Electronic Patient Record Management System (EPRMS)

نظام إدارة ملف المريض الالكتروني

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Abstract

Recent research states that using new and emerging technologies in the areas of telecommunications are widely used in healthcare sector. In this research we will design and implement the Electornic Patient Record Management System (EPRMS). It is a centralized database contains the in-patient record which contains the patient personal info, department lies-in, physician, tours, ,treatment and lab results. Since the patient enters the hospital the workflow starts as the reception user creates new record by entering the personal info and sends the record to assigned department; at this stage the nurse starts update the record by entering the physician comments, required treatment, and sends lab test when it is required. The procedure continues as long as the patient still in the hospital. At last when the patient recovered or died the International Classsification of Diseases (ICD) inserted to the record and out or died date. In addition there are many supported tables that can be updated manually through independent pages by IT administrator. Also the system consists of different users and different user permissions. In addition there are advance search that can help to make statistical reports and researches for the physicians. This system is considered time and cost effective to healthcare.

الخلاصة

مع التطورالهائل لظهور التكنلوجيا الجديدة والحديثة في مجال الاتصالات السلكية واللاسلكية والتي تم استخدامها على نطاق واسع في قطاع الرعاية الصحية.قمنا في هذا البحث بتصميم وتنفيذ نظام لادارة ملف المريض الالكتروني EPRMS . النظام عبارة عن قاعدة بيانات مركزية تحتوي على طبلة المريض الراقد في المستشفى (in patient). حيث ان سجل المريض يحتوي على المعلومات الشخصية والتشخيص والعلاج اضافة الى نتائج الفحوص المختبرية للمريض الراقد. هذا النظام عبارة عن workflow حيث ان المريض بمجرد دخوله باب المستشفى سيقوم موظف الاستقبال بإدخال بياناته الشخصية وجهة الاحالة واسم الطبيب المختص وإرساله الى القسم المطلوب والردهة فمجرد أن يصعد المريض الى الردهة سيجد ان بياناته قد وصلت الى مسؤول الردهة. في هذه المرحلة يصبح مسؤول الردهة (الممرضة) هو المسؤول عن ادخال تشخيص الطبيب والعلاج المصروف له والفحص اليومي tour. وسيتم ارسال نوع الفحوصات المختبرية المطلوبة دون الحاجة الى ارسال اية ورقة.تستمر هذه العملية مازال المريض راقد في المستشفى.أخيرا لو تعافى المريض سيتم ادخال ICDالى السجل وتاريخ الخروج بينما في حالة وفاته سيتم تسجيل تاريخ الوفاة. ايضا هنالك العديد من الجداول المعتمدة التي يمكن تحديثها يدويا من خلال صفحات مستقلة من قبل مسؤول تكنولوجيا المعلومات في المستشفى. كما ان للنظام عدة واجهات كل حسب عمله فمنها لمدير النظام ومدير المستشفى ومسؤولي الردهات واستقبال المرضى ومسؤول المختبر. بالإضافة الى ذلك للنظام القدرة على بحث متقدم (Advance Search) يُمَكِن قسم الاحصاء من عمل التقارير المطلوبة بنقرات بسيطة ويستفيد من هذا البحث ايضا الاطباء بعمل البحوث الطبية. يعتبر هذا النظام كفوء للرعاية الصحية من حيث الوقت والكلفة.

1. Introduction

In the last decade the emerging technologies in Information and Communication technologies lead to very big advances in services for community, especially in healthcare sector. And several studies have emerged for support the healthcare domain; from these studies: It designed a framework for e-health preparedness focusing a much micro level considering the ICT infrastructure as per the definitions of ehealth given by World Health Organization (2003) [1]. Also there is study that suggested a cooperative management methodology for the development of privacy solutions for consumer ehealth [2]. As well as another study that was suggested an e-health platform on which ehealth services can be systematically advanced by utilizing different functions and features, and by following guidelines provided by the platform [3]. In addition another study that advanced a web-based system to interactively display image-based electronic patient records for secured intranet and applications of internet collaborative medical [4]. However we have used this development and deploy it in Iraq, by creating an electronic medical database.

Generally, there are three types of medical care services which are: in-patient (i.e. hospitals), out-patient (i.e. clinics) and emergency. For in-patient hospitals there are two different types: specialized hospitals (GIT Centers, Cardiac Centers, Cancer Centers, etc.), and general hospitals. However in Iraq, the first type is newly introduced, but the latter is already exist. As the hospitals are considered essential in healthcare infrastructure, so we choose it to enhance the services in it. The implemented system (EPRMS) is the first system in Iraq (in general hospitals) which is work as database and workflow. It is helpful for management, patient health, research, and archiving. In management, it could be used for hospital director to see the performance of the physician, or statistical reporting. Also the physician can have the patient history in details from his previous records with less time. The physician can make their researches by using the advance search. Archiving and securing electronic records considered more reliable and trusted than paper-based records.

This research will explain the EPRMS functionalities and its scope and also describe the methodology which will be used during the design of the system and the analysis of its requirements. Lastly the research will introduce some of the system interfaces and results with testing some of its requirments.

1.1 Aims and functionalities of system

The aim of this system is to design and implement a system supports health care providers by its capabilities on treat an in-patient at the hospital as shown in figure (1). It ensures execute all the required functions of software . Also it has possibility of developing a report for each patient case in hospital. As well as it provides the best control of the patient status based on their test results and clarity of the direction of the health status of the patient.

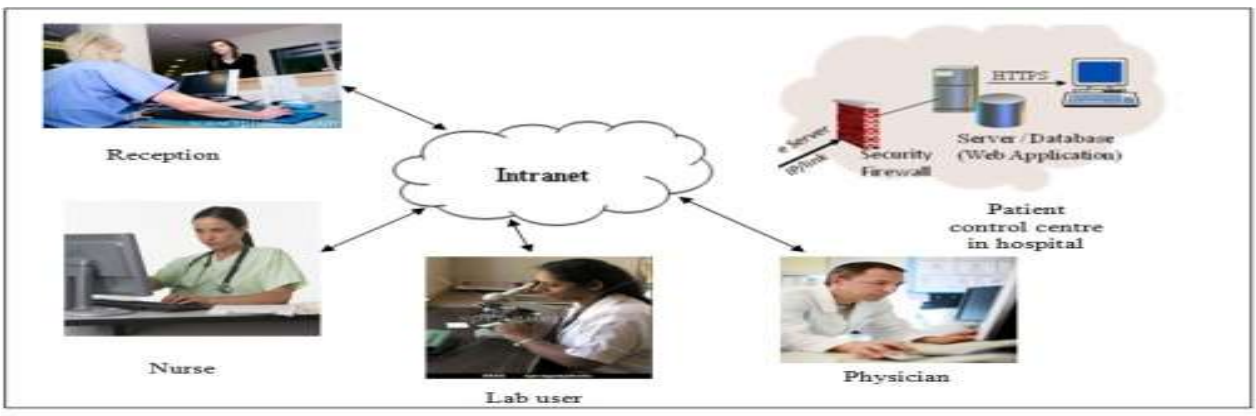

Figure 1: System Architecture for EPRMS

1.2 Project Scope

The scope of this system is to build a reliable web-based EPRMS as shown in Figure (2). The current system is used to illustrate store patients information electronically rather working as a complete workflow [1].

However, requirements for implementing a public health approach to electronic patient record include long-term planning, targeting patients for improved care, and goal setting for outcomes of care [5]. EPRMS has five users which were identified as: Reception user, physician, nurse, lab user and hospital manager and each one has collection of functions inside system. The reception user has the ability to register, login in and login out, add patient, search and, update / edit while the nurse is able to register, login in login out, and add tours (morning/ evening) physician comments, add medicine for each patient, request lab test, and search. The lab user has the ability to register, login in, login out, and add lab result. The physician is able to register, login in, login out, and search [6].

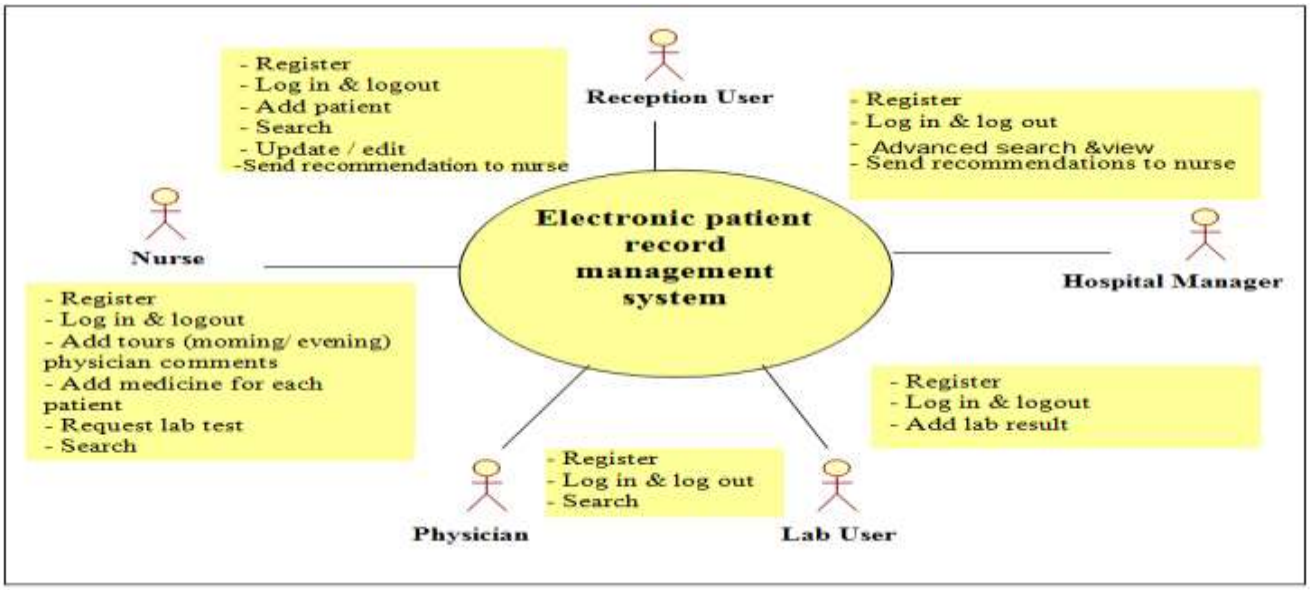

Figure 2: Scope of EPRMS

2. System Method

The methodology which will be used during the design of the EPRMS and the analysis of its requirements will be discussed in details through this section. The system development lifecycle was divided into phases:

2.1 Data Flow Diagram

One of the most widely used system analysis process models is the data flow diagram. A Data Flow Diagram (DFD) is a tool that illustrates the data flow through a system and the work and processing performed by that system. It is used to help understand the existing system and to represent the required system. The diagrams represent the external bodies sending and receiving information [7].

2.2 Unstructured Interview

It is essential to success any system is to understand its requirements. In EPRMS, we had an interview with the health care providers such as physician, nurse and statisitcs department for gathering rich information about system requirements to design and build this system.

2.3 System Requirements Analysis

Requirement is a service that the user desires the solution to perform or display. These requirements should be flexible according to the system needs. However, it is necessary to understand both functional and non–functional requirements through the lifecycle of EPRMS [8].

✓ **Functional Requirements (FR)**

These requiments are decribed as set of system requiremnts, such as:

- Add new patient record.
- The system sends patient record to the nurse to add a new patient.
- The system enables the nurse to search about specify patient.
- Archiving patient record electronically and centrally.
- The system enables the nurse to request a specific lab test.
- The system has ability to send lab results back to nurse or physician.
- The system enables the nurse or physician to search & research. Table 2-1 shows one of the functional requirements of EPRMS.
- The system enables the physian to check patient history by seraching it easily.
- The system enables the reception user to close the record by entering the ICD, patient status and out/died date.

Table 1: One of FR for the system: Add new patient record

Descriptions	The system must allow the reception user to create new patient record.
Rationale	The system enables the reception user to create new patient record which Includes the personal information of patient such as: name, address, contact info,...etc.

✓ **Non-Functional Requirements (NFR)**

There are many non functional requirements of the EPRMS like updateable, security, compatibility, capacity, usability and maintainability, performance with database, for example the system interactive with database immediately as under a second, database searches, updates and retrieval the change to patient information must be fast.

2.4 Users Analysis

Five users were identified in EPRMS who are: physician, nurse, lab user, reception user and admin. Table (2) illustrates role of one user [9].

Table 2: Role of nurse user

User	**Nurse**
Role:	o The nurse will access the system and update the morning and evening tours for the inpatients according to physician comments. o The nurse can send lab test request to Lab department. o The nurse can update the given pharmaciticulas that given to each patient.

3. Design Stage

3.1 System Design

At the design stage beings the decision-making on how to build and operate the system. On the other words, its purpose is to create a technical solution which satisfies the system functional requirements [10]. However Use Case Model, and Use Case Text were used to design the EPRMS.

Use Cases Model allows the definition of the system's boundary, and the relationship between the system and outside of the system [11]. In EPRMS, there are five users in the use case diagram. Each one has many functions in the system as shown in figure (3) while Use Case Specification /Text describes the functionality of the system counting event trigger and expected outputs.

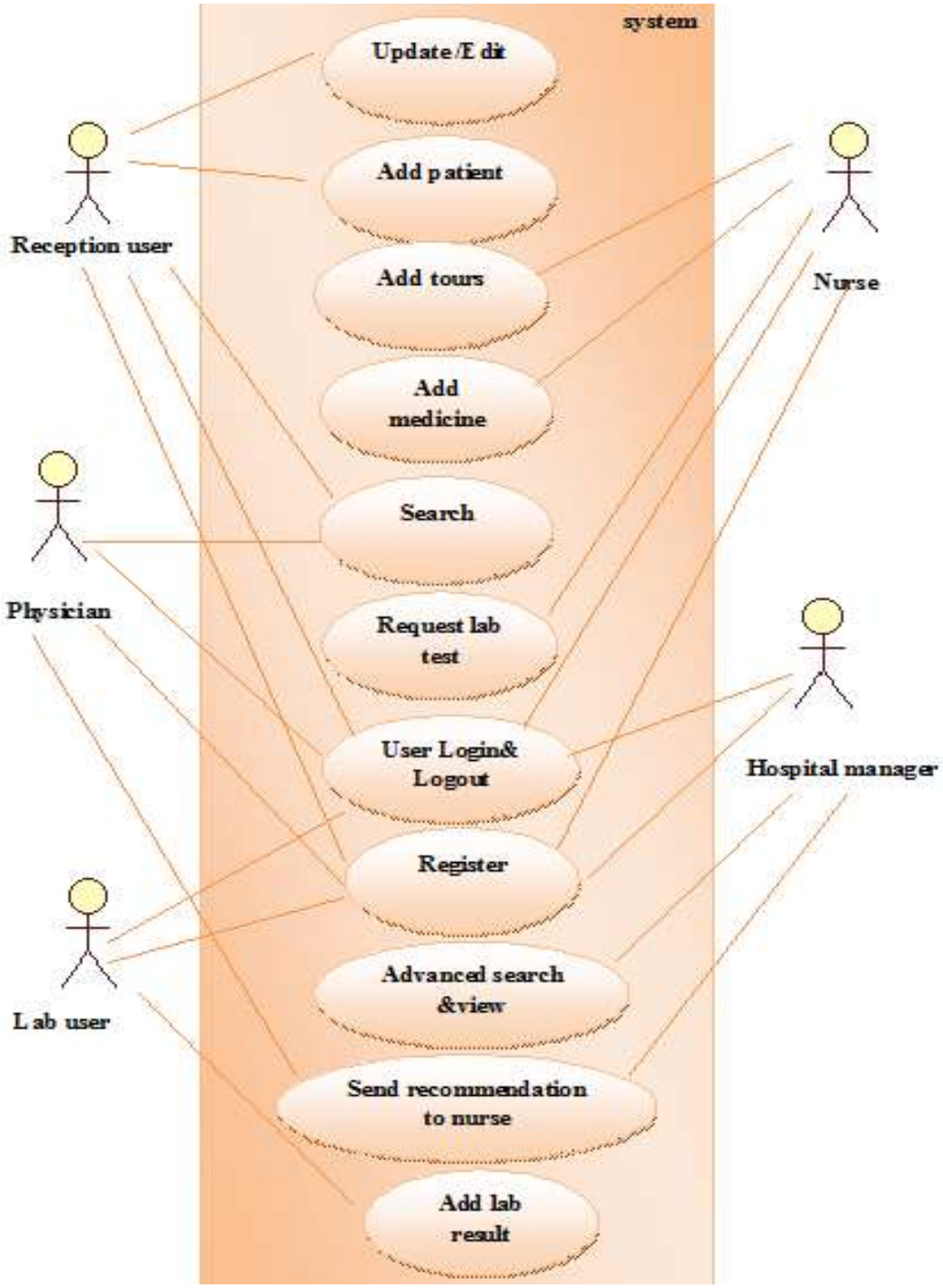

Figure 3: User's functions

3.2 Database Design

In EPRMS, the methodology of database design includes three main phases: conceptual, logical and physical design [12].

The conceptual design describes the relation and the connectivity between all components of the system.

While the logical data model which driven by the conceptual data model. It consists of specified classes that will become tables like: patient, tour, treatment, lab result, ICD, physians, medicine, labtestlist, and users,while their attributes became fields, and the associations became relationships.

Lastly, the final phase in the database design of EPRMS is to translate the logical database into a physical database. It will specify the system usability for instance screen layout.

3.3 System implementation tools

In EPRMS, MySQL database was implemented in the design of system database, while PhpMyAdmin was used to create the database and wampserver, WAMP (Windows Apache MySQL PHP). The WAMP and MySQL use to manage database [13].

4. System Results

Partial of the results which produced during the EPRMS will be showed:

1. The first step is to login in to the system by Admin & Reception as shown in figure (4).

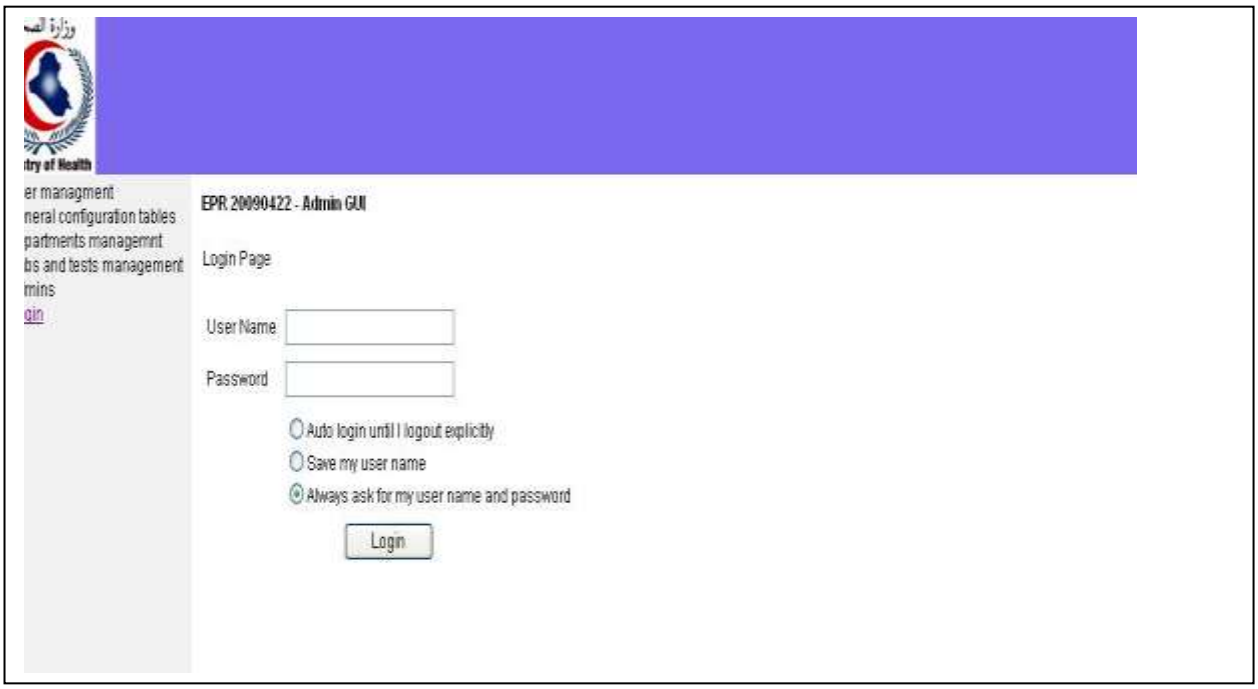

Figure 4: The login page for system administrator & reception

2. The page as shown in figure (5) is for Adding Patient by Reception user.

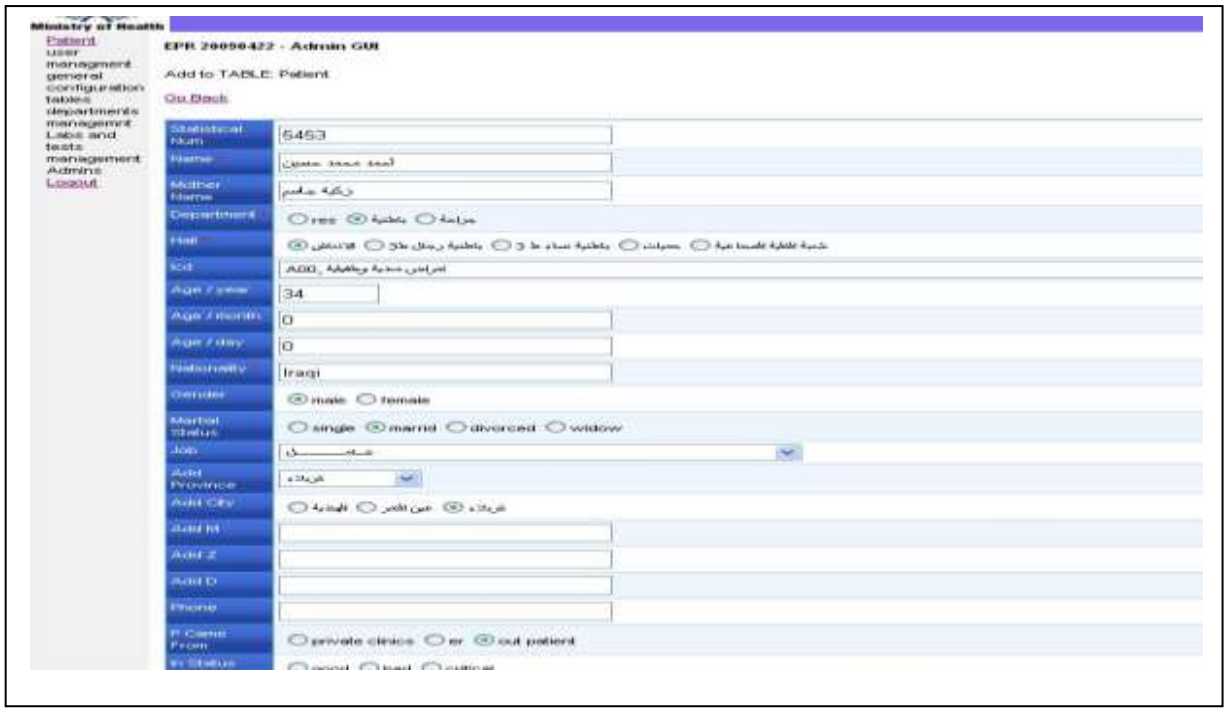

Figure 5: Adding patient page for reception

3. After the log in for the Administrator (IT or hospital manager), they can view the current in-patients (Statistical No., Name, Department, Hall, ICD) and can browse their used medicine and their physician comments or lab results as shown in figure (6).

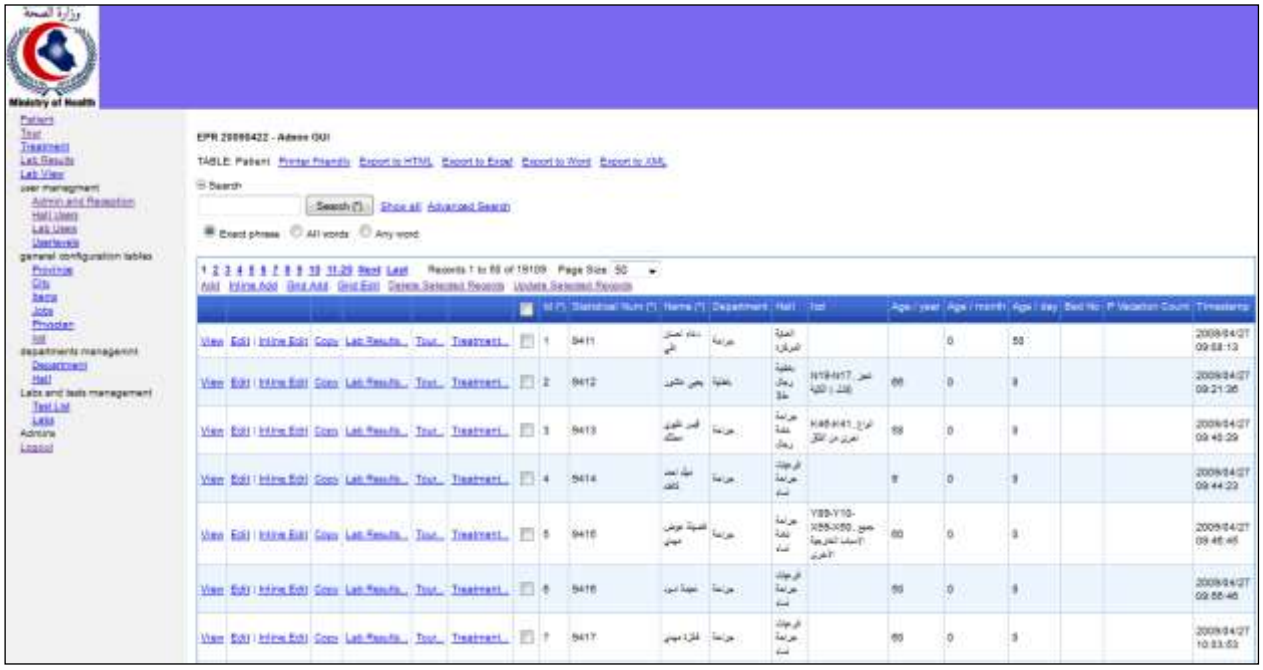

Figure 6: The home page for system administrator

4. The nurse has the major role in the system, she can follow up the patient treatment and status and update it in DB as long as the patient in hospital as shown in figure (7).

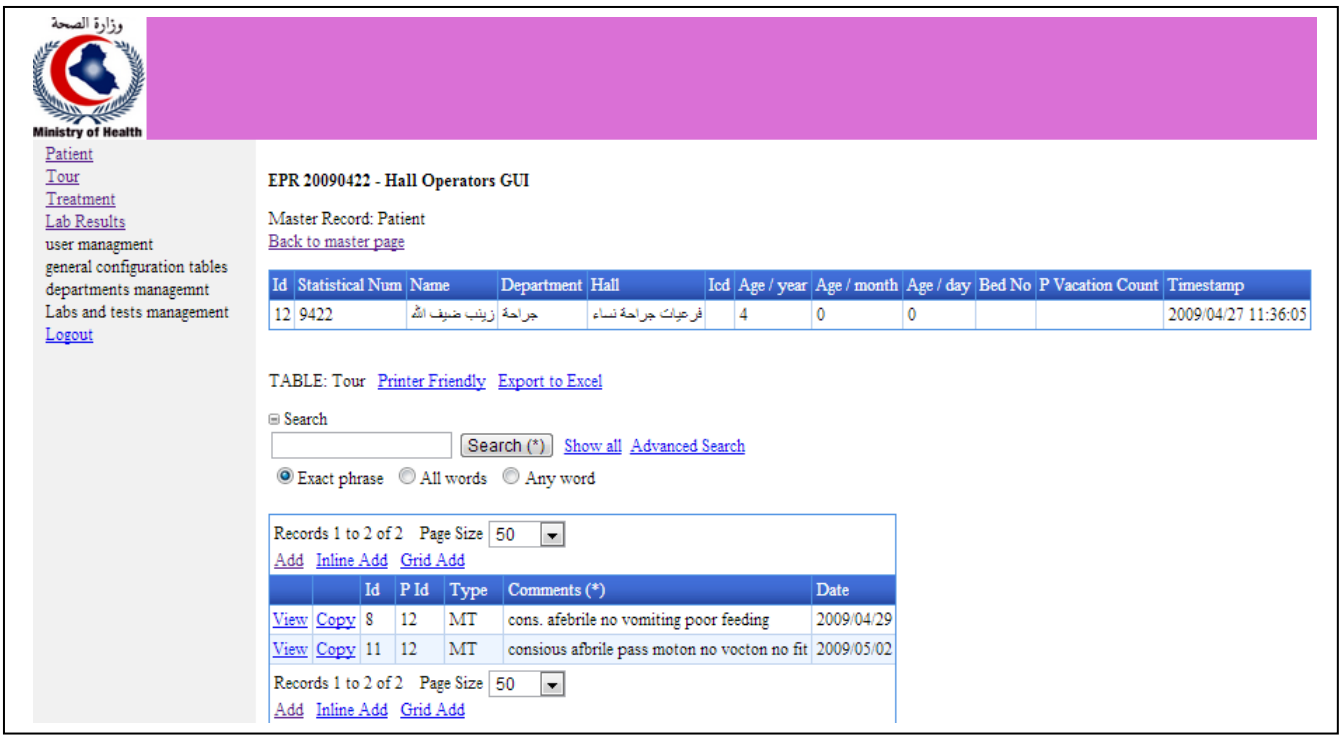

Figure 7: The tour page for a specific patient

5. The lab user can return the result of the required test as shown in figure (8).

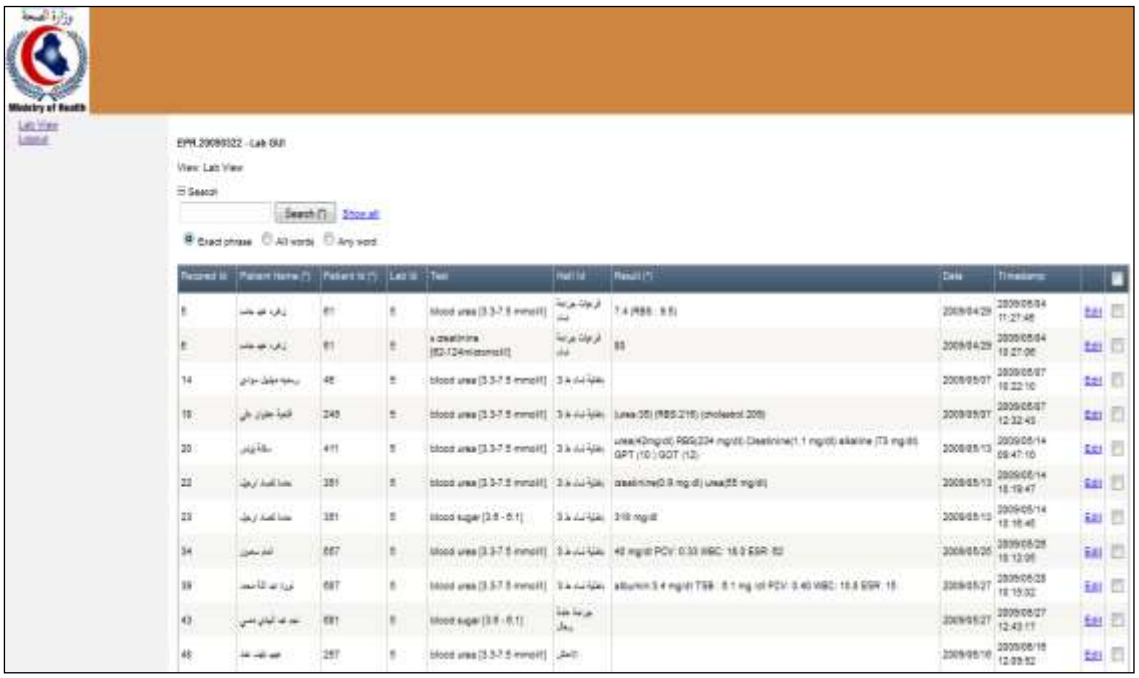

Figure 8: The home page for lab user

6. The page as shown in figure (9) is for the Lab Test Page.

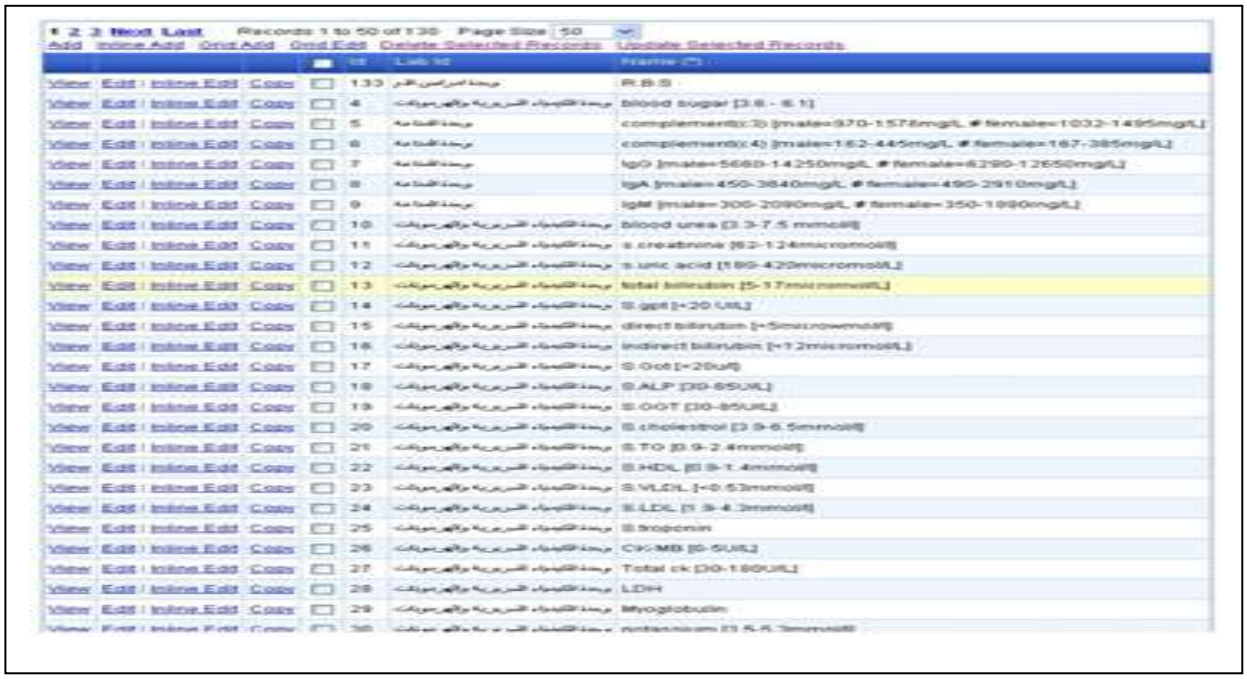

Figure 9: The Lab Test Page

7. The hospital manger,physician and researchers can use the advance search to view the report which they need as shown in figure (10).

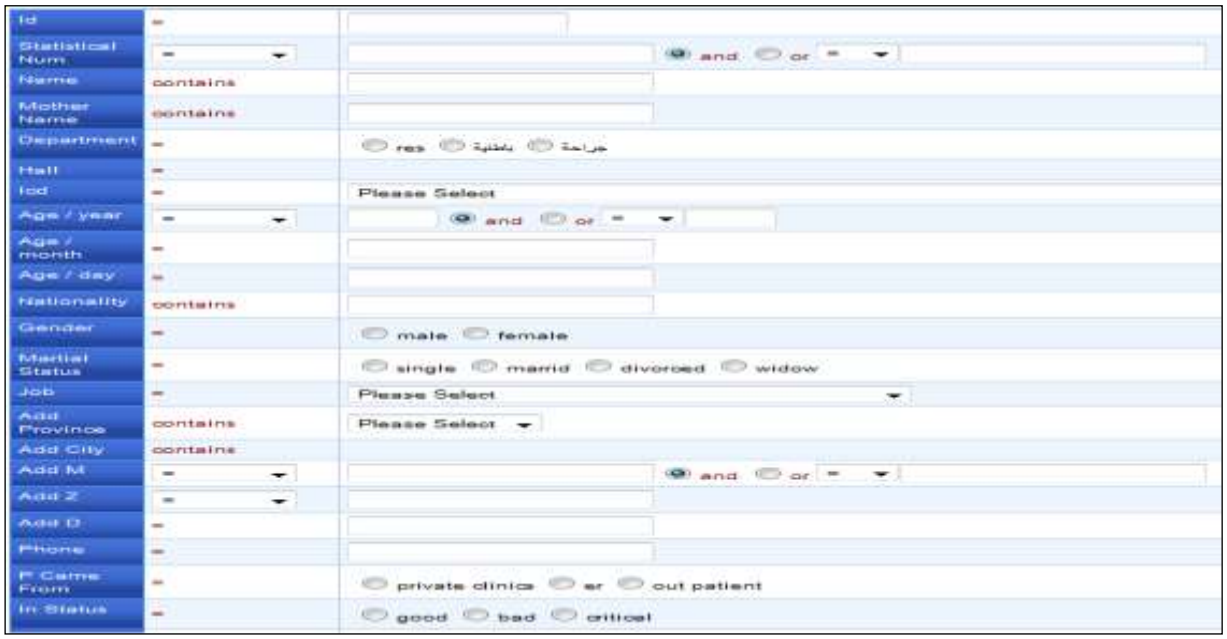

Figure 10: The advance serach

5. System Testing and Future Work

5.1 System Testing

System testing is concerned with testing an entire system based on its functional and non-functional specifications. Tables (3,4) show some of system tests based on the defined requirement.

Table 3: System Testing for Functional Requirements

Functional Requirements	Actor	Level of Importance	Condition
Add new patient record	Nurse	High	The nurse should be able to create a new patient record.
Search of patient profile	Nurse, physician	High	The nurse or physician should be able to search patient profile.
Request a specific lab test	Nurse	High	The system should enable the nurse to request a specific lab test.
Send lab results back to nurse or physician	Nurse , physician	High	The system should have ability to send lab results back to nurse or physician.
Close the record	Reception User	Medium	The reception user should be able to close the patient record by entering the ICD, patient status and out/died date.
Add/Delete/Edit sensor devices	Technician	Low	The technician should be able to add/delete/edit sensor devices on the clinical database.

Table 4: System Testing for Non-Functional Requirements

Non-Functional Requirements	Level of Importance	Condition
Security	High	All users to log into the medical system must have username and password.
Performance	High	Response time of system must be immediately.
Compatibility	Medium	The system should be compatible with multiple web browsers.

In addition Usability Testing is a technique used to evaluate the system; it is focused on how the users interact with the front end of the system. However user acceptance testing considers the final step before the end of the system. In EPRMS the User Acceptance Testing was applied to validate that the system meets [14]. Final users in this testing were given a set of activities to follow in order to test the system. However if a new user with no previous knowledge was able to use the system tasks with simplicity then this would confirm a success. After this test, we found that diverse activities were user friendly.

The hospital nominates two staff from each department to take training on the system. The training period was one week. Twenty percent of the nominees were familiar with windows operating system and internet browsing. The others have no interest or interaction with computers. After the training they find the software user friendly and they were able to use windows and browse internet.

5.2 Future Work

The future improvements to this project by adding the additional functionalities to EPRMS:

- Add more detailed tour fields like (blood pressure, blood sugar, heart rate, etc).
- Add imaging related tables like (CT Scan images, MRI Images, etc).
- Connect the used medicine for the in-patient with the whole Pharmacy inventory.

6. Conclusion

This research has been presented an implementation of Electornic Patient Record Management System (EPRMS) which is a centralized DB contains the in-patient record. The aim of this work was to provide reliable healthcare web-based system. However, after implementing Electornic Patient Record Management System; it will be capable of achieving the following:

1. It is to enhance the provided services to patients by making their records available online and everywhere for physician to follow up the case easily with less effort, and their history would be available also;
2. Hospital director and heads of departments can follow the physician work related to patients from diagnosis and follow up;
3. EPRMS has dependability and consistency execute the required functions of software;
4. It has possibility of developing a report for each patient case in hospital;
5. It provides the best control of the patient status based on their test results;
6. It is considered time and cost effective to healthcare;
7. Lastly securing and archiving the paper-based records is difficult and it can be stolen, burned or modified, so the need for such a system was very essential.

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