ABSTRACT
One of the most important recent advances in information technology is the advent of the electronic social network. However, there is currently no tool in this space designed specifically for patients and their doctors. MedSocial is an application designed for open communication between patients and their doctors about medicines and prescriptions that they are currently taking. With MedSocial one can:

1. Easily keep track of prescriptions and medications
2. Keep one’s doctor updated about medicines taken
3. Receive notifications directly from one’s doctor
4. Inform a doctor about any concerns or side-effects

MedSocial provides direct communication between patients and their doctors as well as feedback to fine tune a patient’s prescriptions.

Categories and Subject Descriptors
H5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous

General Terms
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1. INTRODUCTION
Medication compliance is important to ensure patient health. It is essential that patients take their medication on time and in the right dosage, but a high percentage of patients do not take their medication as prescribed. A study conducted among patients at the Melaka Tengah Health Clinic revealed that out of a total of 464 patients, 56% were non-compliant [3]. Those taking two or more medications were frequently non-compliant, and under-dosing was seen to be more common than overdosing.

Existing solutions to this problem have come in the form of smartphone applications. For the iPhone1, there are applications such as MedsLog [7], Medsy [6], and Dosecast [8]. MedsLog allows users to keep track of a log of taken medications while Medsy and Dosecast allow patients to set reminders for medications. Applications such as Medi-Reminder [10] and OnTimeRx [1] offer similar features for BlackBerry2 smartphones. However, none of these applications deal with compliance. The presence of an alarm does not guarantee that patients are taking their medications when the alarm goes off. Patients can easily dismiss the alarm if they are busy or may even miss the reminder completely.

1 http://www.apple.com/iphone
2 http://blackberry.com
Studies show that an electronic reminder system increases medication compliance [4]. However, while technology has moved towards self-managed care, which has been shown to improve patient compliance [9], it has also moved away from the doctor-patient relationship [5]. In some ways this is discouraging, as directed, personal intervention has been shown to increase compliance [2]. Our project, called MedSocial, is an electronic reminder system that will combine self-management with doctor-patient communication.

The patient interface functions similarly to other prescription reminders on the market [1] [6] [8] [10]. The user has an account, which enables the MedSocial web-service to send alerts to the user’s mobile device when the user is supposed to take a prescription. The user has the option of taking their dosage at the alert, postponing taking the medication, or indicating that they will not take the medication.

If the user chooses not to take the medication, a clinician and (optionally) a guardian are notified. The patient has the option of sending an explanatory message to the clinician. Reasons could be, for example, that the medication is becoming less effective, it is causing adverse side effects, or the patient feels the drug is no longer necessary. With this information, the clinician can act accordingly; either immediately if the situation warrants it, or at the next scheduled appointment.

For example, if a clinician sees that her patient has missed three consecutive doses of their antibiotic, the clinician can immediately call up the patient to intervene. On the other hand, if the patient has missed three doses of their cholesterol medication, such immediate action may not be necessary, and the clinician can wait to bring up the issue until her next appointment with the patient.

2. PRESENTATION OF DESIGN

The application is comprised of two main user interfaces: patient and PPOD. The patient interface deals with reminders to take medication and enables communicating with clinicians. The PPOD interface allows a clinician to view a patient’s medication status, e.g. whether a given patient is taking critical doses of a medication.

For a visual overview of MedSocial’s interface in full, see Appendix A.

2.1 Patient-Side User Interface

The first aspect of the design is the patient interface. The patient interface is primarily a prescription reminder tool with the added benefit of being able to communicate medication needs and problems to clinicians.

The expected users of this part of the interface is any person who has a complex medication regimen, such as those with chronic illnesses. Although it can be used by people with temporary medication schedules (e.g. taking malaria pills while travelling), this application is most beneficial to people whose primary physicians need to know what medication the patient is actually taking, and not just what medication the patient is prescribed to take. This application focuses on being able to provide clinicians with this information, so that they can better treat and manage their patients.

Another expected user will be the guardian or caretaker of a patient suffering from chronic illness. In some cases, chronic illness limits the ability to use an electronic device, and so a caretaker would use MedSocial on behalf of the infirmed.

Elderly patients may have caretakers (such as their children or a live-in nurse) that already manage their prescriptions, so it is only natural for such caretakers to use MedSocial. In this case, the caretaker would use the patient side of the interface to keep track of which medications to give the patient, whether they took them on time, and if there were any side effects.

2.1.1 Login

![Patient login page](image1)

The application login screen is simple and only requires a user’s email and password. As data entry is somewhat difficult on a mobile device, account sign up is available via a website. However if the user wants to sign up on the mobile device, there is an option to do so as well.

![Patient sign up page](image2)
2.1.2 Patient’s Main Interface
The patient’s main interface is designed to require no data entry. Adding prescriptions and managing doctors are tasks that are usually only necessary after a doctor’s visit. The majority of the time, the patient will only need to check what dosings are upcoming. The main interface (Fig. 3) reflects this, displaying any dosings scheduled for the next few hours. Buttons on the bottom of the display are used to navigate to prescription management (section 2.1.5), doctor management (section 2.1.3), and user notes (section 2.1.4).

2.1.3 Managing Doctors

Through the PPOD interface, an invitation is sent to the patient. If the patient accepts, the doctor will then be able to receive updates about the patient. The patient also can accept invitations from his or her PPOD.

2.1.4 Notes

The patient is also able to set notes for themselves. These notes are only visible to the patient and are used to help the patient keep track of important thoughts pertaining to their medication schedules. Notes allow patients to keep track of
information to bring up at their next doctors appointment. The notes page keeps a history of all the notes the patient has written.

2.1.5 Managing Prescriptions

There are two ways for a patient to schedule dosings. The first way is if a PPOD has specified a prescription via the PPOD interface. The patient gets a notification that their PPOD has added a new prescription. The patient then selects the appropriate prescription and creates a schedule for it based on the PPOD’s description. The patient can also set their own medication schedule for any medication that is not prescribed by the doctor by clicking the Add a Prescription button (Fig. 7) to search for the medication and then setting their schedule for it.

![Figure 7: The patient’s main prescription page](image)

Figure 7: The patient’s main prescription page

Upon clicking the View Details button, the patient is routed to the page visible in Figure 8. The clinician’s directions and suggestions are displayed on this page. Additionally, the patient can view a short description of the medication, what day they started taking the medication, and when they are supposed to stop taking it. The patient’s alarm will go off at a specified time on those days.

![Figure 8: Prescription details](image)

Figure 8: Prescription details

Patients can set when an alarm will go off to remind them to take the pill. When creating an alert, patients can enter the name of the prescription, a brief description of the medication (amount or what it looks like), and then set when the alarm will go off. By clicking on the time box a list of times will appear separated by the hour, minute, AM, and PM. In this way, users cannot select a time that does not exist. Users can also select which days of the week they would like to be reminded to take the medication. Finally, the patient selects the Save button to save their reminder or the Cancel button to cancel the reminder.

2.1.6 Alerts

The alert page (Figure 10) is displayed to the user when it is time to take their medication. A list of the medications the user should take is presented. For each medication, the user can take a series of actions, including that they are taking it, not taking it, or to remind them to take it later. The user also has the option of sending a comment to their physician. The comment can say, for example, why the user is not taking their medication (e.g. “The Warfarin gives me headaches”).

![Figure 9: Setting an alert to take a prescription](image)

Figure 9: Setting an alert to take a prescription

2.2 PPOD-Side User Interface

The PPOD uses a separate interface from the patient. The MedSocial PPOD interface is a web-based service. Upon logging in via web browser (section 2.2.1), the main page displays a list of the clinician’s patients, with non-compliant patients highlighted (section 2.2.2). Upon clicking a patient’s name, a list of the patient’s prescriptions, summary of medication history, and a daily compliance report is displayed (section 2.2.3). This report summarizes if and when
the patient took their medication. The PPOD can also read any notes the patient made about their medication. The PPOD can then follow up with the patient.

While MedSocial is meant to allow the PPOD and patient to interact between appointments, PPODs can also use it to look over a summary of their patient’s medication history before a regular appointment. That way, the PPOD can save time by knowing beforehand exactly how the patient is doing with their medication. This is analogous to a PPOD looking over a patient’s chart before an appointment.

The target users for this interface will be PPODs. As PPODs have many patients, one goal of this application is to reduce work load for the PPODs. PPODs may not care if a patient skips a dosage of ibuprofen, but skipping an insulin shot is much more severe and will need the attention of the doctor. The application allows setting notification preferences for specific prescriptions. PPODs should also be able to send comments back to the patient via this interface so that MedSocial fosters a two-way relationship.

2.2.1 Login
The PPOD’s login page (Fig. 11) is very similar to the patient’s (Fig. 1).

2.2.2 PPOD’s Main Interface
The main interface for the PPOD (Fig. 12) is set up as a “news feed.” It is set up in this way so that the PPOD can quickly get up to date with the most recent patient events. Most likely, these events will consist of patients commenting on significant issues with their medications. Other notifications may include if a patient has missed a significant number dosages. Since not every prescription is important, the doctor will have the ability to choose which prescriptions should prompt an event. This is set up in the patient page, which is discussed next. The patient pages can be accessed by clicking on the name of a patient on the right hand column of the main interface.

2.2.3 Patient Page
The patient page (Fig. 13) is similar to the main interface except the news feed contains only events pertaining to a specific patient. The right column is where the PPOD can add, edit, or delete the patient’s prescriptions. Prescriptions are listed by the drug name and the PPOD’s comments from when the prescription was first added. When a PPOD adds a prescription, the patient side interface gets notified and the patient is responsible for setting up the schedule.

2.2.4 Add Prescription
The prescription page (Fig. 14) is where the PPOD manages prescription details and notifications. On this page, the PPOD can give a patient a new prescription or edit an existing one. The user enters the name of the prescription and a description. The patient sees this description when

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3Cf. Facebook’s News Feed (http://www.facebook.com/help/?page=132070650202524)
they add the medication to their list of prescriptions, so the description should include dosing instructions that the patient can use to decide when to take their medication. For example, a description might say “Antibiotics. Take once a day.” This gives the patient flexibility in scheduling. A more rigid system that has the PPOD input more specific dosing instructions, e.g. a form system, would not allow this flexibility.

The PPOD can also specify notifications preferences. This form specifies when the PPOD wants to be notified should a patient miss a dose of their prescription. The top level choice is whether the user wants to be notified at all. If the PPOD selects that they want to be notified, then the PPOD can specify when to be notified. The PPOD can specify to be notified when a patient misses a certain number of consecutive doses, a certain number of total doses, or a percentage of doses.

The PPOD can also specify that a dosage is considered missed if it is late by a certain amount of time, for example, 3 hours. A text field allows the PPOD to input the number (3 in this case), while a combo box allows the user to input the time interval (e.g. hours, days, etc.). Clicking on the Add Prescription button will add an extra entry to the list.

2.2.5 Adding a Patient

On the page visible in Figure 15, the PPOD can add a new patient to the system. The PPOD types the patient’s name into the search field to see if the patient is already in the system. If so, the patient will appear in the list. Otherwise, the doctor is given the option to send an invitation to the patient’s email address.

3. DEVELOPMENT PROCESS

3.1 Low to High Fidelity

In order to move from the low fidelity prototype to the high fidelity prototype, we divided our team into two groups. One group worked on the patient user interface while the other worked on the doctor user interface. Each team member worked on one webpage which was then critiqued by other team members. In this way, every webpage was viewed by at least two team members to ensure that it was developed correctly.

3.2 Usability Tests

A series of usability tests were performed to assess the prototypes.

3.2.1 Patient Tasks

The participant was given the role of a patient who is taking medication for heart disease. They were given tasks to connect their MedSocial application to their PPOD. The other tasks will include viewing PPOD prescriptions, and simulating taking medication when there are alerts.

Before the test began, the patient’s account already had a single doctor connected. The PPOD’s information was:

Name ConnectedDoctor
Email MedSocialConnectedDoctor@gmail.com

The first doctor sent out directions for 2 medications (Altace and Warfarin). Additionally, the patient had an invitation to socialize from a second doctor:

Name InvitingDoctor
Email MedSocialInvitingDoctor@gmail.com

The following task was given to participants:

1. Log in to account
2. Accept an invitation from a doctor
3. Add a new doctor to your account
4. View two preset prescriptions
5. Create alerts for the two prescriptions
   (a) Set the first medication, Altace, to be taken starting today for the next week, every day of the week. Set the time of day to be five minutes from the current time.
   (b) Set the second medication, Warfarin, to be taken at the same time as Altace.
   (c) Add your own prescription named “Aspirin.”
6. Write a note to yourself
3.2.2 PPOD Tasks

The participant was given the role of a doctor for this usability test. The participant was given tasks to connect to patients, give suggestions to patients having problems with their medications, set alerts for certain medications, and send an invitation a patients.

Before the test began, the account was set up for the participant so that there was one patient on the patient list. The patient’s name was “ConnectedPatient.” He already had the two prescriptions associated with his account: “TestMed1” and “TestMed3.”

The following task was given to participants:

1. Log in to account
2. View doctor page and make comments verbally
3. Find where to make changes to account (password, profile picture, email, etc.)
4. Find where to add and remove patients
5. Go to “Gorelick Gabe’s” page and make comments verbally
6. Give Gabe a suggestion about what to do about his problem
7. Add the following prescription for Gorelick Gabe:
   (a) Take one pill of altace once per day
   (b) If Gabe misses his prescription by two days, the dosage is considered late
   (c) Doctor should be notified if Gabe misses his notification three times consecutively
8. Add another prescription for Gabe:
   (a) Take 8 pills of warfarin twice per day
   (b) Do not ask to be notified
9. Remove the warfarin prescription
10. Save changes

3.2.3 Survey

After taking the usability test, the users were asked to fill out a brief survey describing their experience and opinions using the application as shown above. In general, the results were positive. Majority of the users thought the application was easy to navigate, found the performance to be acceptable, and enjoyed using the application. Figures 18–22 in Appendix B show the results of the survey.

4. CONCLUSIONS

MedSocial has matured immensely over the two month development period. The patient-side interface in its current state can sign up and log in users, manage doctors, manage prescriptions and add notes. Management of doctors includes accepting and declining invites, and adding and removing doctors. Management of prescriptions includes adding, editing, and removing prescriptions. The interface also allows the creation of in depth alerts that are linked to their specific prescriptions.

The PPOD-side interface has implemented the main page news feed feature in which the PPOD can respond to the patient. The patient page is accessible as well where the user can search patient history and add prescriptions for the patient as well as set notification preferences for prescriptions.

For future work, the application needs to be refined and improved to complete its base functionality described in this document. For the patient side interface, the calendar needs to be able to show a daily calendar that can display the prescriptions on it and the alert system needs to be created. Additionally, the formats can be refined so that scrollable content is given more space and can more easily view the content inside of it. For the PPOD-side interface, the edit prescriptions function and search for patients functions need to be implemented. Also, the interface needs to be able to show a list of the patients on the main page. Finally, the patient and PPOD interfaces need to be connected to interact with each other.

MedSocial has the capacity for additional features to improve its range of uses. One idea for improvement can be to add a medication counter to the patient-side interface. Sometimes patients forget to take medication because they do not remember if they had taken their medication already or not. The application could have a way to start with the total prescription count and then by counting the remaining pills left, the application could calculate if a pill was taken or not taken.

Another improvement could be to add a reward system for compliance. The application could show statistics of compliance over time, or could have a point system implemented. By having this reward system, the patient has more incentive to keep to their schedules thus improving compliance.

One more improvement could be expanding the application beyond the doctor-patient relationship and generalizing it to different health related areas. For example, exercise schedules could be used in place of a medication regimen. Compliance with the exercise schedule would then be monitored by a trainer instead of a PPOD.

On the PPOD side, tools to harvest the vast amount of data that patients generate in their use of MedSocial could prove to be useful. For example, a clinician may want to spot trends in how a patient takes his medication. Visualization tools and machine learning systems could help with this.

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6. REFERENCES

APPENDIX

A. SURVEY RESULTS
This section gives figures for the results of the conducted survey. See section 3.2.3 for a description the survey.

B. TRANSITION DIAGRAMS
The following transition diagrams give an overview of application flow. Figure 16 gives the patient-side transitions while Figure 17 gives the PPOD-side transitions.
Figure 21: Patient-side transition diagram

Figure 22: PPOD-side transition diagram
Figure 20: Would you use MedSocial?