

Enhanced Quality of Electronic Clinical Record Through Open-Source Tool

Kashif Nisar¹, Saima Nisar², Abas B Md Said²,

¹Universiti Utara Malaysia, Malaysia, kashif@uum.edu.my

²Universiti Teknologi PETRONAS, Malaysia, saimaanisar@gmail.com

ABSTRACT

Electronic records are significant to control healthcare information and save patient lives to increase the value of service in healthcare. This paper is drawn from an ongoing, large-scale research project of implementing an Electronic Clinical Record (ECR). The overall aim in this study is to introduce a new tool for the ECR deeper understanding of the complexities and challenges emerging from the implementation of the ECR, and in particular, to study how to manage a gradual transition to a digital record. The aim is to enable the physician and patient to get access to the electronic clinical record. It will propose a new open-source tool to improve the clinical systems. The objective of this research is to ensure sufficient in-depth knowledge of the challenges confronting service delivery related to health, especially in the healthcare sector; and a grasp of how the underlying ICT infrastructure and an ECR might be expected to assist in meeting these challenges. Results of our study identified the need for more research in this particular area as no definitive solution to the long-term access to electronic clinical records was revealed. Additionally, the research findings highlighted the fact that a few medical institutions may actually be concerned about long-term access to electronic records.

Keywords: ECR, Digital Record, Technology

I INTRODUCTION

Information and Communication Technology (ICT) is observed as a possibility to manage with the rising healthcare needs. ICT has improved remarkable changes in the provision and management of intelligent healthcare services. Healthcare IT has received a lot of attention during past two decades (Li, et al., 2011; Eichelberg, 2005; Schper, et al., 2010). Noticeably, with present ICT also the communication between health professionals and patients can

now be done faster than ever, even real-time. ICT has been a motivating power in the transformation of the community services together with the healthcare sector (Sarlan, 2010). Meanwhile, one of the most commonly referred use of health IT is the electronic record storage and information sharing across providers. ICT has been acknowledged to be used and applied in various industries so as to get better an electronic business processes and boost consumer satisfaction (Ranta, 2010). An electronic record of health associated information that can be organized by authorized clinicians and staff across more than one healthcare institute (Maria, 2010). The electronic record is anticipated to allow enhanced consistency and reduced redundancy of information.

The main use of the electronic record is to present documented information of healthcare to be applied as a means of communication between healthcare managers contributing to the patient's care. Electronic record exchange between healthcares can save time and decrease cost by eliminating unnecessary records and typing errors. Clinical informatics is sciences that manage and use of information for enhanced healthcare. Moreover, healthcare is one of the fastest growing research areas of ICT. This information can also be understood by computerized Decision Support Systems, which can give alert and suggestion to healthcare managers (Bird, et al., 2003). The fast growth of the ICT has accelerated the originality of clinical information systems. (Dixon, et al., 1998; Dixon et al., 1999). This documentation provides a resource of communication between healthcare contributing to the patient's healthcare. The main beneficiaries are the patient and the healthcare(s) (Health informatics, 2004). Its major aim is to achieve safe, patient-centered, and evidence-based health care through deployment of Information Technology (IT). The benefits and importance of electronic information systems have been well recognized in the healthcare industry.

IT plays a great and primary function in organization, allocation and storage of data in healthcare. Interdisciplinary entrance to healthcare data is expected to raise the value and stability of care and treatment of patients (Ruland, 2001). Healthcare services are progressively becoming dividing and specialize with a demand for effectiveness; the introduction of the ECR has had a significant position for coordination (Ellingsen, and Munkvold, 2007). The ECR symbolize the key essential information and communication tool for healthcare experts. Figure 1 shows a process of healthcare experts involved in the treatment chain for the patients.

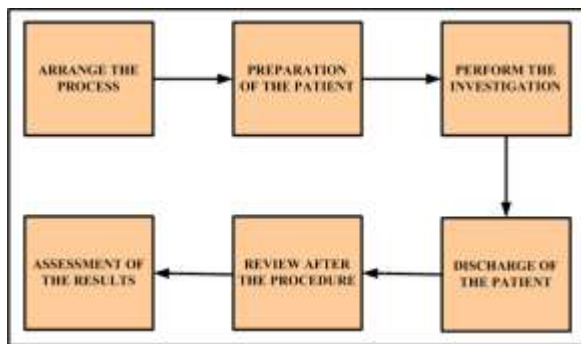


Figure 1. Process of healthcare treatment chain

An Electronic Clinical Record (ECR) is an electronic way for storing Clinical Information Systems (CISs). Most of the ECRs duplicate the formation that is used in the Paper-based Record (PR), and it accumulates all the information that is related to the treatment and nursing care of a patient. Among others, the record includes doctors' notes and nurses' notes concerning the ongoing treatment. Various studies have shown that the PR can not sufficiently maintain the work of patient care in a well-organized manner (Wigertz, 2001). The ECR includes both the CIS: such as diagnoses, allergies, and medicine and demographic information, such as: Personal Information (PI) for non-clinical use. It includes information that is used in various areas for different purposes. Doctors can, for instance, use the ECR for diagnostic and therapeutic decisions (Boulus, 2004). Many people have a preference to go to private clinics for early medical check-ups, cures and medication when they are not well. This could be because of some reason like the far distance from their home to hospital which makes it easier for them to go to nearby clinics for initial treatment; this is also

suitable since they can go to clinics anytime and there is less queuing.

The idea of computerized records that contain information as recorded was introduced in the 1960's and 1970's (Leonard, et al., 2002; Niclolson, 2008). An ECR is supposed to authorize essential development to the healthcare work practice (Collen, 1995). It is not our view to reveal all of them, but only to point out the significant ones. Substituting PRs with ECRs will significantly boost the process by which information is collected, organized, extended, and utilized. Until now, the several of the healthcare records were printed on paper and kept in a PR folder (Naing et al., 2008). The ECR personnel do not want to waste a long time in struggling to write down the PR in the entire clinic while it is continuously offered in the electronic format. The ECR opens up innovative possibilities while it permits various people to examine the same record concurrently from different computers, also to recover the most updated information.

A. Problem Statement

Patient record is considered as the main issue in healthcare system. An electronic record requires reduce clinical errors, more effective methods of communicating and sharing information among clinicians for better manage patient medical records. The use of electronic health record technology would eliminate many of these issues and lead to major improvements in the health and safety of patient care.

The Paper Based Record (PBR) system of healthcare is not good and has many weaknesses like maintaining separate applications is difficult and costly. Also, administration among clinicians is poor in the manual healthcare system, patients are being admitted unnecessarily for stays in the clinic, multiple tests are being ordered, and adverse drug reactions are happening because clinicians are not aware of the drugs prescribed. Since medical errors are a leading cause of death and paper records can be easily lost, misplaced, or are often illegible. Therefore, PBR cannot be guaranteed in the healthcare environment.

Electronic records manage well-documented and anticipated to allow enhanced consistency and reduced redundancy of information. Electronic

Clinical Record (ECR) can support higher quality, lower costs, and increased patient and clinical satisfaction. However, they are not specifically designed to manage clinical records electronically that may cause a problem.

B. Aim and Objectives

The aim of this research is to create a computer understand and retrieve important information from electronic healthcare records. The purpose of this research is to propose a new model that supports the Electronic Clinical Record (ECR). It will study essential related work to examine the available model outcome and drawbacks. It will propose new clinical model to improve the performance of the ECR. It will verify and validate and evaluate with related research. To improve the ECR it should be feasible to solve these problems.

In this research the specific objectives are as follows:

- To study to get a detailed understanding of the electronic healthcare record and do a detailed literature review.
- To propose a new open-source clinical model for ECR that will be able to fulfill the clinical requirements.
- To evaluate, validate and verify newly proposed clinical model with the existing healthcare models.

II RELATED WORK

Information and Communication Technology (ICT) has become the information resource of both selection and requirement and has thus motivated from the margin of healthcare. Quick advances in ICT with reduced costs, improved reliability and better robustness are enabling a new wave of transformation in how and where healthcare can be delivered. The healthcare industry progressively views Information Technology (IT) as a primary asset. The health-related information services are to control of increasing expenses and improving the value of health services. IT in a strategic and new manner to support health-related decision making represents a serious challenge for healthcare organization administration, and for system

developers. Consequently, clinicians should be equipped with and well-informed with the modern technology in providing fine quality services to meet a client's expectation (W. Raghupathi, and J. Tan, 2002).

Many researchers consider that the electronic record will considerably modify healthcare, rather than merely replace the Paper-based Record (PR). This alteration allows data to be used for a wide variety of purposes ranging from direct patient care, decision maintenance, and promise of quality, scientific research, and management of healthcare facilities (J. Van, W. Moorman, and A. Musen, 1990). In their review of the medical related work, the use of electronic medical records is linked with enhanced surrogate outpatient care outcomes (A. Jerant and D. Hill, 2000; S. Tee, 2011). This research will discuss the fundamental background of the related healthcare records. This research also identifies the importance of the healthcare records recorded by electronic methods. This proposal will also study a general discussion of related research work for healthcare real-time applications. There are a number of healthcare methods introduced to meet the above requirements. In the literature review, the manual and electronic healthcare records, advantages, disadvantages, and challenges are described.

A. Electronic Medical Record

Recently, healthcare records, knowledge based systems, and online resources have been built to way in data and maintain clinical decision making. All facilitate entrance to healthcare knowledge; every system is only reachable individually.

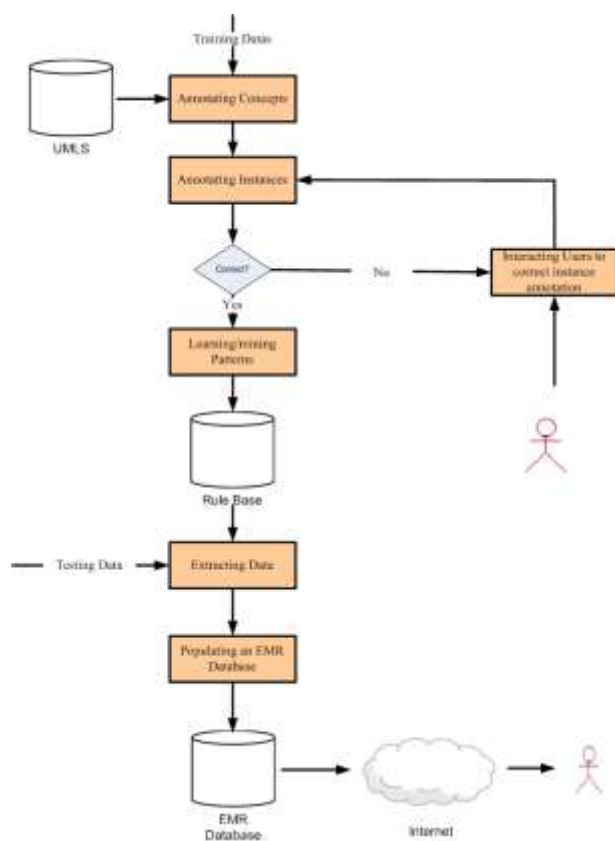


Figure 2. A standard model to produce EMR from clinical [24]

The meaning of Electronic Medical Record (EMR) is that it is an electronic record of health associated information on an individual that is created, collected, managed, and consulted by a certified medical officer and staff from a single organization who are involved in the individual's health and care. EMR system generally works as a request for recording of patients' lab findings, symptoms, drug dosing, and signs information. An EMR is a record regarding only the diagnosis or treatment and is mainly linked with a single health office (M. Hamidfar, 2008).

The drawbacks of the EMR are healthcare information not simple to maintain on daily bases. Details of the rules are generally short; so, doctors often do not properly understand the problems or readily agree to the solution easily. In addition, it cannot be said as complete in all phases because the EMR deals with information of a single patient.

B. Electronic Health Records

The Electronic Health Record (EHR) is a longitudinal electronic record of patient health

information created by one or more encounters in any care delivery condition (Han, et al., 2006). Included in this information are the patient's vital signs, problems, past medical history, demographics, progress notes, medications, laboratory data, immunizations, and radiology reports. The EHR has the aptitude to form a full record of a patient's encounter, as well as supporting other care-related activities directly or indirectly via an interface including evidence-based decision support, quality management, and outcome reporting (MITRE 2006; Kopper, et al., 2009; Mohd, et al., 2005).

The drawbacks of the EHR are with the complexity and the focus on big hospitals which are considered as a big commercial business. An EHR is actually multiple organizations within one. Many EHRs have multiple healthcare facilities, such as affiliated hospitals and numerous specialties, diagnostic and treatment centers, laboratories associated with training and research, and complex business operations to manage all of these complicated components. The EHR which has been a key study field in healthcare is defined as "Digitally stored healthcare information regarding an individual's life span with the reason of supporting stability of care, learning and investigating, and ensuring privacy at all times" (Eichelberg, et al., 2005). In the case of the EHR, it controls the latest data of the patient's health condition. Thus, it is more helpful in the treatment of the patient.

C. Remotely Healthcare Records

The purpose of this study is to produce a method to arrange existing and prospect technologies to remote locations. This research obtains to describe the standard for an arrangement in collaboration with Hastily Formed Networks (HFN) and find ideas of processes. The finding outcome of this work served as a service line for healthcare operations in remote locations where healthcare IT structure had small or no use in the previous period.

In this research, the healthcare records as a form of communication applied on Physicians intercommunicate concerning patients during their remarks in the healthcare record. An attending doctor can utilize the chart to check the earlier attending doctor's notes in order to overtake on the patient's condition. Medical staff can check their patients' charts at the start

of their shift to know if there have been some alter since their previous shift. It is understandable that the medical staff depend a lot on the healthcare record. The drawback of the research is that it is for healthcare operations in remote locations and very difficult to manage for long purpose.

III. RESEARCH METHODOLOGY

The views of the position of an Electronic Clinic Record (ECR) vary broadly with lots of the stakeholder groups focusing on the provider requirements for knowledge management and information sharing. Usually lost in this focal point is the viewpoint and requirements of the patient in managing their medical condition and care.

A. Design of the System

The design of this system includes system interfaces and Unified Modeling Language (UML) diagrams, the UML diagram involve use case diagram, activity diagram and sequence diagram. The interface and UML diagram below describes the overall design. See as below figure 3.

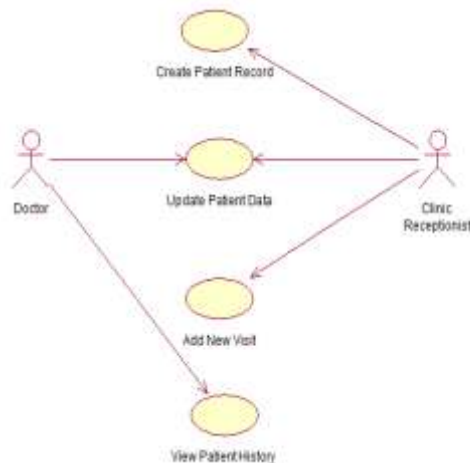


Figure3. Design of the System

The Electronic Clinical Record use case diagram show the doctor and clinical staff or receptionist as the actor in this system and the clinical staff are allow to register new patient, update the existing patient profile and add appointment or new visit of the patients. Doctor allow in this system to update the patient record and view the patient history.

C. Interface Design

This page is the patient profile page and use by the clinical staff, they can add new patient to the system and also update the existing one this form include all basic needed information about the patient as we can see in the figure 4.



Figure4. Interface design

B. Patient Chart Page

This page is used by the clinical staff to find a specified patient record by entering the Patient Name or No in the search box. See as below figure5.

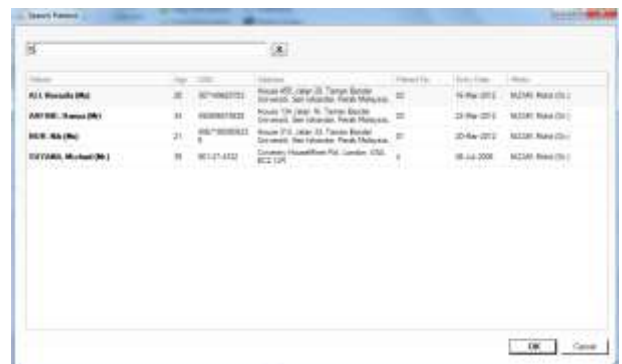


Figure5. Design of the Patient Chart

After that the system will connect to the database and collect all the information including clinical record as we can see in the figure in this form we can see that we have the summary of the patient, appointment date and time, patient list, medical activities, medical record, patient profile and billing

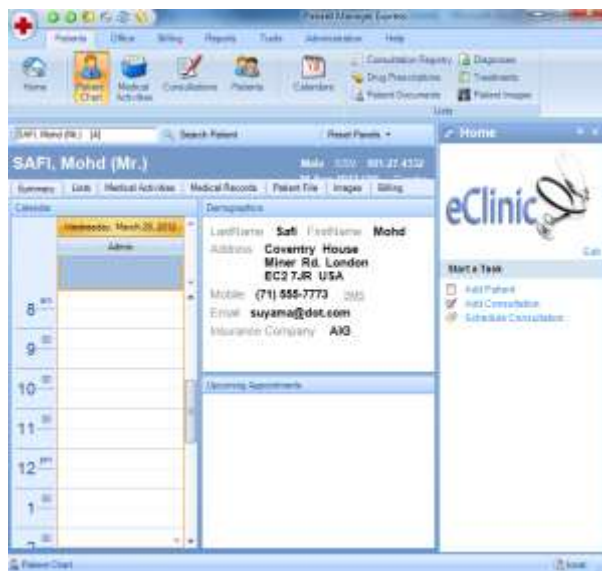


Figure6. Interface of eClinic

IV. CONCLUSION AND FINDINGS

The findings of this research are to propose a new tool that supports the Electronic Clinic Record (ECR) application. It will study essential related work to examine the available healthcare records, outcomes and drawbacks. It will propose a new open-source tool to improve the clinical systems. The objective of this research is to ensure sufficient in-depth knowledge of the challenges confronting service delivery related to health, especially in the healthcare sector; and a grasp of how the underlying ICT infrastructure and an ECR might be expected to assist in meeting these challenges.

REFERENCES

- Li, X., Xue, Y., and Malin, B. (2001). "Towards Understanding the Usage Pattern of Web-based Electronic Medical Record Systems", *World of Wireless, Mobile and Multimedia Networks (WoWMoM)*, 2011 IEEE International Symposium on a, Nashville, TN, USA, pp. 01-07.
- Eichelberg, M. (2005). "A survey and analysis of electronic healthcare record standards," *ACM Computing Surveys (CSUR)*, 37(4).
- Schper, L., and Pervan, (2010). G. "ICT and OTs: A model of information and communication technology acceptance and utilization by occupational therapists," *International Journal of Medical Informatics*, 76, pp. S212-S221.
- Sarlan, A., (2010). "Conceptual Clinic Information System Success Framework for SME Clinics in Malaysia," *International Symposium on Information Technology*, 3, pp. 1142-1146.
- Ranta, P., (2010). "Information and Communications Technology in Health Care," Department of Economics Aalto University School of Economics, Master Thesis, Finland.
- Maria, B., (2010). "Conceptual Health Information Technology in the Netherlands: Barriers to the adoption of Electronic Medical Records, a hospital approach," Master Thesis, Erasmus Universiteit Rotterdam, Netherland.
- Bird, L., Goodchild, A., and Tun, Z. (2003). "Experiences with a Two-Level Modelling Approach to Electronic Health Records", *Journal of Research and Practice in Information Technology*, 35(2), pp. 121-138.
- Dixon, M., Kohoutkov, J., Cook, S., Jeffery K., and Read, B. (1998). "Exchange Medical Records: The Hypermedata solution", *Journal of Informatics in Primary Care*, pp. 8-12, November 1998.
- Dixon, M., Cook, S., and Read, B. (1999). "Implications of WWW technologies for exchanging medical records", *Journal of Informatics in Primary Care*, pp. 2-9.
- Health informatics (2004). - Electronic health record Definition, scope, and context," ISO, Draft Technical Report ISO/DTR 20514.
- Helles, R., and Ruland, C. (2001). "Developing a module for nursing documentation integrated in electronic patient record", *Journal of Clinical Nursing*, Blackwell Publishing Limited, 10: pp. 799-805.
- Ellingsen, G., and Munkvold, G. (2007). "Infrastructural arrangements for integrated care: implementing an electronic nursing plan in a psychogeriatric ward", *International Journal of Integrated Care*- 7.
- Wigertz, B. (2001). "Computer-based Patient Records. In Yearbook of Medical Informatics," Stuttgart: Schattauer Verlagsgesellschaft mbH, pp. 259-261.
- Boulus, N. (2004). "Managing the Gradual Transition from Paper to Electronic Patient Record (EPR)," Cand Scient Thesis, Department of Informatics, University of Oslo, Oslo, Norway.
- Leonard, K. and Winkelman, W. (2002). "Developing electronic patient records: employing interactive methods to ensure patient involvement," *Proceedings of the 28th Meeting of the European Working Group on Operational Research Applied to Health Services (ORAHS)*, Toronto, Canada, pp. 241-255.
- Nicolson, B., (2008). "A Delphi Study Assessing Long-Term Access to Electronic Medical Records (EMR)," Master Thesis, Department of Systems and Engineering Management, Air University, Ohio, USA,
- Collen, M. (1995). "A History of Medical Informatics in the United States, 1950-1990," *American Medical Informatics Association*, Washington, D.C.USA, pp. 1-498.
- Naing, T., Zainuddin, Y., and Zailani, S. (2008). "Determinants of Information System Adoptions in Private Hospitals in Malaysia," 3rd International Conference on information and Communication Technologies: From Theory to Applications, Kuala Lumpur, Penang, Malaysia, pp. 1-2.
- Raghupathi, W., and Tan, J. (2002). "Health Care: Strategic IT Applications," *Communication of the ACM*, 45(12), pp. 56-61.
- Van, J., Moorman, W., and Musen, A. (1999). "Electronic patient records in medical practice: a multidisciplinary endeavour". *Methods Inf Med*, 38(4-5), pp. 287-288.
- Jerant A., and Hill, D. (2000). "Does the use of electronic medical records improve surrogate patient outcomes in outpatient settings?," *Journal of Family Practice*, 49, pp. 349-357.
- Tee, S. (2011). "Using Emergency Re-admission Time Window to Design the Re-admission Prediction Feature in Electronic Medical Record (EMR) Systems," *IEEE Symposium on Computers & Informatics, Cyberjaya, Malaysia*, 2(5), pp. 707-710.
- Hamidfar, M., (2008). "Adoption of Electronic Patient Records' by Iranian Hospitals' Staff," Department of Business Administration and Social Sciences, Division of Industrial Marketing and e-commerce, Master Thesis, Lulea University of Technology, Norway, pp. 1-117, 2008.
- Han, H., Choi, Y., Choi, Y., Zhou, X., and Brooks, A. (2006). "A Generic Framework: From Clinical Notes to Electronic Medical Records," *Proceedings of the 19th IEEE Symposium on Computer-Based Medical Systems (CBMS'06)*, pp. 1-6, 2006.
- MITRE. (2006). "Electronic Health Records Overview," National Institutes of Health National Center for Research Resources,

- MITRE, Centre for Enterprise Modernization McLean, Virginia, USA, pp. 1-30.
- Koppar, A., and Sridhar, V. (2009). "A Workflow Solution for Electronic Health Records to Improve Healthcare Delivery Efficiency in Rural India," International Conference on eHealth, Telemedicine, and Social Medicine, Karnataka, India, pp. 227-232.
- Mohd, H., and Mohamad, S. (2005). "Acceptance Model of Electronic Medical Record," Journal of Advancing Information and Management Studies, Malaysia, 2(1).
- Eichelberg, M., Aden, T., Riesmeier, J., Dogac, A. and Laleci, G. (2005). "A Survey and Analysis of Electronic Healthcare Record Standards," ACM Computing Surveys, 37(4), pp. 277-315.