Enhanced Hospital Information System by Cloud Computing: SHEFA'A

Lamiaa Fattouh Ibrahim[1,2], Suzan Sadek[1], Shahd Hakeem[1], Lana Al-Sabban[1],
Asmaa Ibrahim Mohammed Ahmed [1], and Alaa Hassan Al-Sayed[1]

[1] Department of Information Technology
Faculty of Computing and Information Technology King Abdulaziz University
[2] Institute of Statistical Studies and Research, Cairo University
B.P. 42808 Zip Code 21551- Girl Section, Jeddah, Saudi Arabia
lfibrahim@kau.edu.sa, sadek.suzan@yahoo.com

Abstract. Information Technology is an important part of the healthcare environment. Accuracy and integrity of the information in any hospital system is necessary. Then, this information has to be up-to-date as well to achieve continuous quality improvement in any organization and particularly in a complex area like healthcare. Therefore, diverse information systems must be integrated across the healthcare enterprise. The main objective of this research is to develop a framework for the exchange of patients records located in different hospitals in Saudi Arabia, adding insurance and prescriptions information along with the patient's record to facilitate the insurance process and to automate the medicine prescription process that is currently manual in most hospitals. The proposed framework aims to improve the regular ways of obtaining patients medical records separated in each hospital. For instance, if a particular patient has different medical records in different hospitals visited by that patient, our architecture focuses on the method by which data should be searched and retrieved efficiently from a database on the cloud from different hospitals by preprocessing the data in current hospital's and saving them in the database that resides on the cloud. Our system design is based on cloud computing service oriented architecture. Some of the information included in these medical records is: medical history, prescribed medications and allergies, immunization status, laboratory and test results, radiology images, personal stats like age and weight, diagnoses, order tests and appointments. All of these records are identified by the national ID of the patient. these systems will be utilized by web services asp.net based framework, the doctor will use his/her ID and password to enter the system for security and then enter the patient's ID to send a request for that patient's record that will be sent back to the doctor, the record will be up-to-date since the last visit of the patient to any hospital in Saudi Arabia. The main aim of this study is to provide a data exchange model of patients records, it is used to decrease the time and cost of patients, and help doctors to get up-to-date and accurate information of patients from the records from any hospital in Saudi Arabia. By using e-Patient medical records and Mirth Connect program which use HEALTH LEVEL 7 (HL7) protocol. HL7 protocol is a standard information format of healthcare for data exchange. We provide a single, complete automated patient medical record to give a better

patient care that avoids medical mistakes due to lack of information and unavailability of medical records.

1   Introduction

The need for patient's medical accurate and up-to-date information each time a patient visits a different hospital increased the need for rapid patient medical data exchange. Healthcare organizations use different applications and infrastructures which always need to be updated as a result of the fast growth of healthcare services [2]. The variances in the ways of how these organizations maintain their operations, like patients medical records may result in the difficulties of accessing these data. This paper research studies the implementation of cloud computing in healthcare organizations in order for doctors to have an easy way to access patient's medical data from a browser or mobile.

The objective of this project is to provide the patient with comfort and facilitate the process of transfers between hospitals to get radiations or other required data, taking into account the reliability and availability of the required information quickly in times of need under the privacy.

Better patient care could be provided by avoiding medical mistakes due to lack of information that results of unavailability of the medical record. There would be single, complete and up-to-date e-patient medical records other than only fragmented ones. Communications between all types of doctors would be enhanced, whether they worked on a single treatment for a patient, over many treatments, or over the lifetime of a patient. There would be a single place to permanently store environmental conditions and diseases for an individual that can provide greater emphasis on an individual's preventive care and diseases could be prevented before they occur. Public health agencies can be more quickly informed about public health problems. Facilitate the long process of insurance and make the process of medicine prescription easy and automated.   Some amount of money can be saved.

We will create a web application for hospitals, to unify and facilitate the exchange of patient information for different healthcare systems to have complete and accurate e-patient medical records, along with other services for insurance and pharmacy prescriptions.

Target Users

1. Doctors: doctors in any hospital have a full access to e-patient medical records in the web application.
2. Receptionist: receptionists have partial access to the e-patient medical record; they can create a new e-patient medical record or search for the patient's record if it already exists along with payment and insurance information.
3. Nurses: nurses have partial access to the e-patient medical record; nurses can search for the patient and fill in the examination information for the patient necessary before the doctor examines the patient.

4. Pharmacist: pharmacists have partial access to the e-patient medical record, to make it easy to access the prescription prescribed by the doctor to the particular patient.
5. Insurance-employee: insurance-employees have partial access to the e-patient medical record, to access the necessary patient information to have accurate information about the patient's health to determine the necessary insurance level for the patient.

In section 2 discusses methodology. In section 3, the SHEFA'A package is introduced. The paper conclusion is presented in section 4.

2   Methodology

As explained in our system, In case some hospitals don't want to exchange their current legacy system as it was purchased with millions, and they want to have access to SHEFA'A to benefit the complete set of patients' records, and on the other hand we need the data processed in a specific hospital to be transferred to our storage. As a result different data formats from different hospitals will need to be transferred to our central storage; the problem is that data from different hospitals will have different formats. So in order to get the data, for example, previous patients' information from any hospital to SHEFA'A, we should put the data in a unified format, and send it as a message to SHEFA'A's central storage in that format. This study proposed the use of Health Level Seven International (HL7) which is widely being adopted by health care institutions in several nation-wide EMR implementations [2]. HL7 creates standards for the exchange, management, and integration of health care information system which enable interoperability of messages and documents in standardized way which also bring efficient communication among different users that assist in sharing health care information which makes the integration feasible [3]. Using HL7 we can transfer data without worrying about the current structure of the data. We can use Mirth application in SHEFA'A server in the cloud, in which we can connect to the database's hospitals and get their information dynamically. This open source solution gives us the ability to get the previous data from the database and also whenever there's an update in the database it will be automatically upload it in the cloud database which will leads into synchronized database in the cloud [4].

Mirth Connects template driven approach to creating interfaces allows you to specify the type of message your will be receiving or sending, and then create your mappings and transformations.

Mirth Connect supports numerous transfer protocols used across the healthcare industry and for SHEFA'A we choose HL7 [5] Protocol as the type of sending messages between our system and others healthcare systems.

3   SHEFA'A Concept, Model, and Structure

Only an integrated model of EMR can lead to the health care service quality improvement by strengthen the users' role in managing their own medical care [6]. The use of integrated EMR system will enable data sharing, analysis tools, and

infrastructure that can speed up many research, especially in health care services, by enabling new insights and enhancing efficiency [7]. Figure 1 shows an overview of SHEFA'A system as a model. We divided our system into three separate levels that it could accommodate each hospital with its own needs with different kinds of services and different ranges of requirements.
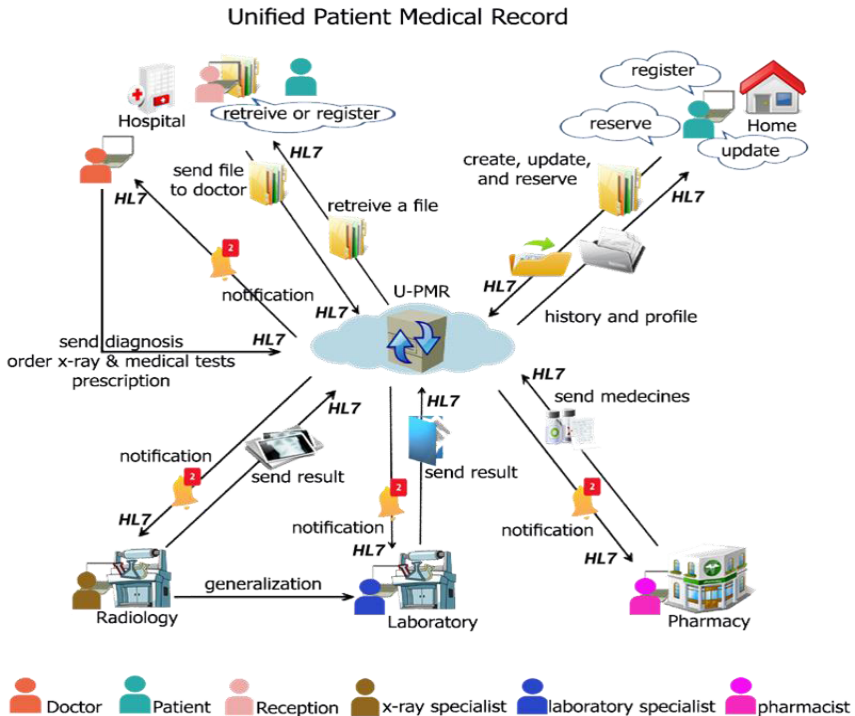

Fig. 1. SHEFA'A System Model

3.1   The Work Flow

Flowchart is a simple schematic mapping tool that shows the sequence of actions within a process. Below is a four-step flow chart diagram for SHEFA'A system.

Step 1: Search Patient or Create a New Account

At the begging the patient can create his account at home or at hospital`s reception. The receptionist can search the patient record in the system by using pat SSN.

If it was exist, the receptionist can view the patient history and all information that he need. He can create a new visit by confirming the reservation.

If it was not exist in the system, he/she can create a new account for the patient and fill all required information and confirm the reservation.
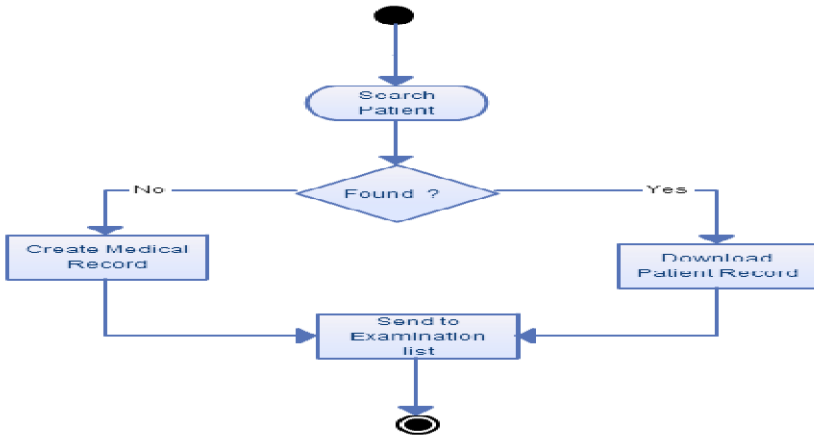
Fig. 2. Search patient or create a new account flow chart

Step 2: Patient Diagnosis

If step 1 is done that means the patient reservation is confirmed and the doctor can see the patient record in the patient diagnostic list. After all the initial examination and diagnostic comment done, the doctor can decide if the patient needs an order to create e-prescription for sending it to the pharmacy. Then, this visit with all the details will be updated in the patient history.
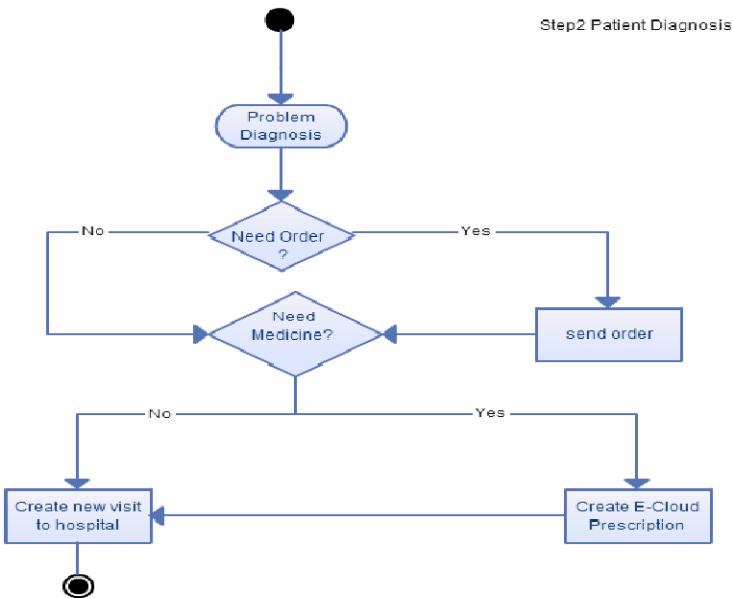

Fig. 3. Step 2: Patient Diagnosis flow chart

Step 3: e-Cloud Outpatient Order

If step 2 is done, the doctor can review patient's order result to add any diagnosis updates or create another e-prescription by clicking Patient Waiting Order Result List. Then, all the updates will be stored in the patient history.
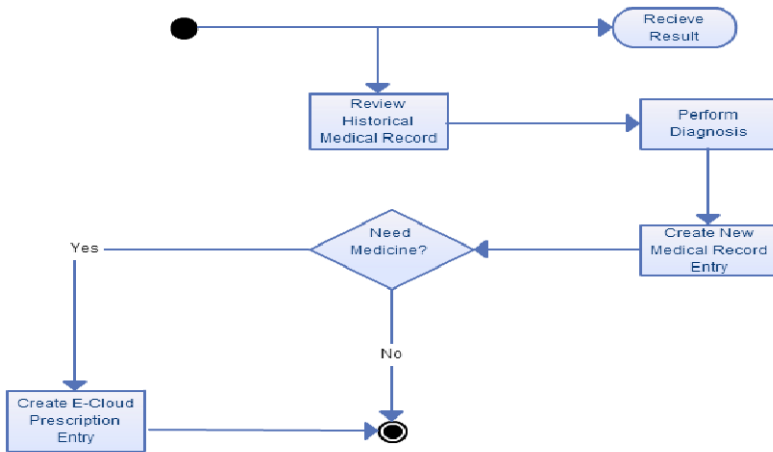

Fig. 4. Step3: e-Cloud Outpatient Order flow chart

Step 4: e-Cloud Prescription Process

At the pharmacy, the pharmacist looking up, for patient prescription if the medicines available in the pharmacy. If it is valid, the pharmacist can update the prescription if needs any editing and then all the changes will saved in the patient history.
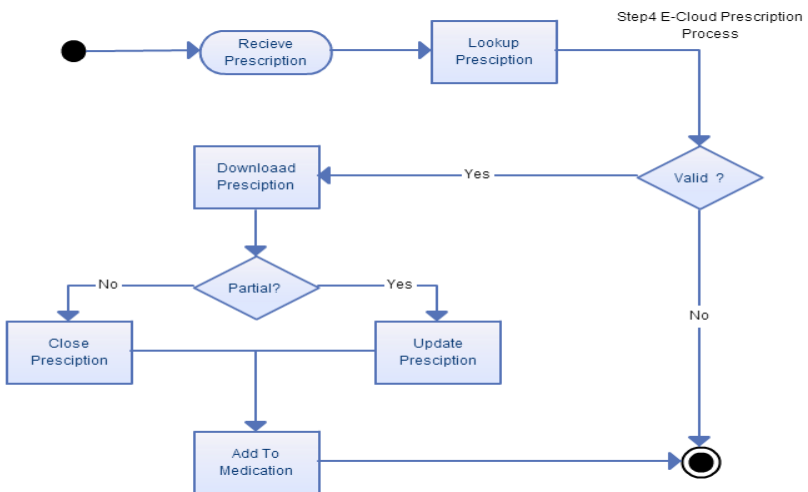

Fig. 5. Step4: e-Cloud Prescription Process flow chart

4   Conclusion and Future Work

In this work, we provide a data exchange model of patient's records in HL7 standard, to decrease the time and cost of patients, and help doctors to get up-to-date and accurate information of patients from the records from any hospital in Saudi Arabia and can be accessed and edited by authorized users from anywhere. our architecture focuses on the method by which data should be searched and retrieved efficiently from a database on the cloud from different hospitals by preprocessing the data in current hospital's and saving them in the database that resides on the cloud. Our system design is based on cloud computing service oriented architecture.

Finally, we have on mind plans to improve our system and reach our future goals. So, we intend to make our system more reactive with patient by making a mobile application contains all services plus the urgent numbers depends on the chosen country by the user. Farther more, improving the existing notifications service by sending notifications to the patient account about any update in his record like completed lab results and sending a notification to remind the patient about his appointments. For critical situations, we intend to add features such as the finger print and eye print as a replacement of SSN to find the medical record of the patient. Also, globalizing SHEFA'A system, so patients records can be accessed from anywhere around the world in case a patient has medical emergency or just wants to be diagnosed by a doctor from another country.

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