Electronic Health Record Application for Dental Clinic

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ABSTRACT

Hard copy format has been a primary source to store information ranging from individual clinical histories to public research data. An Electronic Heath Record (EHR) system facilitate the storage, retrieval, persistence, and sharing of patient data. An electronic health record application for dental clinic should be easy to operate and configure, which also fully utilizes all the features of modern operating systems. All patient report must be clearly shown in one screen and all the relevant information must be reached in a mouse click or two. New advances in information and communication technologies and there in corporation into the dental domain have created opportunities and enhance dental services and provide improvement to workflow at a low cost. The paper states the development of the web application using agile process development. The development process is performed in three phases, i.e., prototype, development of the system using required coding tools such as Python flask, HTML, CSS, Java Script and finally the implementation or testing phase. Some of many advantages of our Electronic Health Record system relation to work with the printed one, especially for larger dental clinics, are easy storage, improved control, better access to the required information etc. To conclude, all patient data can be found in one place and clearly presented. Doctors and teams from different practice can achieve superior communications in order to exchange experiences and opinions with respect to rights of privacy of the patient. This significantly reduces the possibility of setting incorrect diagnosis, it is possible to operate more efficiently and improve the quality of healthcare services.

1. INTRODUCTION

Hard copy format has been a primary source to store information ranging from individual clinical histories to public research data. However, this kind of system demands ever-increasing space, it is in-efficient and is prone to destruction. It can be difficult at times to duplicate the data, even more difficult in organizing and aggregating the data for further analyses. Electronic health records (EHR) are the solution as it allows easy access to the information by digitizing the contained information becoming a database (Asgari, 2018).

An electronic health record application for dental clinic should be easy to operate and configure, which also fully utilizes all the features of modern operating systems (Masic, 2012). It should fully meet the specific needs of modern dental practice. To increase productivity, it must present a natural workflow of work practices, provide opportunities to fully devote professional work and assist so carry out tedious tasks easily and efficiently. It must contain a comprehensive record of all the patients who were treated in the dentistry. All patient information must be clearly shown by tables and graphics in one screen and all the relevant information must be reached in a mouse click or two. It must have a planner showing past and upcoming appointments in a time interval of interest and also number of employees working the same time to allow a flexible schedule. The System must be able to send notices about upcoming appointments, payments, recommendations etc. to the patients via email or text message on patient's cell phone.

Design thinking approach, within health services such as dental clinics, is proven to provide more useful, effective and easily accepted interventions (Amalia, Galang, 2019). New advances in information and communication technologies and there in corporation into the dental domain have created opportunities and enhance dental services and provide improvement to workflow at a low cost (Kamran, Krupa, Weina, 2013). Development of electronic records for oral health requires substantial departures from standard EHRs. In other words, several specialty-specific hints need to be incorporated to maximize the benefits for patients, researchers, practitioners, and academicians, appropriately. Although development and assimilation of electronic oral health records in clinical practice are becoming widespread, their adoption in public research setting is still limited (Richard, Anne, Gary, 2013).

The paper states the development of the web application using agile process development. The EHR application for dental clinic will be developed to meet the requirements of the project. The project will mostly focus on the patient tab where the end user would be able to look up all the patients and their information like phone, email, last visit, next visit, payment state etc. The user will also be able to click on the user to get additional information about the last visit like latest procedure, complaints, allergies or could add a new a patient in the list.

In sum, this paper makes the following contributions:

- It enumerates needs of dental clinics when organizing and aggregating the data for future analysis.
- It presents the design and implementation ideas of a user interface of the EHR application for a dental clinic which must be easy to operate, configure for professional use.
- It provides insights about the effects of EHR applications leading to low treatment cost and increasing productivity

in the dental clinic by being more organized with data about the patient.

- It states the development process of the HER web application mainly focusing on the patient tab.

Collectively, the paper will demonstrate the design and development of a user interface for gaining precise information about patients in few to none mouse clicks.

2. BACKGROUND

2.1. Information in dentistry

Doctors and dentists have different information needs when making diagnoses and medical decisions. While medical knowledge continues to grow at a steady pace, clinicians spend less time on clinical trial issues and develop a plan to set up clinical questions. (Taowie, Krist, Cathrine, 2010) mentioned information seeking process begins with data acquisition. Since the required data about the patients is not directly linked to the databases a hospital may have, we obtain our data through our physician collaborators and a data administrator. At the beginning of a dental case study, the physicians decide the scope of the data that they want to examine. they then requested datab administrators of the hospital to gather the requisite data for the EHR system. They then de-identify and preprocess them for their case studies. During the information seeking process, sometimes the analysts return to the data acquisition stage because they (1) become unsatisfied with the data, (2) found systematic errors in the data, or (3) want to incorporate more data for deeper analyses.

Allan, Meng, Mike, Travis, Lih-ching, Dian, Jackey (2013), states hospitals must maintain records of all the patients that use the hospital's services. This includes all the patients in the outpatient, inpatient and emergency care. One of Taiwan's largest hospitals, the Taipei Veterans General Hospital (VGH), recorded over 2.7 million visits by patients in 2012. In order to be able to quickly retrieve and/or update the necessary records, the VGH maintains a vast database maintaining all the electronic health records (EHRs) of each of these patients. Doctors can access their patients' EHRs at designated work computers such as at nurse stations, clinic examination rooms or in their offices.

Hany, Mohamed, Anil (2007), proposes an automated dental identification system that will provide automated search and matching capabilities for digitized radiographs and photographic images, so as to come with a short match list for dental forensic experts.

Anne-Marie, Minna, Olli, Jani, Neeraj, Kai (2016), made a point in their paper that, Patients are important stakeholders for EHR projects, because they are both targets and participants of the EHR. As citizens, they have a right to access their electronic health record any time.

Vera, Hardisman, Refdinal (2019), mentioned Indonesia with 270 million population and 2820 hospitals has the problem of fragmentation and poor coordination in the national Health Information Systems. Accordingly, EHR is a trusted concept to handle barrier in operating technology in healthcare services in particular, Health Information systems. The EHR is identified as new concept in healthcare contexts particularly in adopting the health information systems. Despite of facts, the related study in terms of the implementation of e-health in developing countries especially in Indonesia is lack of develop

2.2 Information systems in dentistry

Amalia, Galang (2019) have cited that to create efficient and useful human interaction with computers, a user interface must be designed with several things in mind, such as the ability of users to operate the interface and the troubles faced by one user that differ from one another. The Human-Computer Interaction studies how human work with a machine to make sure that the human can easily comprehend the functionalities of the machine, design interface. It also optimizes the process involving humans with machine in which there are a user interface and elements of usability to ensure effectiveness and produce better communication between the machine

3. SYSTEM

3.1. Initial Phase: Prototype

Development of this software has been based on Agile Unified Process development methodology. The software was gradually developed to meet the requirements, as the requirements were not explicitly explained in the prototype of the system. The motive of this system was to create an interactive system for the users where they could not only gain patient information efficiently but also be able to share any interesting and useful article with their co-workers once logged in. Organizing patient's information was the main goal of the system which has been optimized gradually to speed up the data entry and also easier working by getting feedback from the users.

Technically, an Object-Oriented Software Development Method was applied. Application functions were performed by objects defined by existing classes. These classes were in the form of a layered architecture. The highest level of work displayed the interface of the software with users. The middle layer contained classes that control the program's logical function, and finally, the underlying layer was the storage and availability of data related to the program.

3.2. Second Phase: Development of Electronic Health Record System

The application was written using the Python Flask, HTML, CSS, Java Script platform, and classes like bootstrap-css and bootstrap-js was heavily used graphical interface and giving functions to the app. The WTForms class in python complimented to create login, signup, add blog and add patient forms for gaining information from the user which was later stored in the database using SQLite. Since the app did not have a large data to store, the system has used SQLite as a database which did not take too much space in the server and was easy and efficient to gain data. The system

made use of the python class passlib-hash to encrypt some data which could be harmful to the system if in wrong hands. The necessary conditions for the development of the application have been provided with VS Code from Microsoft and Mac Terminal. Oral Health Record App was tested with Google's Chrome and Apple's Safari.

The patient information not real data for this project instead made up data was used to test the system. the software kept users' information in their place and the task of synchronizing information with the server done at the availability of the Internet. For this purpose, the user information has been stored in the form of a database of SQLite type within the client's MacBook. After viewing and browsing, the recorded information. The system was transferred to a Virtual environment, Drexel's sandbox, to keep running the system.

The process of transferring is done using the ssh method from the terminal and from the virtual environment tmux was used to keep the server running. Patient information is extracted from the database displayed iteratively on the dashboard according to this protocol. The posting method is also used to keep users safe and to hide the information from the perspective of others in the form of a POST.

Masic (2012), states dental information systems lately are based on Web applications to facilitate data exchange. Electronic patient record contains basic information and entering of this data is automatically created the protocol of patients that can be printed. Besides these general data Electronic patient record also contains history data related to allergies and other diseases which existence can significantly affect the treatment, data on current diagnosis, location of a pathological process in the tooth refers to the following location (mesial, distal, vestibular, oral, occlusal), teething, therapy of the tooth , type of material used with location on the tooth. The system may define also the surgical procedures that were performed on the teeth such as tooth extraction or tooth root resection with the ability to accurately indicate that the root is resected. Implants, upgrades, grinding teeth, and independent crown can be defined for each tooth and its rightful place if a tooth is missing. Specially designed graphical representation of teeth enables to enter data by first clicking on the tooth or place where it is and also on that occasion to open a menu with options. Control of data entry prevents entry of illogical data.

3.3. Third Phase: Implementation phase as testing

Due to the simplicity and low diversity of functions on the server side, a shared host, Drexel's sandbox, has been used for this software. The SQLlite database server collects all patient information provided by clients' MacBook. The design of this database is a relational database. The illustrated the components of software in are in three levels. At the first level, user's information is received from the user in order for the user to gain more functionality of the system such as add patients and view all the patients in the system. The user may also post an interesting article in the system. The title of the article could be seen to all but if one wants to see the content, they must be able to log in the system. Client for testing could be students, teachers and TA's in Drexel CCI if they would like to test the app. The other client is the host who has access to the data bank. In the second level, controller verifies, handle, and take care of data. To the storage and processing of information, at third level, a server has been considered for holding the information. The server also provides the manager with the data required for processing and analysis the results.

4. EVALUATION

The system was evaluated on the basis of graphics, clarity, store and access patient's data. Function of EHR Demo modules are adapted to work in dental offices using tools for labeling of the dental status of patients. Also used are all the other standard modules for the administration and work with the patients in their offices. The system is assigned a set of dental services which they can provide. Dental practice is treated as a reference drug store with appropriate drugs, dental materials and preparations, whose use is recorded.

The advantage of EHR Demo relation to work with the printed one, especially for larger dental clinics, are multiple. Here are just some of them:

- Improved control over the record,
- Easier storage and data access,
- The possibility of processing large amounts of data in order to conduct scientific research and improve care for patients,
- Better access to information relevant to the management of the clinic/dentist office, etc.

In addition to the options that dentists already have with the use of printed dental records, electronic dental record offers historical overview of all the teeth or the individual teeth by using electronic dental records is readily available from the moment you open the record or the moment of eruption of teeth to the current moment. This functionality can to some extent facilitate dental decision-making regarding further treatment.

Information relevant to decision making in the administration of the clinic/dentist office, can be easily obtained from a database which employees could regularly input using EHR Demo during their daily work. Electronic exchange of data between remote dental clinics/offices, which are allowed to use electronic dental records, can significantly contribute to the overall increase in knowledge in this field. Electronic data exchange between the distant offices which by organization belonging to the same health institution should make easier and speeds up the daily work of these clinics.

Dental record also has a status of official court documents and it can be used in identifying persons. And for this purpose, an electronic format has the advantage over paper because it provides a higher level of data protection from unauthorized reading or registration. Protection of electronic dental records will be achieved through user accounts which are unique to each employee. The rights of access to dental data of the patients can be set for individual users or user groups, each with a change in

the database is memorized and who is here modified so that the possibility of abuse is minimized.

Masic (2012), cited in her paper that we should indicate some objective difficulties in the introduction of electronic records in everyday dental practice in an institution. The biggest problem is the cost of this process, which initially involves the cost of computer equipment, software cost, training of staff and any changes in work processes. However, in institutions where such information systems are introduced into use has been shown that this initial investment pays off by reducing other costs and increase service quality through the use of information systems.

5. DISCUSSION

Based on the recommendations issued by the WHO, for effective decision-making and health planning, oral health information system should covered the aspects of risk factors of oral health, oral health-related quality of life, services and interventions, administrative processes, and quality and outcomes of care in addition to clinical, epidemiological information. (Asgari, 2018). In this regard, the WHO has provided two major tools for health information systems as well as oral health. The STEP approach and the WHO Global InfoBase both based on the views of the common risk factors and providing effective communication with policymakers, donors, and the general public. (Asgari, 2018).

Allan, Meng, Mike, Travis, Lih-ching, Dian, Jackey (2013), states During the training sessions teaching the doctors how to use the EHR system, the host observed that some of the doctors found learning to use the mobile EHR cumbersome, and were rather resistive towards introducing a new device into their work. However, our data tells us that our top users were very dependent on Electronic heath record system. Therefore, we can see that once the learning curve has been overcome, they have found Electronic heath record system to be quite useful. As web browsers become more popular as a platform for EHRs, we envision a more tech-savvy generation of doctors who will find web EHRs indispensable for their work.

Masic, (2012) conditions during the treatment the doctor has access to all relevant patient records, personal information (general data), medical history, documentation and a complete graphical and tabular presentation of the status of the teeth and carried out interventions to date. Thus, all patient data can be found in one place and clearly presented, with the possibility of coping. Also, doctors and teams from different practice can achieve superior communications in order to exchange experiences and opinions with respect to rights of privacy of the patient. This significantly reduces the possibility of setting incorrect diagnosis, it is possible to operate more efficiently and improve the quality of healthcare services. Dental nurses are largely responsible for administrative tasks. With application of electronic dental records administrative tasks are performed in more convenient and easier manner. Patient information is inputted in one or more mouse clicks, which is much faster than using paper folders.

In Denmark, the designed information system for oral health is integrated to the health system, and it has a total coverage for child population (Asgari, 2018). In the academic setting, at the University of British Columbia (2005–2010), an electronic record system for all fields of dentistry has been designed and completed gradually. This application is constantly evaluated by the faculty staff and students (Asgari, 2018). Based on the general changes in health information management, it seems that substitution of paper-based recording to electronic systems in the dental school would be a long-term vision of all departments.

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