Moroccan Electronic Health Record System

Houssam BENBRAHIM, Hanaâ HACHIMI and Aouatif AMINE

BOSS-Team, Systems Engineering Laboratory, National School of Applied Sciences, Ibn Tofail University, Kenitra, Morocco.
houssam.benbrahim@uit.ac.ma, hanaa.hachimi@univ-ibntofail.ac.ma and amine_aouatif@univ-ibntofail.ac.ma

Abstract

The subject of Big Data has been studied more and more in all areas, particularly in the health services sector. Big data technology can eventually change the medical practice by setting up very advanced tools to store, manage, analyze and secure the information collected at a very high level. The goal is to use this data from various sources to improve the management and effectiveness of care, also to monitor the health status of the population. In Morocco, the health field is one of the most important concerns of the government. Access to health data in Morocco is very limited, and in another side this sector encounters several problems in the digital management of these data. For all these reasons, we must think of creative and innovative solutions. Transforming clinical data into knowledge to improve patient care has been the goal of this article, for which we propose a new model called the Moroccan Electronic Health Record System. This last will be common between all health services in Morocco such as hospitals, clinics and medical offices. The system will be national and based on the context of Big Data in order to improve and develop the health sector in Morocco.

Keywords
Big Data, Healthcare, Moroccan Electronic Health Record System.

1. Introduction

Health systems are looking for effective ways to care for more patients in a shorter time, and to increase the quality of care through better coordination. Health organizations strive to improve the patient experience through rapid, accurate and non-invasive diagnostics. To reduce costs, they try to avoid unnecessary procedures and readmissions. The use of the Electronic Health Record (EHR) is critical to achieving these goals as well as the digital shift in hospitals, clinics, pharmacies, medical practices, etc. The EHR system is also important to the overall health economy in the areas of public health, health information exchange, and focused care management on the patient (Thurston, 2014).

Big Data represented as a set of technologies, that allow large-scale of information management, processing, and storage. The term applies to many fields, including telecommunication, finance, industry, public sector, marketing, and healthcare (Ross et al., 2014). The EHR system would be considered as a Big Data environment and we can make better exploitation of the data stored in this framework. Big Data platforms like Hadoop, Spark, Flink, and others, provide opportunities to analyze and process complex medical data in ways traditional relational techniques could not perform (Peters & Buntrock, 2014).

The aim of this work, is to propose the Moroccan Electronic Health Record System (MEHRS). This project is a suggest of a new national system of information technology in the health sector in Morocco, based on the Big Data approach. The MEHRS will help patients to consult their medical situations, doctors make a better analysis, and health stakeholders share the information collected by keeping the notion of anonymity profiles for patients. The deployment of the MEHRS will help the health sector to develop and improve all services associated with this area.

In this article, we start with a general overview of the EHR System. We continue with the information technologies in the health sector in Morocco. Next, we will define the MEHRS and explain the seven steps of deployment of this proposed solution. Finally, we outline a discussion and a conclusion of the paper.

2. Electronic Health Record System

2.1 What is an EHR?

According to the definition of the International Organization for Standardization (ISO) (ISO/TR 20514, 2005), the EHR is a repository of patient data in digital form. Its role is to store all patient information and share it securely between different authorized users. The EHR contain several information, including personal statistics like age and weight, medical history, laboratory test results, radiology images, progress notes, problems, medications, vital signs, immunizations, etc. (CMS, 2012). The primary purpose of the EHR is to support continuing, efficient and quality integrated health care. An EHR system includes data management tools to decision support, and analysis of aggregate information both for care management and for research. It has made available computer-based tools to help the user organize, interpret, and react to data. The EHR systems are created to store data accurately and to capture the state of a patient across time, in order to help doctors to analyze the medical situation of each patient and to take the right decisions (El-Sappagh & El-Masri, 2014).

2.2 What are the benefits of an EHR?

Researchers have explored the advantages of EHRs by considering clinical, organizational, and societal results. Clinical outcomes contain amelioration in the quality of care, a reduction of costs and time, and other improvements (Menachemi & Collum, 2011). The Table 1 shows the different benefits of EHRs.

Table 1. The benefits of EHRs

Advantage	Description
Quality	EHRs can potentially help improve the quality of care (Cebul et al., 2011). They are having the ability to organize patient health information and facilitate its instant distribution among all authorized users involved in a patient's care. EHRs can also improve prevention by providing doctors and patients with a complete access environment: test results, medical condition of patients, recommendations, and many other things (HealthIT, 2017).
Costs	The implementation of EHR system can reduce costs for doctors, hospitals, as well as for patients and their insurance companies (McDonald et al., 2014). This technology allows for more efficient patient visits, eliminates duplicate testing, facilitate documentation, organizes work and other possibilities that minimize costs within health organizations. Digital recordings and integrated communication methods can reduce costs of all health care stakeholders who use the EHRs (Menachemi & Collum, 2011).
Time	EHRs help to save time, the patient data are available in an instant when a health practitioner needs access to information stored in an EHR (Saleem, 2009). According to HealthIT.gov, three-quarters of providers who use EHRs say that allow them to receive lab results faster than before. A study from the Annals of Internal Medicine proved that since the adoption of EHR a relative decrease in time by 65% has been recorded (Chaudhry et al., 2006).

The EHR is designed to overcome many of limitations, as well as to provide additional benefits like giving patients more participation in their own care, provides for more accurate diagnoses and treatment, improves the coordination of patient care among providers, ease of communication, safer prescribing, meaningful use, etc.

2.3 Electronic Medical Record

Even those in the health experts who use the technology confuse between the Electronic Medical Record (EMR) and the EHR, but there is a difference. The EMR is a digital version of the traditional paper charts in hospitals, clinics or clinician offices and it is mostly used by providers for diagnosis and treatment (Makoul et al., 2001). EMRs offer a very limited view of the patient's medical history since they can not be digitally shared with outside providers and health systems. Its are designed to remain in the office for the patient visits. In fact, the patient's record might even have to be printed out and delivered by mail to specialists and other members of the care team. In this aspect, its limited capability is not so different from a paper-based system (Garets & Davis, 2006).

It can be said that it has a big difference between the EMR and the EHR, that the EMR remains very limited unlike the EHR, which represents a general view of the health system itself.

3. Information technology in the health sector in Morocco

3.2 Examples of successful initiatives

Achieving a competitive advantage in hospital services requires improving their quality systems by making better use of Information and Communication Technology (ICT) (Bouhouili et all., 2013). Morocco is also aware of the need for the Information Technology (IT) in the health sector, for this, several initiatives are launched to reform Hospital Information System (HIS). Table 2 lists the various initiatives adopted.

Table 2. Successful overview of the IT in Moroccan health sector

Initiative	Description
Establishment of a new HIS in University Hospital Center - Fez	This project was part of an integrated action between the Laboratory of Automation, Mechanics and Industrial and Human Computing of the University of Valenciennes, Superior School of Technology and the laboratory of Epidemiology of Sidi Mohamed Ben Abdallah University of Fez, and in partnership with Hassan II University Hospital of Fez. The project was over four years, its first year (2005) was dedicated to the training and qualification of the Moroccan team in the field of the HIS. The second year was devoted to the elaboration of a project implementation protocol detailing the different steps to follow, setting up the project group, setting objectives, etc. The last two years have been for the computerization of hospital management procedures (Berraho et al., 2006).
The HIS of Sheikh Zaid Hospital - Rabat	Implementation of an international standard in the form of a new integrated solution (Sivsa / Hosix), replacing economic and financial management system and computerized maintenance management system. Even though he appears to be efficient, this project presents a risk related to the high cost and cultural divergence between the treated sectors. Indeed, Sheikh Zaid Hospital opted for an integrated solution based on the "patient medical record" as basic information support (Makhloufi et al., 2009).

The Royal Armed Forces Health Service of Morocco chooses the MEDASYS-DXCARE solution	In 2014, the Moroccan Royal Armed Forces Health Service selected Medasys solutions to renovate its HIS. The entire Medasys range will be deployed and will allow healthcare professionals to have a unified, communicating and secure health information system. The project was conducted in several phases, the first three of which were focused on the implementation of the complete HIS of the Military Teaching Hospital Mohamed V. The amount of the contract for the first phase amounts to 1 million euro, excluding maintenance (MEDASYS, 2014).
Creation of a new IS for maxillofacial and aesthetic surgery in Mohammed V University Hospital - Marrakech	The objective of this work was to develop a new Information System for the management of the medical records in maxillofacial cosmetic surgery and stomatology. The result is the creation of a medical record database, which allows for quick cross-referencing of cases, calculation of statistics, and archiving of patient 's photographs (Karimi, 2015).

According to what has been quoted, several interesting initiatives are adopted and implemented in multiple health organizations in Morocco. But all these contributions are very modest and limited compared to the needs for the development of a national EHR system in Morocco.

3.2 Constraints

The health sector in Morocco suffers from multiple problems. The implementation of a national EHR system and the deployment of Big Data technologies and tools in this area, will certainly help to solve the majority of its constraints and enhance its achievements. We can mention that:

- The various business processes and support of medical organizations in Morocco are currently managed manually, which causes losses and leaks of a large number of medical and organizational information very important and very sensitive, unnecessary redundancy of data and a complexity of analysis (Bouhriz, 2015).
- The strategy of the Ministry of Health in Morocco devotes a very large part of the budget for the improvement of the health sector, by investing more in human resources and medical devices than in new information technologies (Ministry of Health (Morocco), 2012).
- In the report of Country profiles based on the findings of the 2015 global survey by the Word Health Organization (WHO) global observatory for eHealth – the use of eHealth in support of universal health coverage, mentioned that the National EHR system in Morocco is not applicable, as well as the use of big data in the health sector not applicable (World Health Organization (WHO), 2016).
- Morocco is ranked 76 in the 2015 open data index, with a percentage of 26% open. Open data is the final stage of an information production chain, where governments measure and collect data, process and share data internally, and publish this data openly (Open Knowledge, 2015).

Morocco must give great importance to new information technologies in the health sector. In order to improve this field, the Ministry of Health is obliged to implement Big Data technologies, since these will allow a greater use of medical data produced in large volumes daily, so they support a more flexible exchange between different medical actors.

4. The proposed solution

4.1 What is MEHRS?

Moroccan Electronic Health Record System is a proposal of a new national system for health in Morocco, it will be considered as an advanced module to store, manage, analyze and improve the health of the population, and will be founded on a powerful technology of Big Data. We propose to create a common system between all hospitals, clinics, medical practices, laboratories, etc., in order to have a single platform that brings together the medical situation of patients, their medical histories such as that the medical prescriptions, the images, the results of their medical analyzes, comments, notes, proposals, etc., also, this platform will collect all administrative information. This new work environment will be shared and connected with multiple entities in the field of health, in order to exploit the data and extract useful information that help the development of the health sector in Morocco.

4.2 The 7 steps of deploying the MEHRS

Based on the researches that has been done, to achieve this goal and deploy the new MEHR system, we must follow seven steps, which are:

- **Step 1: national dialogue on the health data**
  We propose that the Moroccan Ministry of Health will organize a national dialogue on health data to exchange opinions between the different health organizations and various workers in this field. The purpose of this dialogue will be to create a national debate on the health data, to sensitize the different national actors of the great importance of health data, even the paramount need to computerize this information, going out with recommendations, establishing a plan of action, and to give all the public a general idea of the MEHR system.

- **Step 2: creation of the law**
  The need for a regulation guide that manage the use of health data. Morocco really needs a law of health data to protect patients' personal information, to frame the method of exploration of these collected data, and define the organizations who can benefit from this opportunity.

- **Step 3: using Big Data**
  The new Big Data technologies help to better store, manage, analyze and exploit data building on a powerful platforms like Hadoop, Spark, Yarn, Pig, Hive, etc. We want to implement the advanced techniques of Big Data in the health sector in Morocco. With this opportunity this field will be developed and improved.

- **Step 4: creation of the system**
  The creation of our work environment MEHR system will be based, firstly, on the results of the national discourse on the health already proposed, in order to establish a well detailed specification, as well on the implementation of the big data technologies to build a powerful and high system. Also, our system must be used according to the new laws on the health data that will be ratified by the Moroccan government. This system must be created by IT experts, especially Big Data, health professionals, and under supervision by rights specialists from the Ministry of Health.

- **Step 5: implementation of the MEHR system**
  After the creation of our system and validation tests, MEHR system must be installed in all Moroccan private or public hospitals, clinics, medical offices, pharmacies, analysis laboratories, etc. This strategy should guarantee better information sharing among all health actors in Morocco, an effective health care environment, and an increasing development of the health sector at all levels. In parallel to better manage the medical situation of patients we propose to create a Medical Identity Card (MID) for each Moroccan citizen. This action is going to be on the responsibility of the Ministry of Health, and contains the following information: personal photo, a number of the MID, full name, date of birth, gender, blood type, expiring date and a barcode that identifies the card. The figure 1 represents an example of the proposed medical identity card.

Figure 1. The proposed Medical Identity Card

- **Step 6: training and qualification of work teams**
  This step is very important, the training and qualification of cadres and all health teams work who can use the MEHR system. These trainings will facilitate the use of this system, and will help health professionals to exploit all the functionality of the MEHR system as much as possible.

- **Step 7: improvement of the system**
  Any system must be developed to achieve the goals and exceed the constraints of the work environment. In order to ensure a reliable, powerful and efficient system we must guarantee a periodic maintenance and permanent improvement.

Our proposed environment MEHR system is a national project that must be framed, funded, and adopted by the Moroccan government, and more specifically by the Ministry of Health. The success of this work is conditioned by the union of all the actors of health in Morocco. The implementation of this new framework will help the health sector in our kingdom to develop in all areas and to have a successful medical environment.

5. Discussion

Many countries around the world place a premium on the development of IT in the healthcare sector, they are invested great deal of resources and time in the implementation of EHRs. In fact, there is a remarkable collaboration among countries in the field of electronic health technology to share ideas, approaches and apply new validated methods. The goal of this approach is to develop EHR templates that help to reduce costs, time, and improve the quality of health in all areas, and bringing patients to the center of this technology initiative (Stone, 2014). The various countries that have deployed EHR system in their health sector, among them we find: Australia, Canada, Estonia, Denmark, Finland, Sweden, United Arab Emirates, England, United States of America, etc. (Soliant, 2012). We want to detail two examples between them:

- **Estonia:** in December 2008, Estonia became the first country in the world to implement a national health information exchange and reference platform, named "birth-to-death" or Estonian Electronic Health Record System for nearly every citizen. First time, the Estonian system was about the resilience of Social Affairs until the creation of the Estonian Foundation for Health Online. Ninety-five percent of health data have been digitized since this system was implemented. Citizens who participate in the program receive an individual card that is used to access their records, such as a national ID (Aaviksoo et all., 2010).

- **Australia**: in July 2012, Australia was initially deployed the Personally Controlled Electronic Health Record (PCEHR) which is dedicated to all Australian citizens. The territorial, state, and federal

governments have given to this national initiative a paramount importance, and this project was the latest in a series of Australian government initiatives in health care IT. With the PCEHR, patients have the ability to post information stored on all information systems of their different health care providers (Morrison et all., 2011). Recently, the Commonwealth Department of Health has announced that the name of the PCEHR has changed to My Health Record.

Currently, the Kingdom of Morocco does not have a National Health Information System. All Countries that have deployed the EHR system was achieved remarkable, important, positive and satisfying results. Moroccan Electronic Health Record System is the proposal of a new dedicated national system for the health sector that will solve the problems accumulated in this field. The MEHR system will be based on the very advanced technologies of Big Data that will help health sector in Morocco to achieve concrete results in a short time.

6. Conclusion

To conclude, the Moroccan Electronic Health Record System article is a new proposed national system for the health sector in Morocco. This project will be developed on the power of Big Data technologies, using well-defined and well-chosen storage, management, and analysis tools and platforms. The goal is to create a common platform for all providers, pharmacies, hospitals, clinics, doctors, etc., to share patient information, maintain medical traceability of health services, ensure effective analysis, and more things. The Moroccan patient should be placed at the center of this national system and their medical data must be secured, controlled and supervised. In order to deploy this system in Morocco, several steps have been proposed, and the most important point is to sensitize Moroccan citizens for encouraging them to participate in the collection of personal medical information. The MEHR system is a platform which will facilitate the analysis of patient data, help improve the quality of health services, and provide a powerful work environment.

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Houssam BENBRAHIM is a Ph.D. student in Computer Engineering, affiliated to the Systems Engineering Laboratory in the National School of Applied Sciences (ENSA), Ibn Tofail University, Kenitra, Morocco. He received his Master's degree in Computer Engineering: Networks and Systems from the Faculty of Sciences and Techniques of Tangier, Abdelmalek Essaadi University. He is currently working in the field of Big Data in the healthcare with the BOSS team: Big Data, Optimization, Service, and Security.

Prof. Hanaâ Hachimi, Ph.D. in Applied Mathematics and Computer Science and a Ph.D. in Mechanics and Systems Reliability. She is a professor and researcher in the ENSA of Kenitra, Ibn Tofail University. She is affiliated with the Systems Engineering Laboratory since October 2013, precisely with the BOSS team. She is responsible and coordinator of the courses: Operational Research, Graph Theory, Statistics, and Probability.

Prof. Aouatif AMINE has been an associate professor in the Ibn Tofail University - Kenitra, Morocco, since 2014. In July 2010, she joined the ENSA of Kenitra. Ex Vice President of IEEE SPS Morocco Chapter, Secretary General of the Moroccan Association for the Development of Electronics, Electrical Engineering, Computer Science and Automation (AMADEIA). Her areas of research include: data classification, object tracking, road safety for intelligent vehicles and pattern recognition.