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# **P<sup>3</sup> Prescription Pharmacy Protocol**

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## **Abstract**

When University of Washington (UW) physicians send a prescription to the pharmacy, the current process requires sending a paper-based form with the prescription information via fax. Many problems arise using this old system. For instance, much time is wasted sending the fax and there is a possibility of forms being mislaid or unprocessed. Following a series of interviews and "think aloud sessions," I concluded that the medical prescription system at the UW should be upgraded. The solution for this problem consisted of building a desktop application, using C# and XML, where physicians fill out an electronic form that contains the prescription information. This form is sent to the pharmacy electronically. As result, the patient information is stored and processed without any risk of mislaying the data and the process of sending the request is faster and easier to read.

## **Why P<sup>3</sup>?**

The most important reasons why P<sup>3</sup> -*Prescription Pharmacy Protocol* has been developed include changing the old fashioned way that hospitals such as Harborview Medical Center and UW Medical Center prescribe medicines to patients and also to help physicians facilitate their work.

It was hard to believe that prestigious hospitals use a fax system to communicate with the pharmacy. The process of communication between physicians and the pharmacy is described as follows:

1. The physician fills out a paper based prescription where she includes drug type, doses and frequency.
2. The doctor deposits the paper form as a fax in the chart.
3. A nurse picks up the prescription-fax from the chart and sends it to the pharmacy through a fax machine.
4. The pharmacist receives and processes the fax.

Physicians find the process of sending prescriptions through a fax machine "slow" and "sometimes faxes get mislaid or misread during the process."

### **Related Work**

The Seattle VA Hospital uses an electronic system for communicating with the pharmacy. This method of interacting between departments serves as a model for the P<sup>3</sup> application. However, as result of interviews with doctors whose communication method consists of this electronic system, P<sup>3</sup> takes another direction with the electronic system. The physician interview sessions included a demonstration of the system used at the VA Hospital, which highlighted the possibilities to improve the electronic prescription system with new approaches based on the suggestions and comments from the physicians.

For example, the simple design for the graphic user interface implemented for P<sup>3</sup> stands in contrast to the electronic version of the VA, and makes the interaction between the physicians and the application easier. Some comments provided by the interviewed potential users consisted of the complex nature of the electronic prescription system used in the VA hospital.

### **Data Collection**

The main source for data gathering consists of interviews with potential users. These interviews were conducted with resident physicians who work in the three UW main hospitals, Harvorview, UW and VA.

The interview sessions planned during the first two weeks of the quarter helped me to understand the necessities and problems that the physicians suffer using both current systems. The following shows an example of question asked during the interview meetings.

### **Interview Questions**

- What type of advantages do you find using the electronic system over the traditional systems of other hospitals?
- What type of disadvantages do you find using the electronic system over the traditional systems of other hospitals?
- Do you find it complicated to interact with the system? If so, how would you make it easier to interact?

- How long does it take to complete and send a prescription using the two methods?
- Have you ever had any incident using the “fax” system? For example, missing prescriptions or delays in the preparation of the prescription.

## Evaluation

### “Think Aloud” Sessions

These sessions were conducted to verify the application is satisfying my clients’ suggestions during the past interviews. In order to perform these sessions, I planned a series of situations where the physicians had to simulate completing a task using the p3 user interface. I decided to use Ten Usability Heuristics by Jacob Nielsen.

List of Tasks to be completed by the user:

#### *Logging into the application*

The potential user was asked to login to the application using her UW id and password. Based on the Consistency and Standards principal, the user felt comfortable interacting with the login window due to the similarity to other input interfaces where the user needs to enter her user name and password.

#### *Searching for a patient*

After the user logged into the application, I asked her to search for a patient. Due to the Aesthetic and Minimalist Design of my interface, the physician did not hesitate when she looked for the search textbox located in the right corner of the window.

Also, my clients found the search feature very useful, where with just entering the first number of the patient, a list of patients starting with that number was displayed so it speeds up the process of entering and retrieving the patient information. As result, I am satisfying the Flexibility and Efficiency of Use concept from the Ten Usability Heuristics, where accelerator features may often speed up the interaction for the user.

#### *Searching for a specific medication*

Based on one of the prior concepts, Flexibility and Efficiency of Use, the search tool dedicated to the medications was very easy to operate for the user. My clients were very impressed with this search tool. Names of drugs sometimes are very complicated so the ability of the feature to auto complete the name of the medicine by just inserting the first letter of the medication was very useful for the two physicians. In addition, my clients agree with the capacity of inserting the name of the drug without the auto complete function.

#### *Filling out the necessary information for the medication*

I asked the users to fill out the fields that included dose, frequency, route and PRN. The feedback here was very positive, because one of the physicians suggested specifying the frequency. Now, the design just shows the field where the user inserts the frequency that the medicine needs to be provided, for example, hourly or daily.

#### *Submit the form with wrong information*

Based on the Help Users Recognize, Diagnose, and Recover from Errors heuristics, I decided to test how the user reacts when wrong information is entered on the application. The user was very satisfied when a non pop up alert message was used to display an incorrect action. Instead of a pop up alert, the application shows a red image next to the field where the error was executed. The only downside of this feature according to one of my clients consists of having to place the mouse over the image in order to see the error displayed. However, she preferred this method to that of the "annoying" pop up alert messages.

#### *Exiting the application without submitting*

In the next task, I asked my clients to try to exit the application in the middle of prescribing a drug. I looked to assure that User Control and Freedom concept was applied. According to this rule, the user would be able to leave the application without the necessity of finishing a task before exiting the program. The user agreed with this decision. They like the opportunity that the application serves for leaving in free will.

#### *Submitting the form*

The users did not have any problem submitting the form with the information. The submit button is visible and easy to indentify. Again, I put in practice the Recognition Rather than Recall rule from the Ten Usability Heuristics where Nielsen states that objects, actions, and options should be visible to the user.

#### *Printing the confirmation page*

The last task consisted of suggesting to the user to print the prescription confirmation page for a patient's records. According to the users, all the information reflected on the confirmation page was "clear and easy to read". Also, the "printer" icon was easy to identify for the users. However, as medical records are electronic, one user thought that this function of printing might not be necessary.

In conclusion, these "think aloud" sessions confirm my success on the design of the user interface and the functionality of the application. There is no doubt that following the Ten Usability Heuristics principals from Jacob Nielsen has contributed to this achievement.

### **Data Collection Findings**

The outcome from the data collection sessions demonstrates the preferences and necessities of our clients for a new prescription system.

- The application should be easy to interact with.
- The data submitted through the electronic prescription system should be integrated with the electronic medical record.

- A printable confirmation page should be available after the submission.
- Users want to validate the information prior submission.
- An auto search feature for medications.
- An auto search feature for patients.
- Physicians favor to have a "comments" field on the form.
- Login into the application should be done with the UW login ID and password.
- User suggested to display non-editable patient information on the application

As result of the data gathering process gained during the interviews, we concluded that an improved electronic system would help physicians to work faster and more efficiently than using the traditional fax system.

### **Functional Requirements**

This functional requirements describes how physicians will interact with the Prescription Pharmacy Protocol (P<sup>3</sup>) application. The main purpose of this tool is to facilitate the communication process between doctors and the pharmacy department located in the Seattle hospitals, Harborview Medical Center and the University of Washington Medical Center. This document will provide a detailed set of procedures typically required to operate the electronic prescription system, from both the doctors' and the pharmacists' viewpoints.

### **Objectives From the doctors' viewpoint**

#### **Input Requirements**

1. The user must login into the application using her personal UW id and password.

The use of an input window is mandatory to ensure that only physicians will be able to prescribe medicines. The system will respond with an alert message indicating that no access will be granted when an unauthorized user tries to access the application.

2. Physicians must provide the corresponding dose, route and frequency of the medicine prescribed.

In order to complete the prescription process, doctors must provide the medicine dose necessary for the patient. It also will prompt for the route by which the medicine will be provided, for example, IV, PO (oral) or subcutaneous. Finally, the user must finish the prescription with the frequency that the drug needs to be administrated, such as once or twice daily.

3. The physicians must sign the medical prescription in order to be validated by the system.

The system will provide a feature where doctors must sign their prescription before they are sent to the pharmacy.

4. Patient information such as first name, last name and admission date must not be altered.

The displaying fields for the patient information must be disabled so the user cannot alter any information related to the patient's demographics. Only medication prescription information is allowed to be entered.

### **Output Requirements**

1. The system must provide a list of medicines available.

Physicians will be provided with the possibility of searching drugs through the application. The names of the medicines are stored in a table which will be part of the database schema of the system.

2. The application provides a search function where doctors can find patients through their patient identification number.

The patient information, including her patient number, first name, last name and date of admission must be accessible to the users. Prescriptions must be linked to a patient.

3. An informative message must indicate that the prescription has been sent to the pharmacy.

When the prescription form is submitted by the doctor a message will confirm the submission of the electronic form.

4. A confirmation page must be display post prescription submission.

After the submission is placed, a confirmation page will display all the information entered to corroborate the data sent to the pharmacy. Also, the user might print the confirmation page to keep it for her records.

5. The application must have the option to be closed.

The user might be able to close the system during or after submitting any prescription to the pharmacy. A message will be prompt to ask the user if she wants to leave the application prior to submitting entered information.

### **Stored Data**

1. All the information, including patient and prescription data, must be stored.

Once the user clicks the submit button, all the information entered in the electronic prescription form must be stored in the corresponding table included in the database schema. These data will be stored in the electronic medical record where all relevant patient information can be found.

2. Data submitted must be validated prior submission.

It is mandatory to verify that the information entered in the form is valid. A series of edit checks such as not allowing empty fields will ensure the correct data submitted.

3. Information can be saved for later submission.

Physicians might be interrupted during the process of writing a prescription. Therefore, a save feature must be provided in order to save the information for later submission.

### **From the pharmacist 's view**

#### **Input Requirements**

1. The user must login into the application using her personal UW id and password.

#### **Output Requirements**

1. The pharmacist must have the option of printing the prescription for her records.

#### **The Solution to the Problem: P<sup>3</sup>**

Even though the mechanism of sending a fax might be easier than using a computer, many problems derive from this old fashion method. For example, according to one of our clients, the process from filling the fax until it is sent, it can take up to ten minutes. Also, sometimes this process has to be repeated due to some faxes being mislaid. As result, an electronic system would help physicians to agile the process of sending any type of prescription to the pharmacy.

#### **Security**

The main concern when developing an application where sensitive information flows consists of security.

The information must be keep close and protected for hackers and crackers, both computers experts who like to trespass private networks.

Therefore, in order to avoid compromising the data, the application is installed as a desktop application that runs through a secure protocol. The connection to the database will take through this protocol avoiding any web based system such as browser or server. As result, the information runs only inside the building without letting any intruder to access the data.

#### **Technology for P<sup>3</sup>**

P<sup>3</sup> is written in C# using Microsoft Visual Studio 2008. Due to the security concern mentioned before, Prescription Pharmacy Protocol uses WinForm technology which contrary to Web Forms does not need to run in a web browser. The result, it is an application that can be deployed to the machine using an executable file instead on uploading the files to a server. The programming language used to develop P<sup>3</sup> consists of C#. The choice of this object oriented programming results for being a simple, modern and general purpose programming language.

The technology used to simulate the data flowing consists of Xml (Extensive Markup Language). Due to time constraints, P<sup>3</sup> retrieves the information using a xml file located in a server. This file simulates the patient table in the same way that it would be used in a database schema.

For example, the patient xml file replicates the patient table which entities consists of Patient Number, Patient Name, Patient Last Name, Admit and Date of Birth.

Next step in the application would be transfer the xml table schema to a relational database.

Finally, Adobe Photoshop and Illustrator served as tool for designing the graphics incorporated in the GUI (Graphic User Interface.)

### **P<sup>3</sup>: The Application**

The following describes the end-product as a user login into the application:

#### **Login into P<sup>3</sup>**

The application starts prompting the user to a login window where a user, in our case a physician, uses her UW id and password to access to application.

The choice of the UW id and password as security method to access the application implies not to create a new account and also it integrates P<sup>3</sup> with the Patient Electronic Chart because both systems uses the same login id and password.



**Logging Fields.** Physicians use UW id and Password to access the application.

**figure 1.** Screenshot from the login page

### **Main Window**

After the application grants the user, a window displays the main electronic form where physicals will prescribe to patients.

Two parts divide the working area on the main window. On the left side, the non editable information shows the patient record. On the right side, the form displays the area where most of the interaction takes place.

The decision of unable doctors to alter any data displayed on the left side resides in the fact that patient's information can only be altered in the main patient record chart application. P<sup>3</sup> saves the prescription information to mentioned application, leaving its only responsibility to send and save information to the pharmacist.

The functional requirements presented before, describes the interaction with the application.

The left side of the form displays the patient information. This data cannot be altered by the user.

The auto-search feature. The user enters the first patient number. As result, a list of patients starting with the input number will show.

“Comments” Area. Physicians can use the comments textbox to reflect any thoughts related to the patient or prescription.

figure 2: Screenshot of the main window

### Notification to the Pharmacist

After the physician submits the prescription, a message window alerts the user that the information travels direct to the pharmacy. On the other side of the hospital, the pharmacist receives and page and email warning him about a prescription submitted.

### Confirmation Page

One of the advantages of P3 consists of the option of physicians to print the prescription. The opportunity to

have a copy of the medicine administered helps the users to keep record of the drugs prescribed to patients. Also, the patients might be willing to have a copy of the prescription for future refills.

Confirmation Page  
Prescription #: 001      Seattle 15 May 2010 8:01:53 AM

Patient Number: 3218547  
Name: JOHN  
Last Name: MUKLEN  
Date of Birth: 06/12/1963  
Date Checked In: 01/13/2010

Medication Name: RISPERDAL  
Dose: 0.5 Milligrams (mg)  
Frequency: 2 Day  
Route: PO  
FSN: As needed

Comments: He had a 15-pack year smoking history but had quit smoking 30 years ago. Medications included Enalapril, Atenolol, Lasix, and Digoxin.

Sign by: cairon

**figure 3:** Confirmation page.

## Pharmacy

The final step involves preparing the prescription for the patient. As mentioned before, the pharmacist receives a pager and an email alerting of a new prescription. The pharmacist logs into P3 and the confirmation page shows the prescription solicited. The only difference between the confirmation page in the doctor view and the confirmation page in the pharmacist view consists of displaying the contact information of the doctor who submitted the prescription. This info helps the pharmacist to contact the physicians just in case of any doubt related with the patient of medicine prescribed.

## Lesson Learned

“Listen to your client” in my opinion, consists of one of the most important things that I have learned working on my capstone. What it really helped P3 to be completed consists on all the input data received by the user. The client’s suggestions and advices during the interviews and “think aloud” sessions guided the project to a successfully end. As result, it is very important to listening to everything that your client suggestion because the client only knows what she really needs to be accomplished.

Another lesson learned includes managing and planning time. It is necessary to follow a schedule set at the beginning of the project in order to deliver a product on time, most important when working only one person on a project, deadlines can be stressful due to the lack of aim from another member. As result, deadlines can be very stressful but with a good plan, delivers can be submitted on time.

Also, the opportunity to put in practice what you have learned during the last two years certifies the preparation to work with a real client.

From the technical aspects of programming to planning manager, I learned that the capstone serves to probe that you are ready for the outside working world.

## Conclusion

There is no doubt that one of the most satisfying moments during the execution of the capstone consists on delivering the final product to the client. The result of working very hard during a whole quarter with professors and TAs and especially with the clients, it

rewards all those stressful moments when milestones seems do not be reached.

In addition, the capstone course represents a great opportunity for all the students to experiment what working for a client feels like. It prepares the student to follow the methods learned during the last past two years. These methods include, to research, gathering data, or application design.

In conclusion, it has been a long journey with a very satisfactory end where clients and recruits work very

hard to deliver a functional application with a satisfactory feeling of a work well done.

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Application available for free downloading at [www.carlosmarin.net/p3/p3.exe](http://www.carlosmarin.net/p3/p3.exe)