The MUHC Oncology Patient Application

The Health Informatics Group
November 26th, 2015

Background

Opal - the MUHC Oncology Patient Application for mobile phones and the web - is a product that has arisen from the winning project of the 2014 MUHC Q+ initiative. The project proposal was submitted by the Health Informatics Group (HIG, see below) and was entitled "*Realistic knowledge-based waiting time estimates for radiation oncology patients - addressing the pain of waiting*". It had as its goal the provision of waiting time estimates to radiation oncology patients.

The HIG team is led by Dr. Tarek Hijal (radiation oncologist at the MUHC), Prof Laurie Hendren (professor of Computer Science at McGill University, former radiotherapy patient and member of the patient's committee of the MUHC Cancer Mission) and Dr. John Kildea (medical physicist at the MUHC). It includes a software developer (David Herrera), a McGill medical physics MSc student (Ackeem Joseph) and a number of undergraduate computer science students supervised by Prof. Hendren and Dr. Kildea.

For the Q+ project, the HIG team has developed a machine learning algorithm that uses timestamp data acquired from the trajectories of previous patients to estimate waiting times for new patients. To communicate these personalized waiting time estimates to patients, a mobile phone and web app, *Opal*, was developed. In developing Opal we realized that it has the potential to be used for much more than simple waiting time estimates and we have integrated a number of other useful features to allow patients access to their personal medical data, personal appointment schedules, and relevant, personalized educational material. Motivation for many of the features within Opal have has come Prof. Hendren who identified them as features that she would like have found useful had they been available during her time as a radiation oncology patient.

Features

Opal will provide the following information, individually personalized for each patient:

- Treatment/appointment schedule
- Status of treatment/treatment planning
- Check-in and waiting room management
- Access to an overview of the patient's treatment plan and other documents within the patient's electronic health record
- Patient's blood test information
- Patient education material, specific to the patient's diagnosis, treatment and phase of treatment
- Contact information for treating team and a messaging system
- Tools to complete surveys and patient reported outcome questionnaires

- A backend tool to allow physicians to see what their patients see in the app and to control the publishing of documents and patient education material.
- The possibility to request an appointment or an appointment change.

Timeline

A working demo of Opal, that does not access real patient data, is available at depdocs.com/opal. Table 1 lists the milestones that we have identified in the development and release of Opal.

Table 1. Milestones in the development and release of Opal

Milestone	**When**	**Status**
App conception and initial design	Spring 2015	Complete
App development	Summer 2015 - Spring 2016	In progress
Security approval	Winter 2015/2016	Started
Patient focus group	January 2016	Presently recruiting patients
Pilot release to select patents	March 2016	Pending approval
Release	Summer 2016	Pending approval

Architecture

Two versions of Opal have been developed, one for mobile phones and another for the web. The architecture is the same for each, just the content format differs between them. Figures 1 and 2 provide screenshots of the phone and web apps respectively. The apps are written in AngularJS, a Javascript framework provided by Google Inc. The content is formatted using the Onsen CSS and Javascript framework and native phone functionality is provided by the Apache Cordova framework.

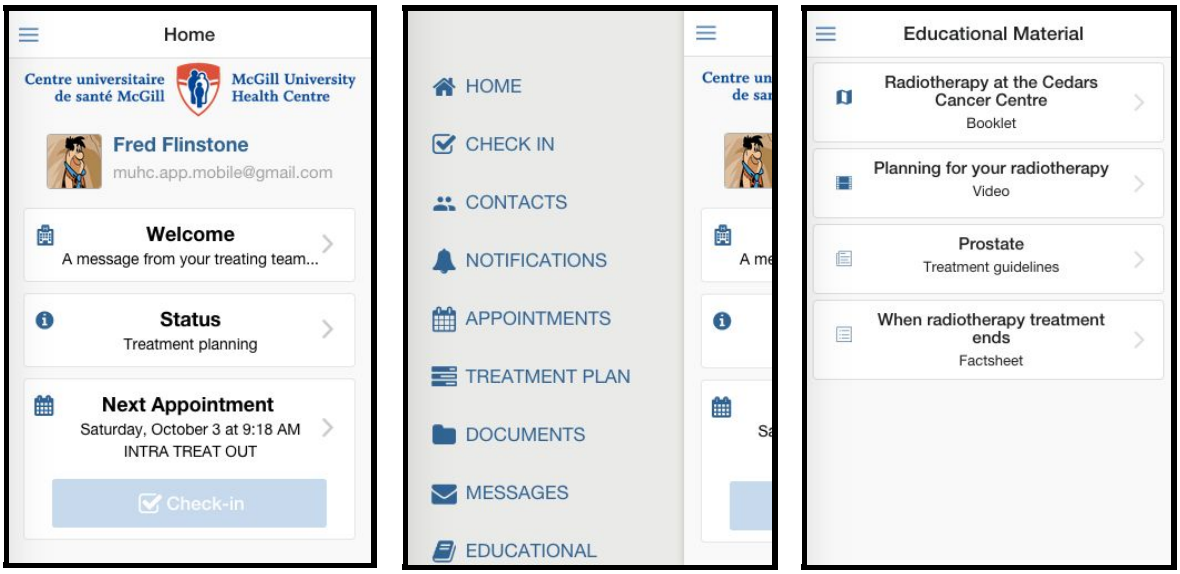

Figure 1: Screenshots of Opal on a smartphone. Left: welcome screen, centre: main menu, right: patient education material.

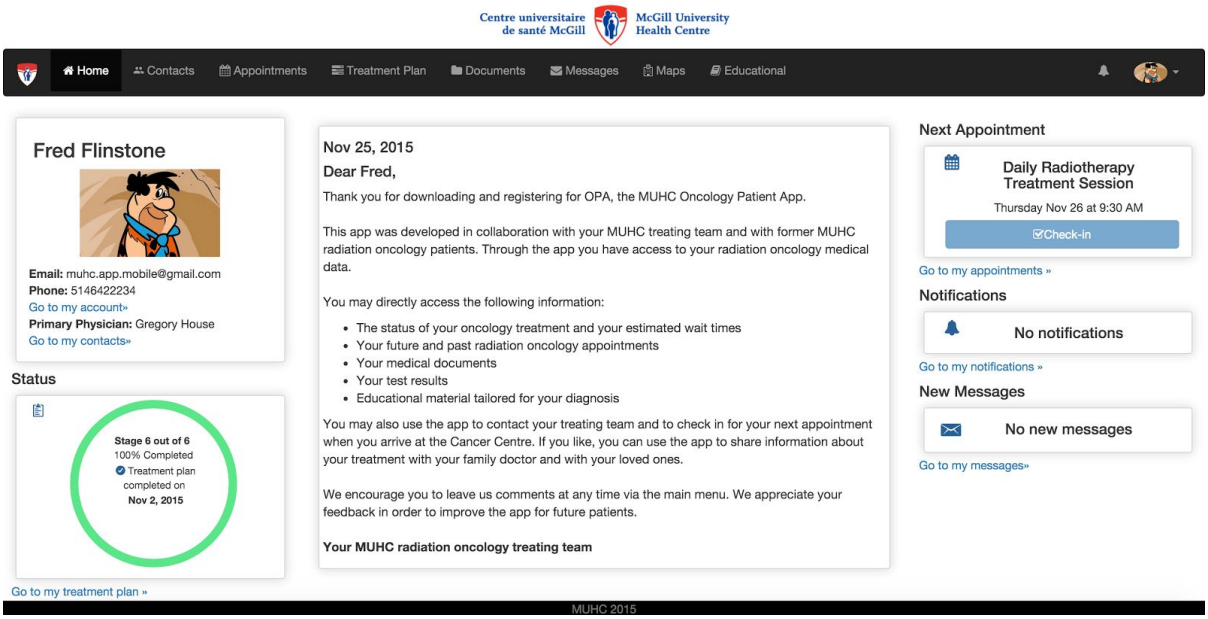

Figure 2: Screenshot of Opal in a web browser.

Data Flow and Communication

Patient data is provided by the *Aria* electronic medical record system in use in the Department of Radiation Oncology at the MUHC. Aria is maintained by physicists and engineers within the Department of Medical Physics. Incoming interfaces with the MUHC ADT and labs provide patient demographic data and pathology/test results respectively. An outgoing interface with Streamline allows pdf documents/forms to be sent to Oacis.

Figure 3 presents an overview of the data flow from Aria to Opal. To serve data to Opal, while simultaneously insulating access to Aria, we have developed a custom database internal to the MUHC firewall, shown as *AppDB* in Figure 3. Select data are transferred from

Aria to AppDB using a cron job that copies across approved appointments, tasks and documents, where approval is determined by a list of “publishing rules”. A *Publish Manager* interface allows the clinical team to set the publishing rules and to decide which data are publishable to the patients and how those data appear in the app. French and English versions of all data will be provided.

Secure serving of data through the MUHC firewall to Opal is provided via Firebase, a cloud database by Google Inc. Firebase is designed such that all applications that are connected to it are served data in real time. As such, if any data on Firebase are changed, all connected applications immediately see the change. The communication sequence for data from AppDB to Opal through Firebase is as follows:

1. Patient opens Opal. Opal logs the patient into Firebase (login token set on Firebase to say that the patient has logged in).
2. An internal MUHC listener that is connected to Firebase sees that the patient’s login token has been set. The patient's data is immediately retrieved by the listener from AppDB and pushed out to Firebase.
3. Opal sees the updated information on Firebase and downloads it to the phone.
4. When the data have been downloaded and stored on the phone, Opal deletes them from Firebase.

The communication sequence ensures that patient data (always encrypted as described below) never sit on the Firebase server, they just move through the server en route to the phone. Updates and refreshes are made in the same manner as initial login requests. Notifications from the clinical team to the patient (eg an alert to the patient to come from the waiting room to the treatment room) are also routed in a similar manner.

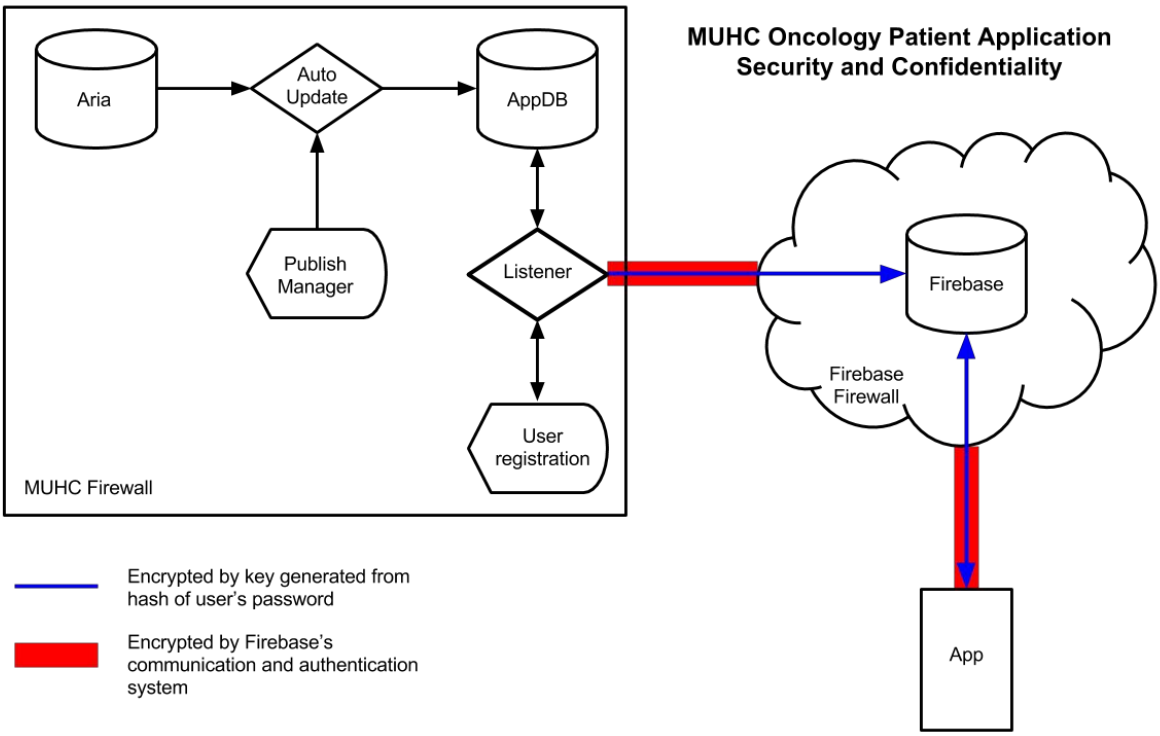

Figure 3. Data flow and communication for Opal - the Oncology patient application. Firebase is a real-time cloud database by Google Inc that immediately updates all listeners when data in the database is changed.

Security and Confidentiality

Data security, user authentication and confidentiality are achieved through a combination of Firebase's security and authentication settings and encryption of the data before they leave the MUHC firewall.

By default, all data sent to and from Firebase are transferred over a secure SSL connection. User authentication and data access within Firebase are rules based. Opal users first need to register in person at the MUHC, where they set their usernames and passwords for Firebase. Their Opal accounts are then connected, within AppDB, to their Aria data. A hash (plus additional information) representation of their passwords is used as the key to encrypt all data that is sent to/from the MUHC and to/from Opal. This ensures that all data within Firebase (even if they are only stored there for a very short time period) are encrypted and cannot be read by Firebase/Google employees. Also, in the event of a compromise (eg password retrieval through a phishing attack), only the patient's own data are compromised, and the compromise cannot extend further than Firebase. Furthermore, neither Firebase nor Opal know anything about the MUHC servers.