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Data-Medi: A Web Database System for E-Health

Anika Tabassum, Tahmidul Islam, and Tajim Md. Niamat Ullah Akhund

Abstract E-health system is helping mankind in a great extent. This work proposes a smart system to manage all types of health-related records of a patient having a variety of users. Currently, this type of combined system is very rare. Main purpose of the system is to gather all types of information in one database accessible at anytime from anywhere. This work resulted a cost-effective, smart, secure, and maintainable web-based health history management system for doctors, patients, donors, pharmacist, and general health concern people.

Keywords Medical database · E-health · Health history management · Health informatics · HCI

1 Introduction

Health history is very important for any treatment and for better understanding of the patient's condition. Usually, it is collected in medical forms. A digital health history is a digital version of a patient's paper chart. It contains a patient's medical history, diagnoses, medications, treatment plans, immunization dates, allergies, and all type of test results. Pharmacists can also use medical database to give appropriate medicine to the patients easily. In hospital, generally patients wait for doctors for a long time and sometimes patient lost their test reports. This is very time consuming and hard to diagnose the patient's condition. An automated E-health history management system can be a great solution to all these problems. The purpose of this proposed work is to create a web-based patient database system. This system is effective for patients, doctors, pharmacists, and others. Anyone who has access to this system can view all kind of correct information in one place at any time. By the proposed system, patients can view own records and prescribed medicines. They can update

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their personal information and print their prescription. Doctors can view patient's record from the system. Assistant can submit all information from prescription. After submitting information like medicine name, attributes of the medicine, and test results in the system, doctors, patients, and pharmacists can view all this information after access verification. Pharmacists can provide medicine according to the prescription. Doctors can also view donor list and contact donor in emergency case, where donor willingly wants to donate blood, plasma, or any organs.

2 Literature Review

Patient health history is the current collection of organized information unique to an individual [1]. Relevant aspects of the history include biographical, demographic, physical, mental, emotional, sociocultural, and spiritual data [2]. E-health history can play a big role in health sector [3]. The National Cancer Database (NCDB) is one of the largest databases and data resources to study the care of cancer in the United States which stored all types of cancer related research papers [4]. A study which was done in Saudi Arabia [5] has the most similarities with our research. But integrating their system with local data will be major challenge. Some major lacking in this research are data storage issues, lack of system interoperability, incorrect datasets, poor data analytics. Authors of [5, 6] match with our concept, like how to set the system and how to collect data and set a chart. Another relevant database is the CaPSURE database. But this database stores patient and doctor's suggested medicines and lab test only for prostate cancer [7]. This database does not stores patient's personal information. It has lack of uses and their privileges. The German rheumatological database contains clinical and patient derived data [1]. Patients can contact a rheumatologist in individual practice directly by using this database. This database is only for patient and doctors. Patient cannot take extra medicine from pharmacy because patient's exact record is available in the system. Japan Chronic Kidney Disease Database (J-CKD-DB) stores only the kidney disease related information for all type of age's people [8]. All data elements are extracted automatically to avoid input error and burden on physicians [9]. But in this database, there is no information about kidney donor and transfer. Nowadays, IoT, ICT, and robotics are helping in medical fields [10–12], remote sensing [3], virus affected people management [6], food management [5], disabled person helping [13], and patient management [14, 15]. Database systems can also do a great job of secure voting [15]. This motivates to make more helpful works for E-health. In [16], database design has multiple user-based database system. But it also has lack of user types which contrast with our developed system.

3 Database Structure and Design

This work proposed a health history management system from where anyone can view all information accurately in crucial time. Proposed system has four types of users. They are doctor, patient, pharmacist, and assistant. Doctor will prescribe medicine and patient receives that prescription. Doctors will have assistant. Assistant will input that prescription into E-health system and help patient to understand prescription. Because nowadays doctors are too busy to check and visit patients. Patient can view their own records from this system. Patient can update personal information like address, email, contact number, and can print their prescription. Doctors can view patient's all records and donor list. Some people want to donate their organ willingly. In that case, doctor can contact donor when any patient is in critical condition. Pharmacist can access E-health system and gives medicine according to patient prescription. The system is password protected. Every user has separate account and do not have access to another user's information. After being registered in the system, user can access in their own profile. From Fig. 1, we can see the four Actors mentioned before. Users can log-in the system. The system checks user password before letting user in the system.

From Fig. 1a, doctor can prescribe medicine, where data will be added to the system and can change power of medicine. Doctor can view patient records and view donor list and contact donor for patient in case of emergency.

From Fig. 1b, patient can view his own medical records. Patient can update their personal information. They also can print their prescription if they want. From Fig. 1c, pharmacist can view prescription and can give medicine to patient according to the prescription. Assistant can input a prescription in E-health system.

From sequence diagram mentioned in Fig. 2a, any user can enter their password for three times. If any user fails to verify the password, the user will be blocked. Figure 2b shows how doctor can view patient record by searching patient ID from E-health system. Figure 2c shows how in critical moment doctor can search donor for patient who needs donor. Figure 2d illustrates how doctor can search previous prescription and can change power of medicine. After getting information from database, doctor can also contact donor. System will fetch prescription from database and return to patient. Patient can also print his own prescription if he/she wants, showed in Fig. 2e, f. Figure 3a shows how pharmacists can view prescription and give medicine according to the prescription. Figure 3b illustrates how assistants can search patient ID and input prescription into E-health system with that id. Then, it will save in database. Figure 3c shows the entity relationship diagram of the full system. The algorithm of the system is mentioned in Fig. 4. As back-end, programming languages PHP and JAVASCRIPT were used. In front-end, HTML, CSS, and bootstrap were used to create a nice user interface of the proposed system which made it more user friendly and more accessible. XAMPP local server was uses to keep the data, which can be converted in cloud or web later. MySQL was used as database language. Relational database management system is used to control the system.

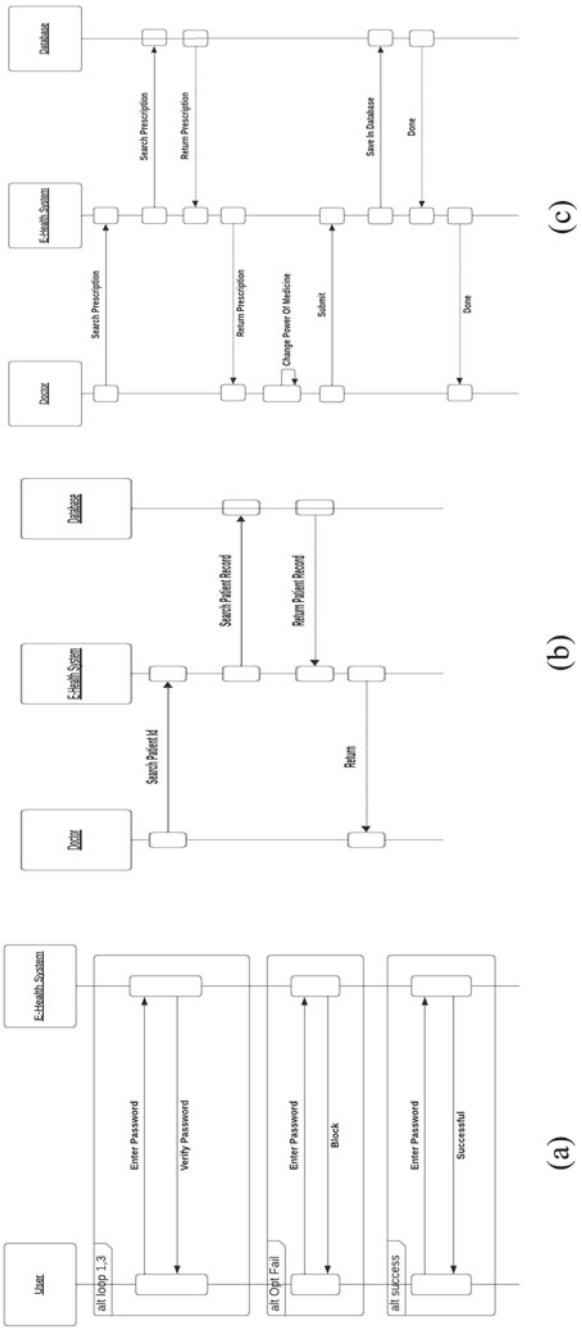

Fig. 1 Use case diagram of **a** doctor and assistant **b** patient **c** pharmacist

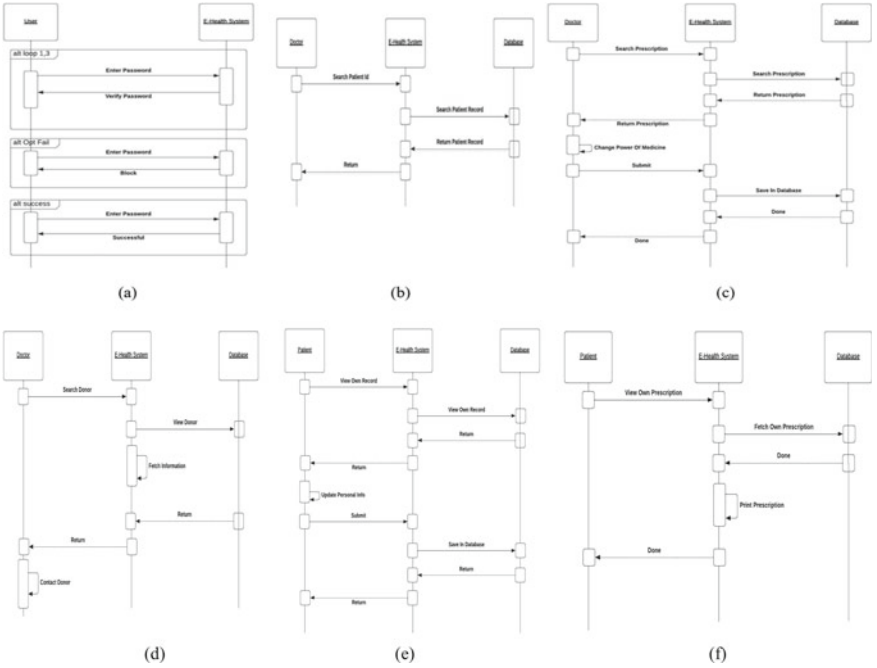

Fig. 2 **a** Sequence diagram of log-in, **b**, **c**, and **d** sequence diagram of doctor, **e** and **f** sequence diagram of patient

4 Results

Brief overview of the system and the outcomes are described in this section.

Log-In Page: First page of the demo is Log-in page (Fig. 5a). Any user can log-in using verified user id and password.

User Type: Each type of user's description with feature given below:

1. **Admin**: Admin is the controller of the system and can add any type of user on the system (Fig. 5b), view user list and can search and delete any type of user using their user id (Fig. 5c). Also, admin can check how many users in the system.
2. **Doctor**: Doctor can check any patient's prescriptions (Fig. 5h) and medical test (Fig. 5e) records if they search it by their patient id. Doctor can update, delete, or add (Fig. 5 (d, f) a prescription or add more tests (Fig. 5g) for patient too. They can search for donor from the donor list (Fig. 5i). Doctor can contact donor by searching them using donor type or blood group.
3. **Assistant**: Assistant can check and search any patient's records by using their patient id. Assistant can update or delete prescription of a patient. Also, assistant can add more prescription and more tests for patient too.

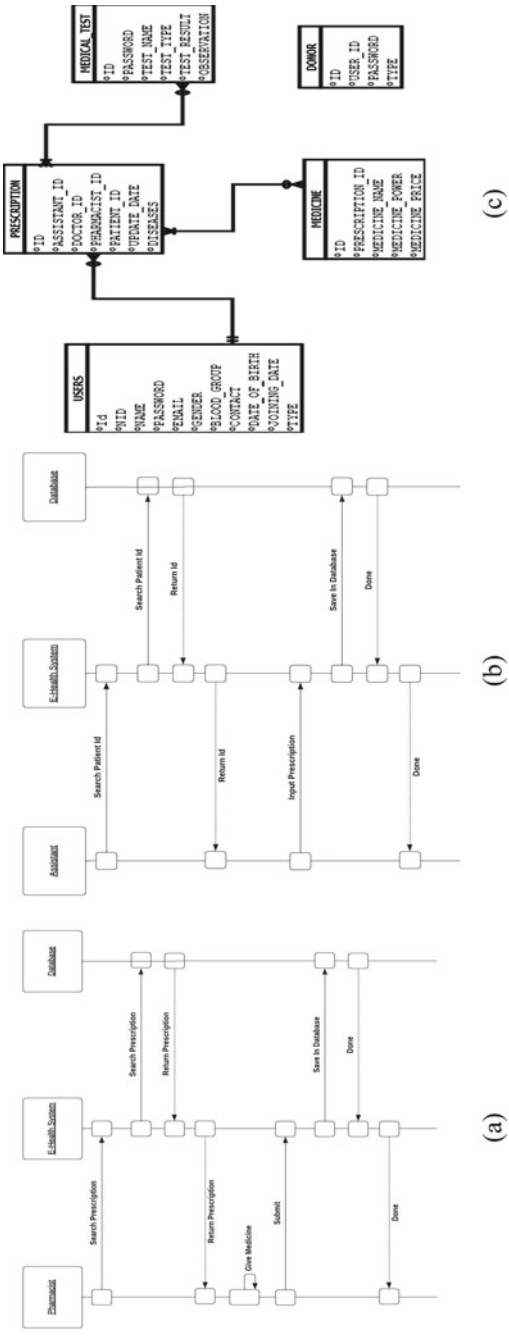

Fig. 3 Sequence diagram of pharmacist (**a**), assistant (**b**), ER diagram of the system (**c**)

```
If (Log_In_Attempt < = 3 && user_name_and_ password_are_valid) then
  Log_In_Successful;
        if (user_type = doctor)
                if (patient_id_valid_) then
                    can_view_patient_record;
                    can_change_power_of_medicines;
                    can_give_prescription;

                else if (donor_id_valid) then
                    can_view_donor_record;
                    can_contact_donor;
                else, Not_Valid;

                end
        else if (user_type = patient) then

        can_view_own_record;
                if (click_update_information_option) then
                update_personal_information;
                continue;
                else if (click_print_prescription_option) then
                print_prescription;
                end
        else if (user_type = phasmacist)
                if (patient_id_is_valid) then
                    can_view_patient_prescription;
                    can_give_medicine;
                else, Not_Valid;

                end
        else if (user_type = assistant)
                if (patient_id_valid) then
                    input_prescription_into_E-health_system;

                else, Not_Valid;


                end
        end
else
  Log_In_Failed;
  Block_user_for_three_minutes;

end
```

Fig. 4 Algorithm of the system

4. **Pharmacist**: Pharmacist can check patient's medical record (Fig. 5j). A pharmacist can give medicine according to the prescription.
5. **Patient**: Patient can see their own medical records like prescription or medical test (Fig. 5j, k). They can also print them.

The cost analysis of the proposed system is mentioned in Table 1.

After studying multiple database management systems [16], the estimated total system capital cost is 16,700 USD per year. Also, there will be additional future cost for data entry and reconciliation, human resources, training cost, completion of documentation. These additional costs cannot be calculated at this stage of the research as it will be growing with time.

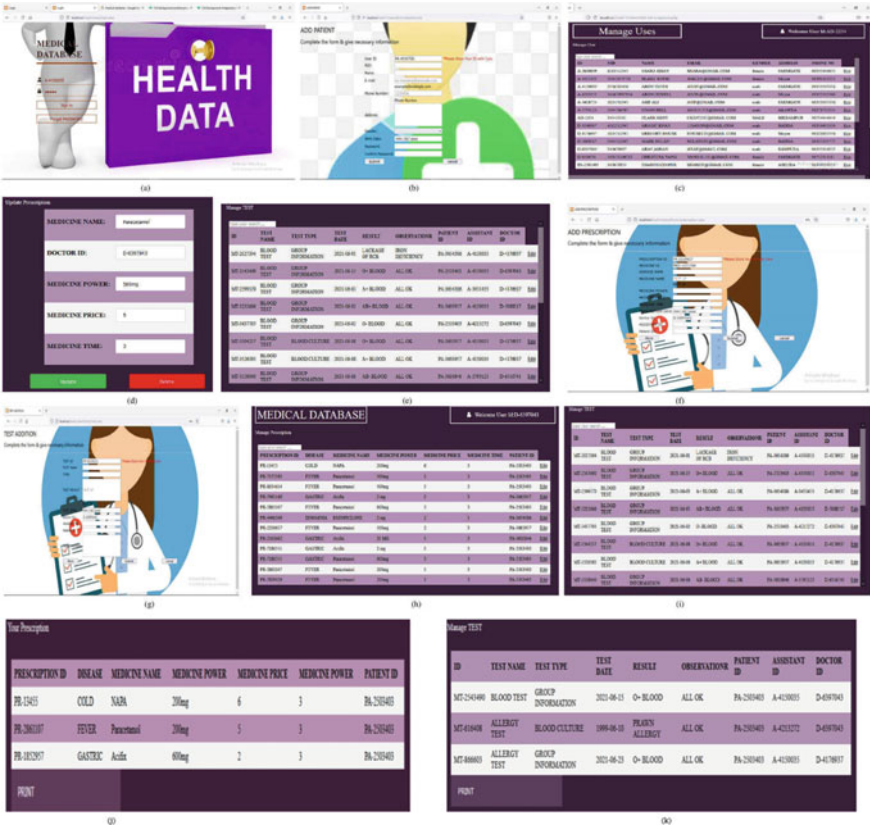

Fig. 5 Web pages of **a** log-in **b** add user **c** user list **d** update prescription **e** medical test list **f** add prescription **g** update prescription **h** prescription list (all) **i** donor list **j** prescription list (patient) **k** medical test list (patient). For source code, see [17]

Table 1 System capital cost per year

Category	Expenditure (USD)
Hardware maintenance	4000
System analysis and programming	4500
Timesharing services	3200
Management cost	3500
Miscellaneous	1500
Total	16,700

Finally, this system has achieved the following features:

1. All types of disease information, test report, and medicine of a patient can be saved in this system.
2. Patients can view their own records and prescribed medicine. They can update own personal information and print prescription from the automated system.
3. Doctors can view patients records from the system, prescribe medicine, and change medicine. They can also find donor list and contact donor in emergency cases, where donor willingly wants to donate blood, plasma, and their body organs.
4. Assistant can input all information in the system from prescription. When assistant put information in this system like medicines name, power of medicine and test results then doctors, patient and pharmacist can view all this information.
5. Pharmacists can give patient medicine according to prescription of the database.

Web technologies are used to implement this system which is easily accessible for the users at any time from anywhere. Unlike others medical database, it has pharmacist as a user. The addition of pharmacist can cause major change in the system. It makes their job easier and faster. Also, the input insertion is very easy and over all the system is user friendly.

5 Conclusion

This work developed a smart web-based structure of patient database system, where all types of information are organized in one database and people can see correct information. All types of disease information, test report, and medicine of a patient can be saved in the system. This system will keep patient's information all together which will help doctor to check all information quickly and efficiently. Pharmacist can also give medicine easily. Some scope of the future development can be made on this work. When pharmacist request to view record for patient then patient will get a code in his own phone. After inputting that code into system, pharmacist will get access to view patient record. Pharmacist can get notification if a patient in his area got prescribed any rare kind of medicine. Patient can check availability of medicine in nearby pharmacies. Machine learning approaches can be applied on the stored data of a patient to predict future condition.

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