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BMI 591- Final Report

Medication Administration

Introduction

Medication administration is a process which is error prone and complex. Inpatient medication administration is carried out by nurses who have to rely on their knowledge and have no good clinical decision support tool to help them. Medication administration errors account for 35% of medication errors. [Medication administration errors in adult patients in the ICU (http://www.ncbi.nlm.nih.gov/pubmed/11685299)] The project is aimed at providing a tool that is follows the workflow guidelines that the nurses follow and provide clinical decision support in the form of alerts, alternative options to deviations in the workflow and required information at the right time. The following diagram was designed for the BMI
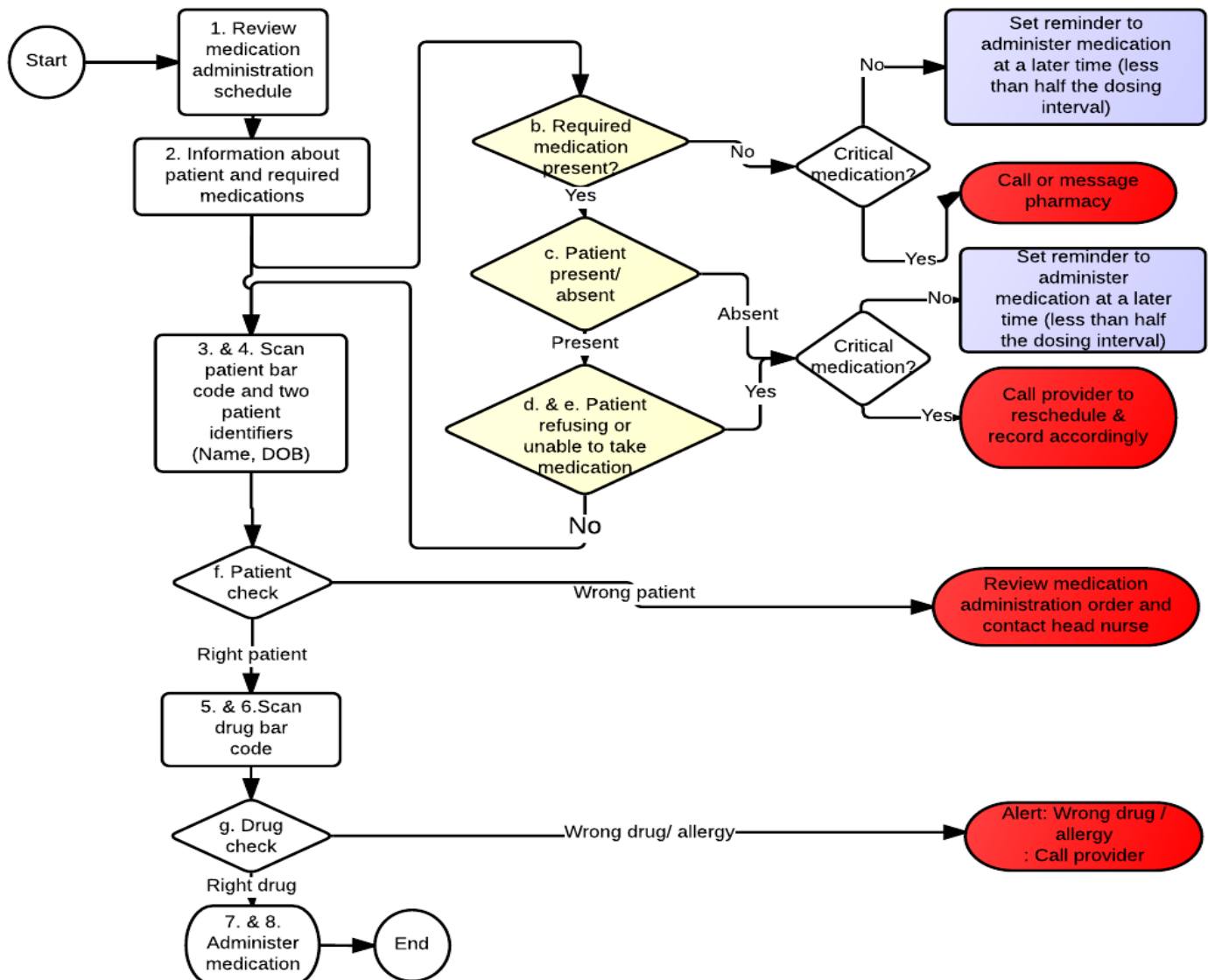
Methods

Data and Information Model

Information model used to map the data is Fast Healthcare Interoperability Resources (FHIR). FHIR schema was downloaded locally in .xsd files and were converted to Java classes.

The data for the application will be acquired through the EHR using appropriate APIs. For the purpose of this course, a number of FHIR resource examples containing information about patient, medication prescription, medication etc. has been taken in XML file format. All the XML files (scr/main/resources) are test data.

Test data are the following FHIR resources:

1. Medication
2. Medication Administration
3. Medication Prescription
4. Patient
5. Practitioner
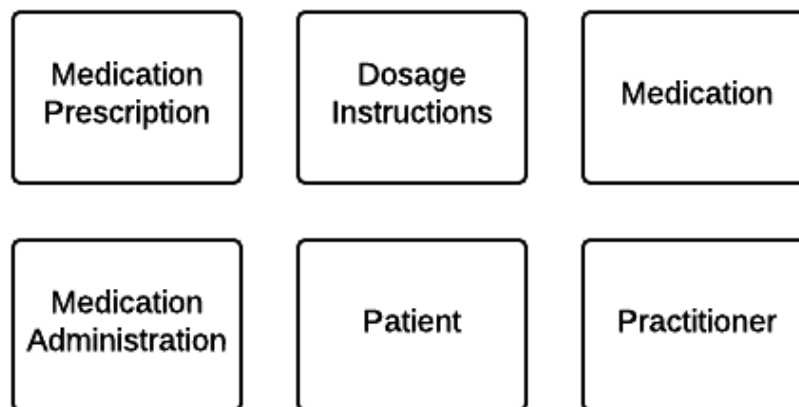
Dosage instructions are part of the Medication prescription FHIR resource. The allergy intolerance and substance resource will later be used to alert user of patient's allergies.

For an real-time implementation an API would have to be written to convert data from EHR to FHIR

resources in XML format. The data is then deserialized into Java Objects using JaxB. Future work will also include implementing the FHIR database ORM model using HyperJaxB. A local hsqldb containing the same test data will be used.

Knowledge Base

Hospitals use National Drug Code (NDC) to identify drugs. NDC directory is maintained by the FDA. The single identifier NDC gives information regarding the drug, route, dose, package, form etc. The barcodes of drug packages contain the NDC code of the particular drug. To implement NDC codes into the application the APIs provided by RxNorm (SOAP engine, the WSDL file for RxNorm and Java client side stubs) needs to be used. A web service call is made to the URL: "http://mor.nlm.nih.gov/axis/services/RxNormDBService" and drug data is queried as required. As for the definitions for various terms like practitioner, route, dose etc will be defined by Snomed CT. Snomed CT codes can be linked to various terms in the snomed ontology. Currently all the Snomed CT codes and RxNom (NDC) codes are manually entered. Future work will include creating an API that automatically retrieves, updates and populates the information in the application.

Application
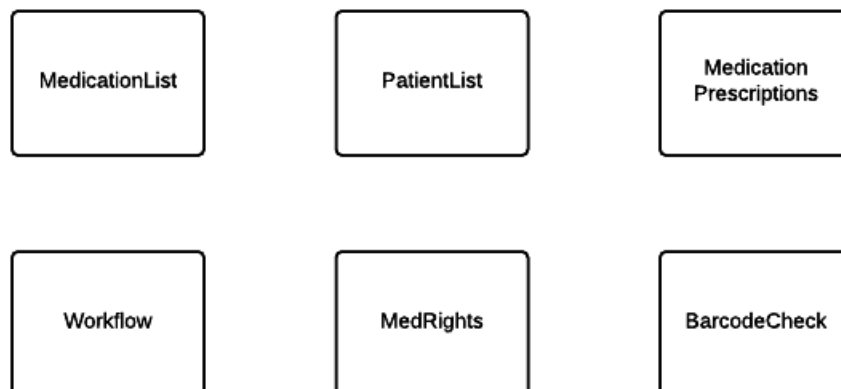
Application is written in Java programming language. Clinical package has classes that deals with acquiring data from XML files (unmarshalling) and putting them into Java classes. A single instance (patient, medication, prescription etc) was selected. However provision has been made for multiple

values by the use of data structures like Array Lists and Hash Maps. Hash Maps <key MRN, Patient>, Hash Map <key NDC, Medication> and Hash Map <key MRN, List<Prescription>> are the main three data structures. Medication administration includes the instructions from the prescription and the patient MRN. Workflow package deals with medication administration workflow shown in workflow diagram. Workflow creates the list of rooms which have patients that require medication administration, creates a Java class which contains the Five Rights of Medication Administration: Right Patient, Right Drug, Right Dose, Right Route and Right Time. Nurses require the Five Rights to administer medication to a patient. Patient check class and Drug check class respectively make sure that the scanned barcode information matches with the patient's MRN and drug NDC code. Future work will include creating classes for various exceptions that are shown in the workflow diagram. The user interface is going to be designed using Android studio. Android SDK 19 (4.4) and Glass development kit (GDK) is used. Android studio uses gradle as a build tool instead of Maven. Development of Glass application is yet to be started. However the initial setup has been done.

Conclusion

There is still a lot more work to be done but the basic layout of the entire application has been thought through and laid out. Further refinement of Java classes using Solid principles of coding design and integration of Glass interface with Java classes. This project will be continued for my Masters thesis.