

Implementing Health Information System in King Hamad University Hospital Benefits and Challenges

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ABSTRACT

As a university hospital, it prides itself on using the latest techniques, medical and diagnostic curriculum, as well as up-to-the-minute medical equipment and fully equipped facilities. It has over 1700 employees and accommodates more than 311 beds and 9 operating theatres, a number of internal wards plus an intensive care unit with 12 beds. Healthcare organizations now believe in improved efficiency, reduced costs, improved patient care and quality of services, and safety when they are preparing to apply new information and communication technology (ICT) based applications. Health IT systems allow the gathering of data for use for quality management, outcome reporting, and public health disease surveillance and reporting. However, development is needed with all health IT, particularly concerning design, implementation, and integration between platforms within the surroundings of work.

Keywords: Computers, electronic medical information systems, electronic records, health professional.

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I. INTRODUCTION

Patient records, also known as patient files, are important, and their importance is linked to many demands and goals of healthcare institutions and organizations. Patient records serve as documentation of people's health, whether they are ill or healthy. This enables medical personnel to examine symptoms from a wider perspective, resulting in more accurate diagnoses and effective treatment [1], [2]. There is a significant need for storage space in major medical facilities for paper-based records, making it challenging to keep them up to date or even to find a quick and simple way to access patient's files to find the data required to assess a patient's prior medical history [3], [4]. Since the amount of information and knowledge that clinicians and decision-makers in healthcare institutions must deal with constantly has increased and extended to such an extent that it is challenging to deal with in traditional methods, medical decisions face many challenges [5], [6]. The second-largest public hospital in Bahrain is King Hamad University Hospital (KHUH), which opened its doors in 2012. Due to its comprehensive array of healthcare services and high-quality therapy and diagnostics, not just because of superior internal knowledge, but also because of the tight cooperation with other Bahraini medical facilities, particularly the Bahrain Defense Force Hospital. In order to deliver the best possible

patient care, King Hamad University Hospital uses Oracle APEX to speed up application development and save costs. The HOPE (Healthcare Operating Environment) healthcare information system covers every facet of the healthcare system, including scheduling, admissions, electronic medical records, lab testing, specialist care, pharmacy, catering, and revenue management [7], [8]. The hospital was having trouble with strict, legacy hospital administration information systems. The facility offers more than 40 specialties and serves as a secondary and tertiary national referral center for patients with general and cancer conditions. In the very dynamic and complex healthcare environment, it might be difficult to make changes that are actually effective. Executives from the hospital tested two separate local systems, one that used Oracle Forms and the other Adobe Flash, but adding additional needs and connecting data proved to be excessively expensive and challenging to manage, which resulted in project delays. The hospital debated whether to purchase CERNER, a widely used hospital application, or to develop its own system from scratch. The Electronic Medical Record (EMR), which is used in most clinics and hospitals, is the digital equivalent of paper medical records. It contains patient data that has been gathered by nurses or doctors for use in diagnosis and treatment. Compared to paper records, this technique of recording is more efficient. The EMR improves the quality of

healthcare services by providing access to tracking patient data over time and selecting patients for health checks and screenings. Patients can also be monitored through this system. EMR stores patient history information, including results of tests, medications taken, allergies, operations conducted, and a variety of other aspects. The cost of developing an information system is reduced as a result of advancements in information technology. The quality of the services offered to patients and the coherence of the patient care process improves when this data is accessed through the EMR system rather than the paper system [9], [10]. The importance of this study stems from its intention to concentrate primarily on the requirement of the acceptance and completion of health information systems and electronic medical records in Bahrain, on the major barriers, which represent a hesitant block on the path of the successful achievement of health information systems and electronic medical records in an effective and efficient way and on a large scale, which would enable health care professionals and providers to make better decisions. Health information systems use. Solutions for the electronic and digital storage of these documents would be quickly created to ease their management with the evolution and advancement of information technology [11], [12]. Many professions now need the use of computers and information systems, particularly those involving the management, storing, processing, and retrieval of health information [13]-[17].

II. METHODS

King Hamad University Hospital selected Oracle Application Express (APEX) as its custom health information management system because it provided a superior application development framework for improved performance and productivity at a fraction of the time, cost, and errors compared to the previous two attempts. Compared to conventional Java and .Net application programs, the straightforward, low-code APEX framework is a free choice within Oracle Database that enables creation at breakneck speed. It enabled the hospital to gradually develop HOPE, its own system, while phasing out legacy modules. This made it possible for the hospital to consistently offer new breakthroughs in healthcare.

Fig. 1 shows the home page of the HOPE system, after one of the healthcare team member's logs in to the system with their accounts, this interface will be shown for them. There are many options they have to choose from, as an example you can search by patient's name to get more information about him, "By MRN #" option is used to enter the patient's Central Population Registry (CPR) number to view all of his information and the member can search for any patient on the specific ward as well.



Fig. 2. Interface of the lab.

The Fig. 2 demonstrates the interface of the lab results viewer, there are many tests performed for the demo patient. In the left corner, there is the doctor's name who requested the test and his department with the date of request. If more details are required for the doctor, clicking on the test required will open a window that shows further details for the test performed earlier. The results can be printed by clicking on the printer icon.

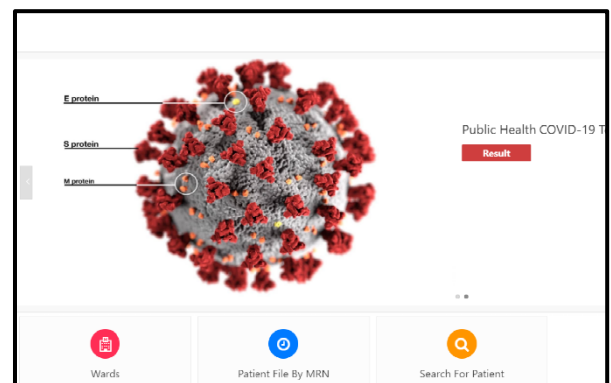


Fig. 2. Medical Report Interface.

The doctor can access the medical reports in the system, this demo in Fig. 3 illustrates the patient's medical report which is stored in the database. The doctor can see all the details of that report. The database of medical imaging is stored in a third-party archiving system called Jivex, this system is Picture Archiving and Communication System (PACS) [3]. HOPE system is integrated with the archiving system, so the doctors do not need to access that system to view the images, they need to login into his HOPE account then click on the viewing icon, and then all exams were done for the patient will be shown as presented in Fig. 4.

The patient's name, birth date, date of the exam and type of the exam (MRI-X-ray-Ultrasound etc) will be shown in that window also.

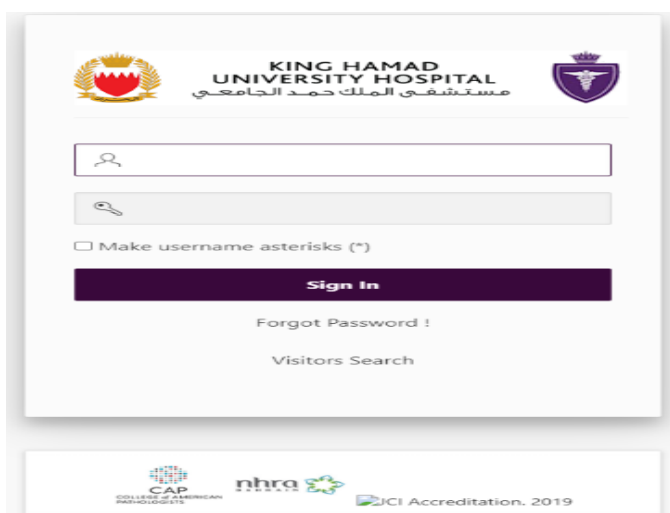


Fig. 1. HOPE home page.

After clicking on the required exam, a new window will be open to view the exam as per the Fig. 4, there is an option to control the image by increasing and decreasing the brightness, rotate the image, angle measurements, etc.

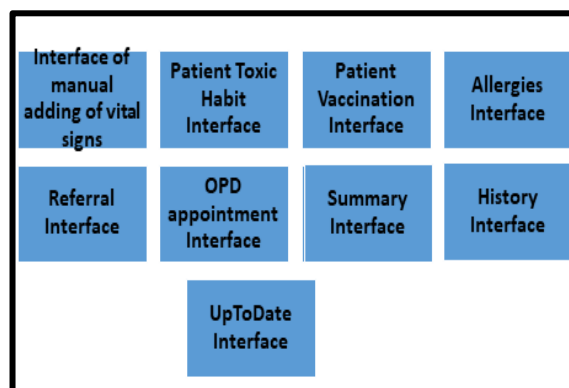


Fig. 3. Jivex Viewer Interface.



Fig. 5. Interface of manual adding of vital signs.

Patient's vital signs are measured using either patients monitor or vital sign monitor, these data can be integrated into the HOPE system if the vital sign monitor is configured for this function, in-case if the monitors are not configured yet with HOPE, so there is an option to enter the vital sign manually in the system as demonstrated in Fig. 5. These vitals include Non Invasive Blood Pressure (NIBP), Heart Rate (HR), body temperature, Respiration Rate (RR) and oxygen saturation. During a patient's diagnosis, the doctor might ask his patient's questions related to their toxic habits which include nicotine, alcohol and other substance. In each of that habit, there is much information need to be filled like the status, frequency of usage, units and the duration of that habit as mentioned in Fig. 5. This information-filled without the need of writing that information it is like the click and saves feature. Patient vaccination records in too important for doctors and the need for that medical record is increased during the pandemic. As shown in Fig. 8 in the HOPE system, all of the vaccine taken by every person is recorded and the doctors can access these data. The patient vaccination window shows the date of each vaccine with the name of that vaccine, it shows the number of the dose and if there is any reaction to that vaccine will be reported in the system. More information like date, nurse name and batch number is also shown in that window. It is too important when evaluating the patient is to know if he has any allergies. During the evaluation the question related to any allergies is reported in the system as presented in Fig. 5, this information includes

the source of the allergy, category, severity, incidence and if the allergy is still active or not. All of these questions are mentioned in the Fig. 4. During the treatment, the doctor might refer the patient to another doctor with a different specialty. The Fig. 5 epitomizes the page when the doctor requires the patient's referral, there are many specialties such as cardiac, diabetic, genetic, neurology, etc. It also mentioned the status with the severity of that case and the date of diagnosis with some information should be written about the treatment plan. If the patient has an appointment in the Out Patient Department (OPD), it's shown in a window Fig. 5. After all of the information is written during the evaluation, any doctor login into the system can see the summary written by other doctors during their evaluations like allergies, a procedure performed, or medication served Fig. 5. This window also presents the laboratory test taken for that patient and radiology images. This screen will summarize all the medical records and give easy access for the next doctor to see and evaluate. In the history screen Fig. 5, further details of the case will be shown with the name and department of that doctor. This information includes the complaints, subjective, objective and plans for that case. All assessments performed will be shown in that window. Up-to-date software is one of the software used by the physician to access the current database of clinical information. It addresses a specific type of clinical issue and gives the newest way of treatment. It is a helpful tool used commonly these days. HOPE system integrates Up-to-date software to it Fig. 5. This integration saves time for the physicians, instead of opening a new window to open that software, the HOPE developer easy the access method by this integration and saves the time.

When the patient performs an ECG test, the ECG record will be shown in the HOPE system with the date and time of that test Fig. 6. The data is transferred from MUSE system to HOPE system. MUSE Cardiology Information System is a database management system to view the cardiac data recorded. HOPE system is integrated with MUSE and gives the physicians direct access to these data. All ECG records can be viewed and printed with the feature added by the HOPE system.

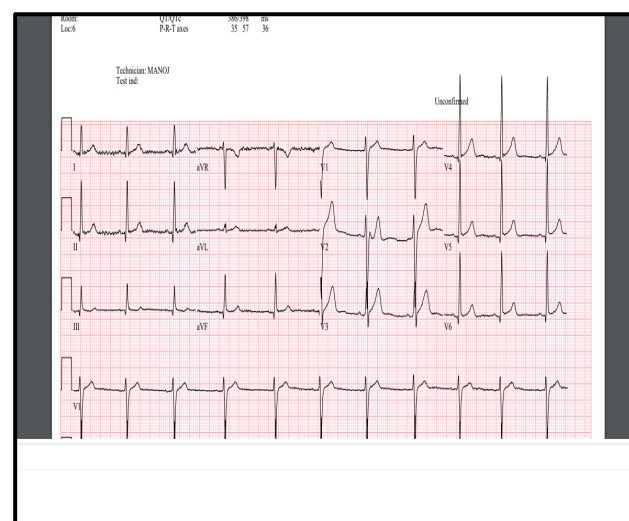


Fig. 6. ECG Report.

To reach the highest level of patient care delivery the HOPE system has an option for the doctors to see all the

medication written for that patient. The medicine name is mentioned, strength, duration, dose rate, unit, route, frequency, etc. All of this information gives the physicians better tools for better diagnoses.

III. RESULTS

The hospital modernized its operating environment using Oracle APEX by creating one large application that spans a suite of more than 40 modules. Application development speed increased 5X, from months to weeks, and even days. Not only is the hospital in a better situation with paperless, modern information systems that are integrated and accurate, but it also has saved at least 80% in costs, or more than \$27 million, during a 10-year budget period.

The cost savings are reinvested into innovation, with the goal of being the first and only hospital group to connect to National Electronic Medical Records (NEMR), National Healthcare Insurance Information System (NHIIS), Drug Utilization Review (DUR), plus a fully automated robotic pharmacy for outpatient and inpatient dispensation, as well as chemotherapy preparation. In response to the pandemic, it quickly developed testing and vaccination services and created telemedicine services to provide remote care.

The Oracle APEX app engine is also optimized for high performance at very low cost because it is included in Oracle Database licensing. Also, it is automatically integrated for less manual interaction and computing resources. The hospital app serves 5,000 users, including all physicians and staff. Even though the app handles 4 to 5 million hits per day and 8,000 to 10,000 sessions per day, Oracle's database runs at only 25% capacity on 2 CPUs and 64 GB of RAM on commodity server hardware, with peak reporting periods at 30%.

IV. CONCLUSION

After trying many other systems, we realized we had to build our own. Today, KHUH are very proud to have developed HOPE. It has shown that it is a robust, user-friendly system with proven excellence over the years. This development in healthcare system provides the healthcare providers the optimal way of delivering healthcare services. Implementing HOPE with all of those features contribute to achieving the hospital's goals for better health care technologies.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest or potential conflicts of interest.

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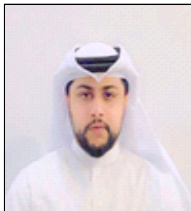
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