they were being observed and may have provided the observer with an idealized version of the processes involved. The same effect occurs when a subject is interviewed; they will often answer the question posed to them 'by the book' and not reveal the actual process that takes place.

The final and greatest limitation of this study is the fact that it is based on a narrow task focus and does not take into account of the complex multi-tasking that occurs in practice. In practice, filling a prescription may not always occur as a synchronous process, but an asynchronous one, fraught with interruptions and interspersed with other simultaneous duties such as communications with co-workers or acknowledgement of new customers. .

Conclusion and Future Work

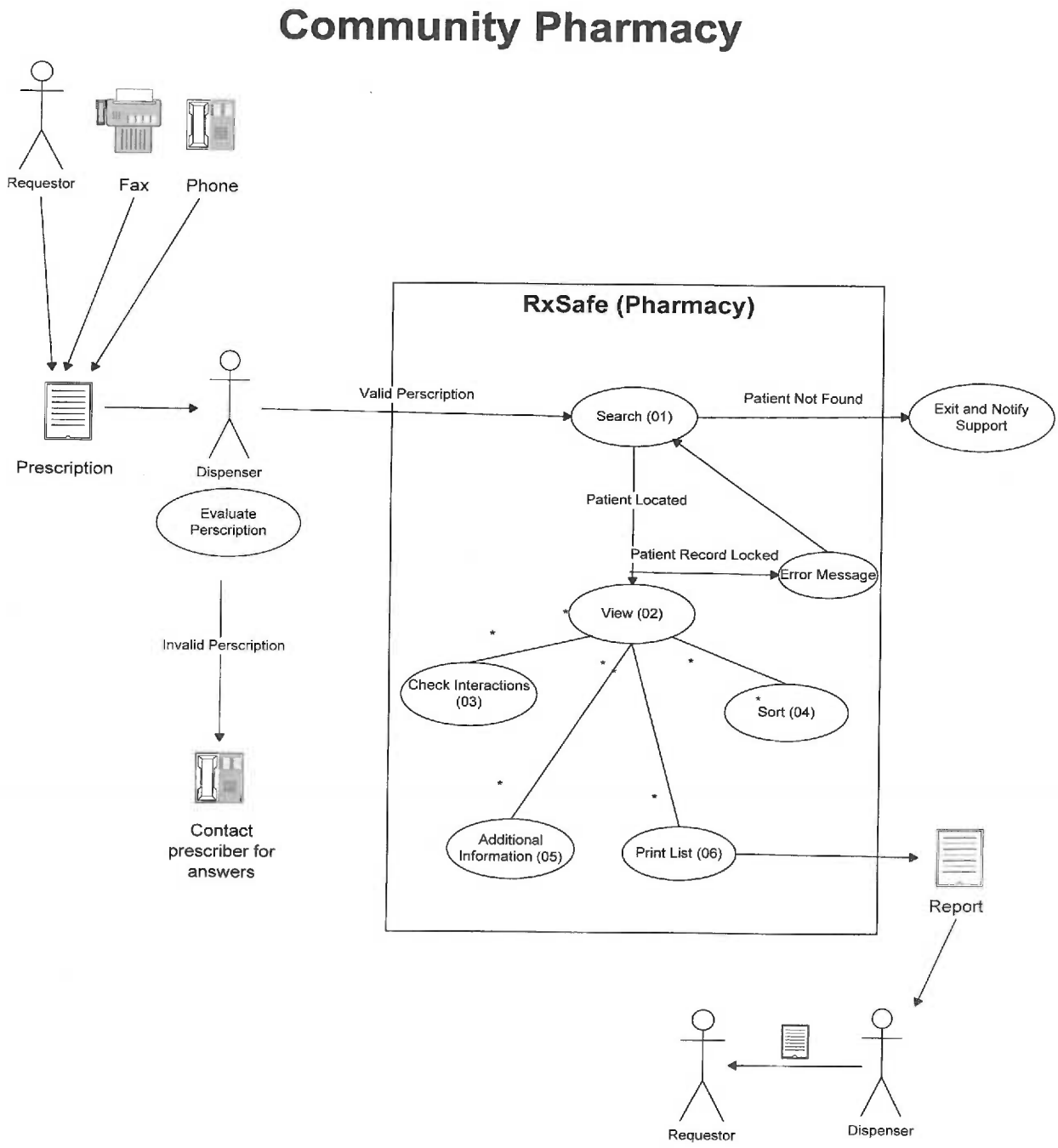
Interviews with pharmacists working different environments indicated that their needs are strikingly similar. Both community pharmacists and long-term care pharmacist expressed the need for a centralized location to access a patient's complete medication information. Currently this information is located on various sources and in multiple formats. This lack of integration gives rise to the possibility of medication errors. By

having a complete list of a patient's medication along with basic information, medication errors are more likely to be avoided.

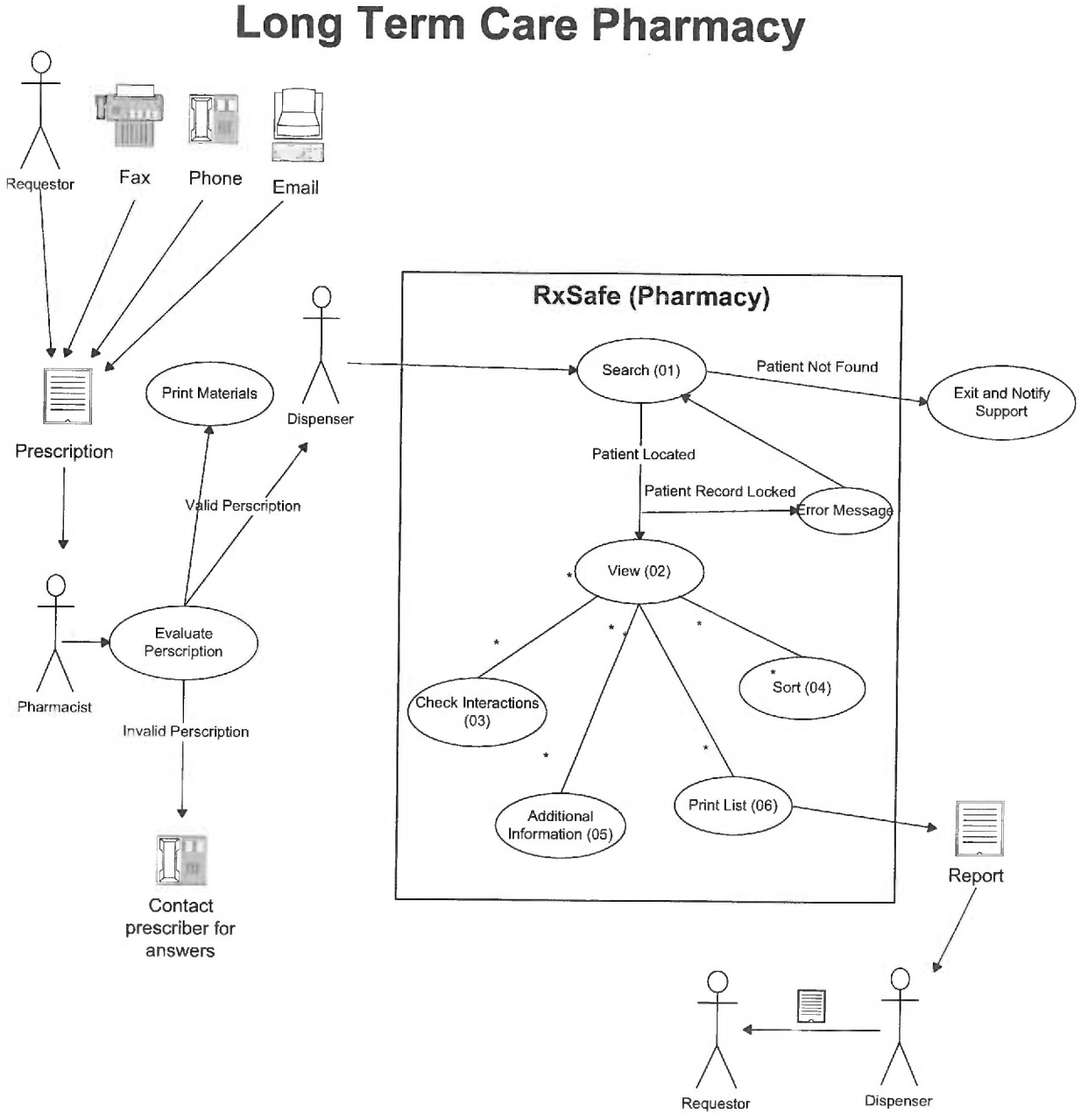
This study was the initial step in the overall *RxSafe* project intended to provide medication reconciliation support for pharmacists in various settings. The next step that needs to occur in this project is have the workflow and use cases reviewed by a larger group of pharmacists who practice in a variety of settings. Once the pharmacists have validated the use cases and the workflow, the next step will be to build an interactive prototype for testing. During the testing of the interactive prototype the use cases and workflow can be revised accordingly as well as refining them to include additional necessary functionality as requested by the pharmacist participants. The end result will be the final specifications needed to create a medication reconciliation support software application that pharmacists will be able to utilize in their day-to-day practice.

In today's environment, there is an ever-increasing public concern about patient safety in general and the magnitude of medication errors. A networked system that provides pharmacists with the ability to access accurate, timely and comprehensive information on a consistent basis would essentially create an additional safety net with the potential for significant positive impact. It would also facilitate an integration of this population of highly trained and knowledgeable clinicians into the realm of healthcare providers who would be better able to provide clinical consultation and advice to their patients and help ease a worsening shortage of healthcare providers.

APPENDIX 1

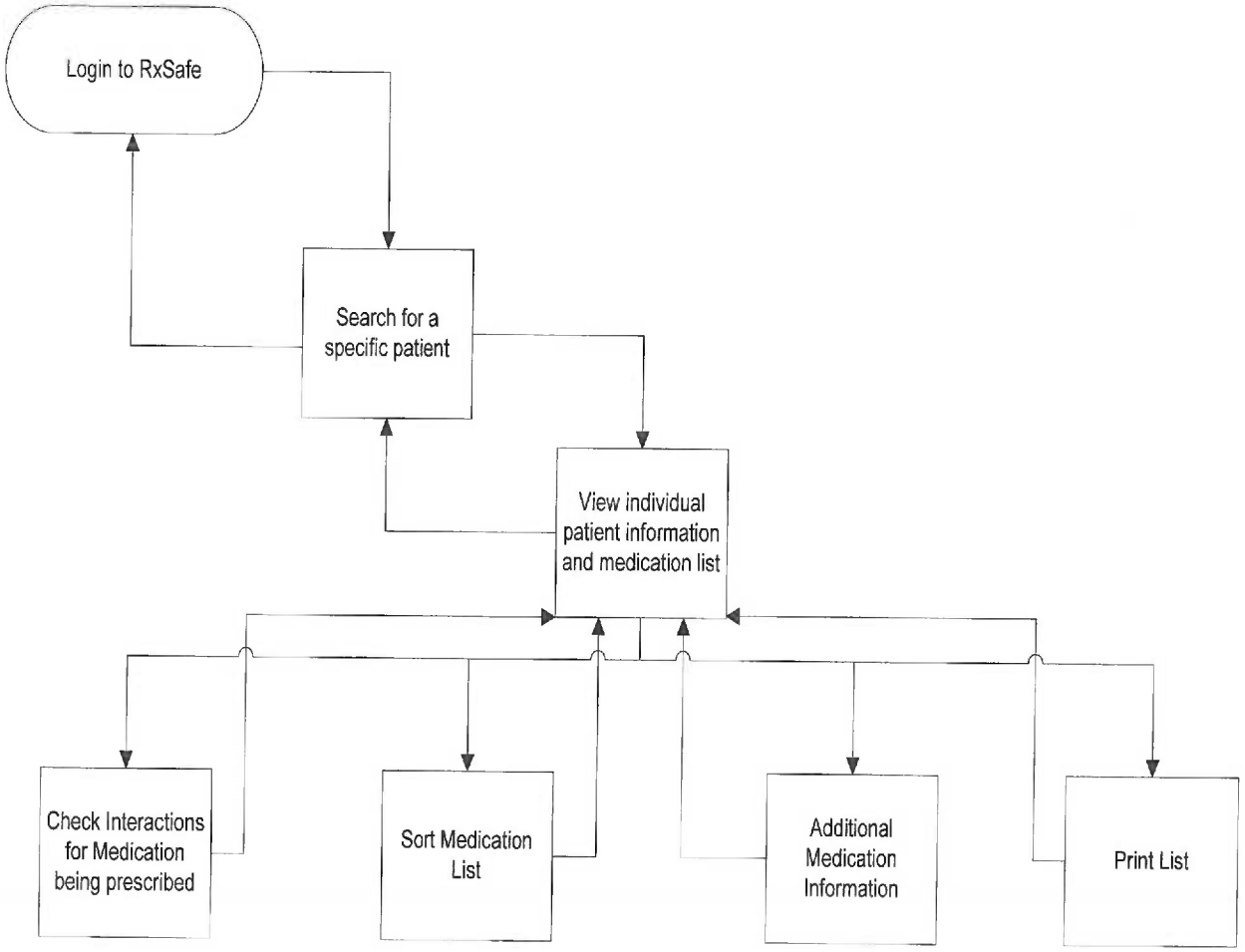

Community Pharmacy
Requestor
Fax
Phone
Prescription
Dispenser
Evaluate Perscription
Invalid Perscription
Contact prescriber for answers
RxSafe (Pharmacy)
Valid Perscription
Search (01)
Patient Not Found
Exit and Notify Support
Patient Located
Patient Record Locked
Error Message
View (02)
Check Interactions (03)
Sort (04)
Additional Information (05)
Print List (06)
Report
Requestor
Dispenser

APPENDIX 2


Long Term Care Pharmacy
Requestor
Fax
Phone
Email
Prescription
Print Materials
Dispenser
Valid Perscription
Pharmacist
Evaluate Perscription
Invalid Perscription
Contact prescriber for answers
RxSafe (Pharmacy)
Search (01)
Patient Not Found
Exit and Notify Support
Patient Located
Patient Record Locked
Error Message
View (02)
Check Interactions (03)
Sort (04)
Additional Information (05)
Print List (06)
Report
Requestor
Dispenser

APPENDIX 3

Pharmacist Workflow Support Needed for *RxSafe*



APPENDIX 4

Information Currently Available to Pharmacists

Data	Community Pharmacy	Long-Term Care Pharmacy
Pt Name	X	X
Correct Date of Birth	S	X
Allergies	S	X
Complete list of medication	S	S
Diagnosis	N	X
OTC Medications Taking	S	S

X – Have the information

S – Sometimes have the information

N – Do not have the information readily available

APPENDIX 5

Functionality Requested by Pharmacists & Corresponding Use Case

Major Functionality	Description	Use Case
Complete List	The ability to have a single list that contains all of the medication for an individual patient	2
Medication Interactions	The ability to check for interactions within a patients complete list of medication	3
Minor Functionality	**Description**	**Use Case**
Obtain Additional Information	The ability to get additional information on a medication	5
Sort	The ability to sort a complete medication list by a user specified criteria	4
Print a List	The ability to print out a medication list/report	6

APPENDIX 6

Use Case Details

Use Case 01	Search for an individual patient record
Pre Conditions	• The pharmacist is logged into RxSafe • Have a patient to look up
Post-Conditions	• Patient was located
Description	This use case describes the process by which a patient account is located and retrieved
Trigger	A prescription is submitted to be filled or there is a question about a patient
Main Scenario	1. User wants to retrieve a patients account 2. User enters search criteria (at least one item is required) 2.1Date of Birth 2.2 Last Name 2.3 Phone Number 3. Submit the search 4. Patients matching search criteria are returned 5. User selects patient from the list that is returned 6. End Use Case
Alternative Scenario	2.1a Date of birth is in the wrong format 2.1a.1 Error message is displayed 2.1a.2 Return to step 02 2.2a Last name is too long 2.2a.1 Error message is displayed 2.2a.2 Return to step 02 2.3a Phone number is in the wrong format 2.3a.1 Error message is displayed 2.3a.2 Return to step 02 3a. No criteria given to search 3a.1 Error message is displayed telling the user to enter search criteria 3a.2 Return to step 02 4a. No patients found 4a.1 User refines search criteria 4a.2 Return to step 03

Use Case 02	View an individual patient's information
Pre Conditions	• The pharmacist is logged into RxSafe • The pharmacist has completed a successful patient search
Post-Conditions	• Patient information viewed
Description	This use case describes the process by which a patient information can be viewed
Trigger	A patients individual information needs to be viewed
Main Scenario	1. User selects patient from the list of patients 2. The patient information is retrieved 3. Patient's information displayed 3.1Demographic information 3.2 Allergies 3.3 Diagnosis code 3.4 Patient vaccination information 3.5 Patient medication list 4. End Use Case
Alternative Scenario	2a. Patient information is not retrieved 02a.1 Go back to previous screen 02a.2 Clear search criteria 02a.3 Return to step 01 2b. Patient information record locked 02a.1 Display error message 02b.2 Go back to previous screen 02b.3 Return to step 01 2c. Patient information not in system 02c.1 End Use Case

Use Case 03	Check for medication interactions
Pre Conditions	• The pharmacist is logged into RxSafe • An individual patient record is being viewed
Post-Conditions	• Medication interactions are brought to the attention of the pharmacist
Description	This use case describes the process by which a patient's potential medication interactions are displayed.
Trigger	An existing patient comes in with new prescription
Main Scenario	1. The user puts focus on the medication list 2. The user enters the name of the medication that the pharmacist has received a prescription for in the textbox above the list 3. The user hits the interactions button 4. Medications that interact with the new medication are outputted in some format. 4.1 A list 4.2 Highlighted 5. End Use Case
Alternative Scenario	3a. No medication name was entered 3.a1 An error message is displayed 3.a2 Prompt user to enter medication name 3.a3 Return to step 2 4.1a. The name of the new prescription is not found 4.1a.1Check for spelling errors 4.1a.2Return to step 2 4b. Medication not in system 4b.1Report this to administrator 4b.2 End Use Case

Use Case 04	Sort Medication List
Pre Conditions	• The pharmacist is logged into RxSafe • An individual patient record is being viewed
Post-Conditions	Medication in the patient's medication list are grouped and sorted according to the pharmacist's request.
Description	This use case describes the process by which a patient's medication list can be sorted according to the pharmacists needs
Trigger	An existing patient's medication list needs to be reviewed
Main Scenario	1. The user puts focus on the medication list 2. The user selects item for sort order desired 2.1 Alphabetically 2.2 Family 2.3 Class 2.4 Physician 03. End Use Case
Alternative Scenario	

Use Case 05	Retrieve additional information on a medication
Pre Conditions	• The pharmacist is logged into RxSafe • An individual patient record is being viewed
Post-Conditions	Medication in the patients medication list is being reviewed
Description	This use case describes the process by which a medication in a patient's medication list can be looked up
Trigger	A medication in an existing patients medication list needs to have additional information looked up.
Main Scenario	1. The user puts focus on the medication list 2. The user selects a medication on the list 3. The user then clicks on the lookup button 4. A separate window is opened with the information about the drug. 5. End Use Case
Alternative Scenario	3a. No medication selected to be looked up 3a.1 Return to step 02 3b. Medication not found 3b.1Report this to administrator 3b.2 End Use Case

Use Case 06	Print a list of medications for a patient
Pre Conditions	• The pharmacist is logged into RxSafe • An individual patient record is being viewed
Post-Conditions	A medication list is printed out for a patient
Description	This use case describes the process by which a list of medication in a patient's medication list can be printed out for an individual patient. This would be a 'customized' list that includes instructions and times that medication/s need to be taken.
Trigger	A patient requests a printout out about their medication, or the pharmacist feels that the patient would benefit from a print out of the medications that they are currently taking.
Main Scenario	1. The user puts focus on the medication list 2. The user clicks on the print a list button; which opens up a new window with the medication list 3. The user selects the medications that are to be on the print out. (ex: a checkbox for each medication.) 4. The user hits the print button. 5. The report is printed out and given to the patient 6. End Use Case
Alternative Scenario	4a. No medication(s) have been selected 4a.1 Display message that no medications have been selected; please choose medication(s) to be printed out 4a.2 Return to step 2 4b. Medication list did not print 4b.1Check printer 4b.2 End Use Case

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