MyRx: Final Report

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December 5, 2011
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PREAMBLE

Abstract
MyRx is an electronic prescription system. The main idea behind our design was to not only eliminate the errors that are made in the prescription filling process by both physicians and pharmacists, but to make the process easier for both sets of users.

We designed our interface with two sets of users in mind; physicians and pharmacists. Each user has separate login information, which directs them to the appropriate part of our system.

Physicians can request use of our system by creating a profile, but they will not receive log in information until their physician’s license can be verified. Once they have received their login information, they will be able to send prescriptions to a participating pharmacy electronically. As for the pharmacists, they will be able to view prescriptions and fill them by using our system as well.

Keywords
1. Prescription: an official note from a physician for a specific type of medicine that is not available over the counter (OTC).
2. Pop-up Prescription Box: This is the box that appears when a physician wishes to view detailed information about a prescription.
3. Trade Names: This is the name that a medication is called. For example, the prescription drug name is a contraceptive, while the trade name could be Yaz.
4. Dosage: This is the unit and how much of the medication will be in the prescription (i.e. 100 mg, 20 mL, 300mg, etc.)
5. Prescription Instructions: These are the set of instructions that are given to a patient when prescribing medication. They instruct the patient on how exactly the medication should be taken.

1. INTRODUCTION

1.1 Overview
In the medical field, despite the advancements of modern science, errors still exist in the process of diagnosing and prescribing medication in order to treat these conditions. Errors are common in the communication between doctors and pharmacists when relaying the prescription information. According to the Institute of Medicine of the National Academies, “Medication errors are the most common medical errors, harming at least 1.5 million people” (National Academies), which therefore proves that because there is such a large number of prescription errors every year, there exists a need for a system which prevents those errors from happening. Our goal is to develop a system that eliminates any possibility of these simple errors from occurring.

1.2 Previous Work
Currently there exist examples that are similar to our application, however each has minor imperfections that we wish to polish in order to perfect our service for our users.

1.2.1 Allscripts
Allscripts acts as an online data and organizational center containing information related to one's prescription(s). It is accessible through the web and mobile devices. Its main feature is providing safety checks on drug interactions and dosage levels in addition to providing instant access to information on the drug the patient is taking.

1.2.2 Costco
These services are only available to Costco members and require an online profile to be created. They offer online abilities to transfer or reorder prescriptions previously filled at Costco or other verifiable pharmacies. Home delivery is offered through standard mail, two or three day shipping. New prescriptions can be filled with a doctor’s verification.

1.2.3 CVS Pharmacy
CVS has a current online pharmacy that allows for prescriptions to be transferred from other pharmacies which can either be delivered to a home or picked up at a local CVS store. They also allow for online refills of existing prescriptions, which can also be delivered or picked up. New prescriptions can also be filled out online, however they also require a written copy of the prescription to be mailed in by the doctor or the patient.

1.2.4 FamilyMeds
This system offers users the ability to create an online profile to deal with all of their prescription information. A doctor profile also has to be created for each patient including all of the doctors contact information. In order for a prescription to be filled, the doctor will be called to verify it. In addition, an insurance profile is available to be created for those whose medications are covered.
1.3 Previous Work Issues

1.3.5 Problems Filling Prescriptions
Most problems present in getting a prescription filled involve poor communication. Illegible prescription notes, refills not being ready, and long lines at the pharmacy checkout line are just a few of the communication errors that can plague a pharmacy transaction. Our site will be able to fix many of these by eliminating the human error element involved in the process by digitizing and automating all transactions.

1.3.6 How to Fill Prescriptions
The process of getting controlled medication involves first going to the doctor who addresses your symptoms and decides on a proper medication based off of his or her observations. The doctor then writes a prescription for the medication, which you have to take to a pharmacist who will “fill” it by giving you the proper dosage of the medication the doctor prescribed.

1.3.7 Prescription Fraud
Prescription fraud is very prevalent in pharmacy practice, especially for painkillers that are highly addictive and highly abused. Many jurisdictions across the United States report various forms of forging, altering and stealing blank prescription notes from doctors.

1.3.8 Pharmacy Errors
Under federal law Pharmacies are not required to report errors in prescriptions that result in injury or death, so the extent of the problem is not exactly known. Studies have found that common errors stem from wrong time of administration, omission, wrong dosage and unauthorized drugs being administered. All of these can be fixed by an automated transaction system.

2 PRESENTATION OF DESIGN

2.3 The Problem
MyRx seeks to solve the problem that pharmacists and doctors experience when there is a lack of easy, instant, paperless communication between the two entities. MyRx also seeks to allow doctors an easily manageable web interface to view their currently filled and unfilled prescriptions as well as the pharmacies they are registered with. MyRx also provides an instant and continuous interface for both the doctors and pharmacists to access at any time. This is convenient for both parties, as they don't have to rely on a phone call or other real time communication to get their information between each other. This makes it easy for both to do their part of the prescription filling process whenever is most convenient. Finally, MyRx aims to allow pharmacists an easier way to access paperless records of written prescriptions, doctor information, and allow for further peace of mind when confirming the validity of a patient’s prescription.

2.4 The Solution
Our idea was to create a clean and simple web interface, which allowed for doctors to send their prescriptions to the pharmacy electronically. The doctor would be able to specify exactly which medication to prescribe, the dosage, and all of the necessary attributes.

Our product would provide a clean and simple web interface where doctors could send prescriptions out to a pharmacy and a pharmacy could send receipts of pick-up if requested. Patients would be able to receive their medication at any one of the registered pharmacies by providing the valid identification. Doctors would maintain a profile with MyRx and would be allowed to view all current and past prescriptions.

Patient information and prescription records would be held by our database for easy access by the doctor prescribing the medication. Pharmacies would be signed up for our service directly through our management, while doctors could create a profile, which would then be subject to verification before linking them to registered pharmacies. The patient is allowed to receive their prescriptions or modifications to their prescriptions faster, and electronically. All three entities, patient, doctor, and pharmacy, all benefit from the ease of use that our product provides.

2.5 Our Design
The first screen that the users encounter is our main home page that also serves as a log in for the doctors and pharmacists, which is shown in Figure 1. The page is very simple, only including the basic functionality needed for a log in screen. A large image of our logo is in the middle with a form below for the user to enter their currently filled and unfilled prescriptions as well as the pharmacies they are registered with. MyRx also provides an instant and continuous interface for both the doctors and pharmacists to access at any time. This is convenient for both parties, as they don't have to rely on a phone call or other real time communication to get their information between each other. This makes it easy for both to do their part of the prescription filling process whenever is most convenient. Finally, MyRx aims to allow pharmacists an easier way to access paperless records of written prescriptions, doctor information, and allow for further peace of mind when confirming the validity of a patient’s prescription.
2.5.1. **Creating a Profile**

For first time users to our site, the next screen they will have to encounter will be the “Create a Profile” screen, which is shown in Figure 2. This is where the doctor is able to enter information needed to create a profile so that they will be able to log into our site and begin entering prescriptions to be filled by a pharmacy for their patients. Again the page has a very simple setup that obtains all of the necessary information, but keeps the doctors from becoming confused by extra distracting components. We display our logo in the top left and the page title in the top center so that the user has an understanding of their current position within our page. This also reminds them of the current task they are in the process of completing. We also display the current date in the top right corner for convenience for the user to reference if needed.

2.5.2. **The Doctor User Interface**

After the doctor logs into our site, they are redirected to the doctor home page, which is shown in Figure 3. This page contains a header bar that is consistent with the layout of the rest of our site. There is the logo in the top left, the title in the middle and the date in the top right. The doctor’s home page contains a button in the top right that gives the doctor the option to logout. Our logo is also printed in the middle of the screen. Additionally, the word “Doctors” is printed in cursive in our logo so that the users are reminded what kind of user they are logged in as. Along the left column is where we list the tools for the doctor, which consists of filling prescriptions for their patients. The “Fill a Prescription” button needs to be clicked to begin the process.

When a doctor clicks the button to fill a prescription, they are brought to the Fill a Prescription page, which is shown in Figure 4 (below). The consistent header contains our specialized doctor’s logo, a title of the page, the date, and the ability for the doctor to log out. By this point, the doctor should recognize the header and understand the general layout of the site. The main part of this page is the most important part of our entire interface. It contains a form in which the user fills out their patient’s information, the pharmacy’s information, and the medication information. Because of the importance of this form, the various fields have certain requirements in order to be submitted. Every doctor maintains a list of patients, and every patient entry also contains his or her personal information as well. Also, the system has a list of registered pharmacies. The prescription name field is a list of all available prescription drugs in the United States. The Prescription Details field contains a list of all dosages and trade names for the selected prescription drug name. Therefore, the name of the patient name, pharmacy name, prescription drug name, and prescription details fields are all selected by using the JQuery autocomplete feature to reduce any possible errors made by the doctor. The text valid or invalid will appear next to the remaining fields to indicate to the user if they have entered in valid information. Once the form is complete, and the doctor
clicks on the submit button, the doctor will see a confirmation screen, which is depicted in Figure 5.

![Figure 4: "Fill a prescription" Screenshot](image1)

![Figure 5: "Prescription Request Confirmation" Screenshot](image2)

### 2.5.2. The Pharmacist User Interface

When a pharmacist logs into our system, they are brought to the pharmacy part of our site, which is shown in Figure 6. This interface contains the same header as that of the doctor except the logo has “Pharmacists” written above it instead of doctor. The title in the middle reflects the fact that the user is on the pharmacy home page. After logging in, the list of unfilled prescriptions is displayed by default, because those are the ones of the highest priority for the pharmacist. Within the list, the user is able to customize how many entries are displayed at a time. They are also able to sort order of the lists display by any one of the column titles. A patient can be selected by clicking on their name. Once this is done, an additional information screen pops up containing the patient’s information along with a full description of the prescription (Figure 7). Along the left column, there are two links listed underneath of the tools. These allow the user to switch back in forth between a list of prescriptions that have already been filled, with those that are yet to be filled. The style and functionality of the two tables is identical with the only difference being the title of the chart and the information that it displays in the table.

![Figure 6: Pharmacist Home Screenshot](image3)

![Figure 7: Patient Information Screenshot](image4)

### 3 REPORT ON DEVELOPMENT

#### 3.3 Low Fidelity Prototypes

The goal of the low fidelity prototypes was to provide projections of what our final web interface design was going to be. Three prototypes were presented, each of which contained each of the pages from our project flow chart (Figure 9) at the time.
3.4 Arriving at High Fidelity Prototype

The individual components that were planned in the project flow chart were split up amongst group members to be developed. Some functionality that was originally planned was eliminated due to project adjustments. For example, the patient user group was removed after the project shifted to primarily a doctor-pharmacist focus rather than doctor-patient-pharmacist. Different parts of the individual low fidelity prototypes were combined into the high fidelity prototype. For example, elements in the low-fidelity prototype for the “create a profile” page were incorporated into the high fidelity “create a profile page.” Other presentation cues from the prototypes were included into the high fidelity prototype too, such as the MyRx logo that had its roots in the picture present in the “login page” (Figure 1). In general, the high fidelity prototype was generated using the low fidelity prototypes as archetypes from which adjustments were made through the course of this project.

3.5 Usability Testing Process

The purpose of our usability tests was to evaluate if our interface included all of the necessary information to allow for a smooth transition of information from doctor to pharmacist without error. Our test subjects were selected from doctors who write prescriptions regularly. This gave us subjects who were familiar with the process and terms involved in dealing with a pharmacy. Our tests asked them to create a profile on our site so that they could begin the process of getting their prescription to the pharmacy. The subjects were set up in a familiar environment such as in their office on an internet enabled computer. We asked them to enter a prescription for an anonymous patient in order to test our interfaces usability. After that we had the doctor submit the prescription. Next we got another group of test subjects who worked as pharmacists. This group had experience in filling prescriptions and understood information they received from the doctors. We had them log onto our site as pharmacists and then attempt to fill a prescription that one of the test doctors had submitted.

3.5.6 Doctors Task List
1. Bring up site on web browser
2. Create an online profile
3. Click a link to submit a new prescription
4. Fill out the form for a prescription that needs to be filled
5. Submit form
6. Log out

3.5.7 Pharmacists Task List
1. Bring up site on web browser
2. Create an online profile
3. Receive a message from a doctor that a new prescription is needed to be filled
4. View form submitted by doctor
5. Fill the prescription
6. Send prescription to doctor / patient
7. Acknowledge prescription has been filled out / sent out
8. Log out

3.5.8 Pre-Test Questions
- What is your gender?
- What is your age?
- How many years have you been a physician?
- Approximately how many hours per week are you using the Internet?
- Have you used electronic information technologies in the doctor’s office before?
Approximately how much time is currently spent per week writing prescriptions?

Have you ever used an electronic prescription service before?

Do you have any vision impairment issues when viewing a website? If so, what are they?

Do you have any hearing impairment issues when viewing a website? If so, what are they?

Do you have any physical mobility issues when viewing a website? If so, what are they?

3.6.9 Post-Test Questions

What was your favorite aspect of the interface?

What was your least favorite aspect of the interface?

Were there any options for submitting a prescription that you would want that were absent from the interface?

Describe from 1 to 9 (1 being extremely difficult and 9 being very easy) the difficulty level of navigating through the website interface to submit a prescription.

Describe from 1 to 9 (1 being extremely difficult and 9 being very easy) the difficulty level of using the website forms to submit a prescription.

3.6 Test Subject Experience and Feedback

3.6.6 Description of Users and Their Reactions

We ran usability tests at the University of Maryland Health Center, and our mentor and a few of his employees tested our system as well. Since our mentor lives in Texas, we were unable to witness their reactions, but we were able to witness how the test went at the Health Center.

The tests went very well. The following describes each user, and if they tested our system in person, their personal reactions that we witnessed.

3.6.6.1 Pharmacist #1

This user was a 53-year-old female who has been a pharmacist for 31 years. She also spends approximately 10 hours a day on the internet, has used electronic information technologies in the pharmacy before, and spends 10 hours a week filling prescriptions. She had no vision, hearing, or mobility impairments.

After speaking with her after the test, she was impressed by the system, and she expressed interest in our system if we included the ability to edit a prescription.

3.6.6.2 Pharmacist #2

This user was a 51-year-old female who has been a pharmacist for 23 years. She also uses the internet for approximately 7 hours a week, spends 40 hours a week filling prescriptions, and has never used electronic information technologies in the pharmacy before. She had no vision, hearing, or mobility impairments.

She was extremely enthusiastic in helping us learn about the elements that should be included in our system. She liked how the tables were set up, but she said that we needed to include the doctor who prescribed the medication along with the date the medication was prescribed, as these are some of the most vital information that is included on a prescription.

3.6.6.3 Physician #1

This user was a 61-year-old female who has been a physician for 36 years. She spends approximately 1-3 hours a day using the internet, 2-3 hours a week writing prescriptions, and had used electronic information technologies in the office before. She also used the electronic prescription service before which was called Point & Click. She had no vision, hearing, or mobility impairments.

She did not seem to care much for our system, but she did offer helpful ways to improve the system. She said that our form to fill out a prescription was way too long and that most doctors don’t want to waste that much time filling out that same form every day. So although she may not have been as enthusiastic, her criticisms were extremely helpful.

3.6.6.4 Express Scripts #1

This user was a 50-year-old male who has been a pharmacist for 28 years. He spends approximately 50 hours a week on the computer and has used electronic information technologies in the pharmacy before. Although he is a manager now, he used to spend 40-50 hours a week filling prescriptions. The electronic prescription services that he has used before is Rx Hub, and Medi-script. He had no vision, hearing, or mobility impairments.

3.6.6.5 Express Scripts #2

This user was a 38-year-old male, who has been a pharmacist for 15 years. He spends approximately 30 hours a week using a computer, spends 20 hours a week filling prescriptions, and has used electronic information technologies in the pharmacy before. The electronic prescription services that he had used before were Allscripts, DrFirst, and Epic. He had no vision, hearing, or mobility impairments.

3.6.7 Proposed Modifications

- In order to meet legal requirements, there needs to be an electronic image created for each prescription.
- The display needs to include doctors DEA and NPI numbers.
- A prescription number needs to be assigned to all completed prescriptions.
A query by prescription number should be available

Replace the word “unit” on the display with “strength”

Include enhancements to the UI to allow for handling of hand-written or verbal communications

Create a “hold at later date” option or “holding area” when prescription inventory is unavailable

Doctors address and phone number should be on display info

3.6.8 Feedback-implemented revisions

While we did implement the minor revisions with the user interface as proposed by our usability test subjects, many of the proposed major revisions were not feasible in the time period given for this project. Proposed revisions include assigning and querying by prescription number, and creating a unique electronic image assigned to each prescription. What we did do, is assign a difficulty rating for each of these proposed revisions and address the possibility of implementing them as well as an enhanced database in our “Recommendations for Future Developers” section.

3.7 Survey Numerical Results

4 CONCLUSION

4.3 Final Status

The final status of MyRx is that we have a working prototype of the interface with a limited amount of real world functionality. We implemented the functionality for logging into the system, creating a doctor’s account, requesting a prescription as a doctor, and viewing current and filled prescriptions as a pharmacist. The prescription filling functionality includes verification of input fields and autocomplete for prescription names and their associated dosages. The prescription viewing functionality allows pharmacists to click on a prescription and see a summary of all the information associated with it.

4.3.2 Ultimate Comparison to Available Commercial Products

Our product is not exactly like any one of the products currently offered. The most significant difference between our product and others is that it is centered on the
pharmacist-to-doctor exchange. While later versions of our product could theoretically offer patient sign-in, our interface is simple and effective in that it is designed strictly for the transmission and retrieval of prescriptions. The transmission is straightforward and easy for anyone to complete, as well as the retrieval on the pharmacist end. Verifying a patient’s credentials is also as simple as one click.

CVS pharmacy requires a written form of their prescription even when doctors fill one out online. Our product has the potential to alleviate this need for paper to switch hands. Based on our usability tests from experts in the field, to achieve paperless transactions, we would need to generate unique prescription numbers and images for each prescription, which should not be an impossible feat.

Our product further differs from products like FamilyMeds in that FamilyMeds requires a doctor profile to be created for each patient. Our service allows profiles to be created independently and linked up at our end based on the profiles received and the local areas we wish to cover.

While our product in its current stage is not completely ready for infusion into the public sphere, the key aspects of our product make us unique to the current products that are already available. Our simplicity, and strict doctor-to-pharmacist relationship gives our product the ease of use and the reliability without the clutter of some more complex social-media based products.

4.4 Future Work Possibilities

For MyRx to be a commercial product, the most important future work is implementing a database to manage current and new drugs, their dosages, doctors and pharmacies that have accounts on the system, and active prescriptions. Currently, this data is only held in an array, and is not in a format that allows it to be easily extensible. Other necessary additions include a system to verify doctor’s credentials when they create an account, the creation of a virtual image for each prescription that is submitted, a system to allow doctors to virtually sign prescriptions, and attaching each prescription and doctor with various identification numbers used in the prescription drug industry. Another possibility is adding a section for patients to view their current prescriptions and receive notifications about them.

4.5 Recommendations for Future Developers

Future development of this project essentially comes down to database management and adhering to prescription drug classification standards. A relational database consisting of all current prescriptions, all possible drugs, participating doctors, pharmacies, and patients would make the system much more robust and expandable for new users and drugs. The system also needs to incorporate industry standard identification numbers for doctors and drugs. In summary, future developers should be focused on database management and working with doctors and pharmacists to make the information in the database reflect industry standards.

5 ACKNOWLEDGMENTS

We would like to thank everyone that contributed to completing this project. Firstly, we would like to extend our gratitude to our mentor Thomas Koontz from Express Scripts. He originally gave us the idea for the project, and was very helpful throughout the whole process. Also, we would like to thank all the physicians and pharmacists at the University of Maryland Health Center for contributing to our usability tests. And finally, we would like to thank all others who have not been mentioned, but were extremely helpful in guiding this project to completion.

6 Credits

- Heather Klinar
  - Organized group meetings
  - Team leader
  - Assembled all components of the project to make a complete system
  - Wrote the CSS styles for the project
  - Wrote the autocomplete functionality for the prescription form along with part of the data used.
  - Created the notification boxes (i.e. after submitting a prescription, and a profile request)
  - Coordinator for usability tests (contacted users, and administered the tests)
  - Wrote the title page, abstract, and key phrases
  - Made the video clips of the system

- Adam Anderson
  - Introduction
  - Formatted and assembled all the components for the final report.
  - Entered the data for the prescription information used with the autocomplete functionality in the prescription form
  - Wrote the sample data used for the pharmacist interface.

- Stephen Gardner
  - Wrote the form for the “Create Profile” page
  - Wrote the Presentation of Design
  - Wrote the References
- Created the final PowerPoint presentation
- Contributed to the help pages
- Final revisions - Added sections on:
  - Feedback Implemented Revisions
  - Ultimate Comparison to Other Commercial Products

- Bingchen Hu
  - Wrote and designed the pharmacist aspect of the interface (this includes the data tables and the pop-up dialog box)
  - Wrote the report on development process

- Chris Muller
  - Wrote the original form for the doctor (‘fill-a-prescription form’)
  - Contributed to the help pages
  - Wrote the conclusion

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