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Tracking the Implementation of Electronic Medical Records in Dubai, United Arab Emirates, Using an Adoption Benchmarking Tool

Osama El-Hassan [a], Amer Sharif [b], Mohammad Al Redha [a], Iain Blair [c]

a Health Data and Information Analysis Department, Dubai Health Authority, PO Box: 4545 Dubai, UAE
b Education Department, Dubai Healthcare City, PO Box 66566 Dubai, United Arab Emirates
c Institute of Public Health, College of Medicine and Health Sciences, United Arab Emirates University, PO Box 17666, Al Ain, United Arab Emirates

Abstract

In the United Arab Emirates (UAE), health services have developed greatly in the past 40 years. To ensure they continue to meet the needs of the population, innovation and change are required including investment in a strong e-Health infrastructure with a single transferrable electronic patient record. In this paper, using the Emirate of Dubai as a case study, we report on the Middle East Electronic Medical Record Adoption Model (EMRAM). Between 2011-2016, the number of participating hospitals has increased from 23 to 33. Currently, while 20/33 of hospitals are at Stage 2 or less, 10/33 have reached Stage 5. Also Dubai's median EMRAM score in 2016 (2.5) was higher than the scores reported from Australia (2.2), New Zealand (2.3), Malaysia (0.06), the Philippines ((0.06) and Thailand (0.5). EMRAM has allowed the tracking of the progress being made by healthcare facilities in Dubai towards upgrading their information technology infrastructure and the introduction of electronic medical records.

Keywords:

Electronic Health Records, Health Services, Benchmarking

Introduction

A feature of health systems throughout the world over the past 20 years has been the increased use and reliance on Information and Communications Technology (ICT). Also called Health Information Technology (HIT) or eHealth, these developments are being pursued because of their potential to transform the delivery of health care by making it safer, more effective, and more efficient.

The application of ICT in health can be seen in various forms but one of the most recognizable is the Electronic Medical Record (EMR) or Electronic Health Record (EHR). Generally the EMR comprises a hardware and software platform that supports a dataset on each patient and which allows tests and treatments to be ordered and progress to be documented. More complex systems will support clinical decisionmaking and will allow information to be shared and reported. The EMR is a key part of a health information system (HIS) along with other sub-systems such as human resources and finance [1].

Often the terms EMR and EHR are used interchangeably but there are important differences. The EMR is an organization-centric system that manages patient medical records from different sources that are used during a patient's care (diagnosis, treatment, lab tests, imaging, medication) while an EHR system is "inter-organization", connecting several EMRs for the purpose of sharing information among the owners of those EMRs [2].

The goal of the EMR is a clinical environment that is paper-free. EMR systems are found at all levels from primary to continuing care and in all specialties. They vary in size and complexity from those serving a single doctor's office to systems involving groups of hospitals, clinics and other service providers. EMR systems have been extensively researched and a number of different research themes have emerged.

The installation of an EMR system is usually an expensive investment and early researchers focused on the net benefits in terms of cost saving and improved outcomes. In one tertiary hospital in a low-income country, EMR reduced length of stay, transcription times and laboratory costs resulting in a net benefit over five years of US$ 613,681 [3]. In the United States (US), in an outpatient setting the introduction of EMR was estimated to have resulted in reductions in spending and increases in revenue of more than US$ 952,000 compared with the year before implementation [4]. Also in the US, in a primary care setting, the net benefits from using EMR over a 5-year period was US$ 86,400 for each provider due to savings in drug expenditures, better use of radiology tests, better capture of charges and decreased billing errors [5]. Implementing an EMR system at a general hospital in China produced a net benefit over a six-year period of US$ 559,025 from a reduction in staff engaged in the creation of new patient records, fewer adverse drug events and dose errors, improved charge capture and decreased billing errors [6]. With respect to improved outcomes, a randomized clinical trial of an EMR-based clinical decision support system for diabetes showed that patients in the intervention group had significantly better diabetes control with increases in lifetime quality-adjusted life years (QALY) at a cost of US$ 3,017 per QALY [7]. In a US trauma center, EMR increased attending surgeons' involvement in patient care, leading to increases in revenue and a reduction in hospital mortality [8]. Research has also focused on the implementation of EMR systems as this can be problematic. The successful implementation of an EMR system in a large Swedish teaching hospital was dependent on factors relating to the system of choice, clinician involvement, a realistic timetable and a willingness to change [9].

As the literature on the net benefits of EMR has accumulated, a number of systematic reviews have been published. The conclusions of these reviews have been mixed. One review found that while EMR may improve user and patient satisfaction, their impact on patient outcomes and quality of care was inconclusive [10]. A landmark report following an extensive review of the published literature on the benefits and

costs of EMR concluded that, while in individual pilot sites there was clear evidence that health care had been made safer, more effective and more efficient, the findings were not generalizable to other settings [11]. In particular there was a lack of knowledge about what specific systems and implementation methods should be adopted. Much of the positive evidence came from bespoke systems developed at academic medical centers or in very large health systems [12].

In many countries and in the US in particular the implementation of EMR is seen as a solution for the increasing costs of health care and as such has become a strategic goal [13]. In the US, the 2009 Health Information Technology for Economic and Clinical Health (HITECH) Act allows for incentive payments to increase adoption of EMR systems [14]. To qualify for these payments physicians must have "certified" or approved EMR systems and must be using them in a specially defined way, known as "meaningful use", which includes at a minimum e-prescribing and electronic exchange of health information to improve quality. This requirement has led to considerable new research efforts to assess the proportion of providers that are achieving meaningful use and the characteristics of those that have done so [15]. Annual surveys are carried out and EMR adoption rates are published as performance indicators. Commercial and non-profit agencies have been established to which subscribers can report their progress on EMR implementation and thereby benchmark their performance against their peers and competitors. One such program is the EMR Adoption Model^{SM} (EMRAM) offered by HIMSS Analytics® [16]. The EMRAM is an eight-step process that allows providers to track their level of EMR adoption and make comparisons with other healthcare organizations. Originating in the US, EMRAM is now established in many other countries around the world.

The United Arab Emirates (UAE) is a federation of seven emirates and since its foundation in 1971 it has undergone rapid development and modernization. Mainly due to large net immigration of expatriates, over the last 10 years the population has more than doubled and in 2015 was estimated to be 9.2 million [17]. During the same period, the average life expectancy improved from 72 years to 77 years [18]. The UAE also performs very well on other international indicators for development and health [19].

Abu Dhabi, the capital of UAE, has its own health system while in the northern Emirates of Ajman, Fujairah, Ras Al Khaimah, Sharjah, and Umm Al-Quwain the Federal Ministry of Health retains a major role in the provision and regulation of health services in addition to its strategic UAE-wide role. The focus of this paper is on the Emirate of Dubai, which in 2015 had a population of 2.4 million and a modern infrastructure including excellent health services [20, 21].

Dubai Health and Medical Services (DOHMS) was established in 1970 as a local health authority and service provider. DOHMS continued to be the main local health authority in Dubai even after the formation of the federal Ministry of Health (MoH). In 2007, the Dubai Health Authority (DHA) was formed to oversee health strategy and regulation when it was separated from health service provision. Private health insurance is becoming the preferred funding source, although the Dubai government is still an important provider of services.

The DHA strategy is to develop efficient, high quality and accessible healthcare services for its population, and to achieve this it focuses on three critical areas: care delivery redesign, payment incentives and patient engagement. It does this in partnership with regulators, payers, providers and consumers, and the need to connect these health system players together means that ICT and the management of medical information will play a key part in the delivery of the strategy [22, 23]. The potential of timely and accurate health information to improve population and individual health is clear [24]. However, the fragmentation of health information systems in the UAE is a challenge and leaders and decision-makers in the healthcare field often lack appreciation of the benefits of timely and accurate data [25]. Like many other countries Dubai has therefore developed an eHealth strategic plan to accommodate the changing role of ICT in improving health system performance and overcoming the current challenges. The Health Data and Information Analysis Department (HDIAD) is a directorate of DHA which focuses on both operational and strategic aspects of eHealth. In addition to providing decision makers in DHA and other government departments with health data for health system management, it also leads in the development and implementation of the strategic eHealth plan for Dubai. The purpose of this paper is to review how far healthcare organizations in Dubai have progressed in their automation journey from paper-based to paper-less health records management and the adoption of the Electronic Medical Record.

Methods

In this study we make use of data from the *Middle East EMR Adoption Model* (EMRAM), a self-reported survey tool that has been developed in a partnership between HDIAD and HIMSS Analytics, a global health IT organization [26]. Participants, comprising public and private hospitals in Dubai, submit their data by means of the EMRAM web-based tool and are then ranked at one of eight stages which cover the spectrum of EHR implementation from stage zero (a paper-based environment) to stage seven (an environemnt that is paper-free). Participants are also given an overall *EMRAM Score* which combines the current stage with credit for partially achieving higher stage applications. The requirements of each stage are shown in Table 1. HIMSS and HDIAD teams are responsible for setting up the EMRAM cycle or data collection round. They also follow up with participants to make sure that they complete the survey on time and to the required standards. The teams also conduct validation procedures to ensure the eligibility of participants who are ranked at stage five or above; these include site visits and telephone contact with chief information officers (CIO). Occasionally contact is required with software vendors involved in establishing or upgrading participants' EMR systems. Data collection rounds have taken place in 2011, 2012, 2013, and 2014, 2015 and 2016 (quarter 2).

Results

All public and private hospitals in Dubai are required to participate so the response rate is 100% for each data collection round. During the five-year period 2011-2016 the number of participating hospitals has increased from 23 to 33 (because new facilities have opened). In 2011, 21/23 (90%) hospitals were at Stage 2 or less and no hospitals were at Stage 5. Currently (2016, quarter 2), while 20/33 (60%) of hospitals are at Stage 2 or less, 10/33 (30%) have reached Stage 5 (Table 1). Between 2011 and 2016 the median EMRAM score increased from 1.2 to 2.6 and the proportion of hospitals achieving at least Stage 2 increased from 40% to 91%. This is important because Stage 2 is the minimum EMRAM stage required by Dubai Health Authority before a hospital can be considered for feasible integration with the Emirate-wide health data exchange platform. One hospital in Dubai has now achieved an EMRAM

Table 1. Stages of the EMR Adoption Model, number of Dubai hospitals achieving each stage, 2011-2016

Stage	Cumulative Capabilities	2011	2012	2013	2014	2015	2016
Stage 7	Complete Electronic Medical Record; Continuity of Care Document transactions to share data; Data warehousing; Data continuity with Emergency Department , ambulatory care and Out-patient departments	0	0	0	0	0	0
Stage 6	Physician documentation (structured templates), full Clinical Decision Support System (variance & compliance), closed loop medication administration	0	0	0	0	0	0
Stage 5	Full complement of Radiology-Picture Archiving and Communication System displaces all film-based images	0	2	6	6	10	10
Stage 4	Computer Practitioner Order Entry, Clinical Decision Support (clinical protocols)	1	2	1	1	1	1
Stage 3	Nursing / clinical documentation (flow sheets), Clinical Decision Support System (error checking), Picture Archiving and Communication System available outside Radiology	1	1	2	1	1	1
Stage 2	Clinical Data Repository, Controlled Medical Vocabulary, Clinical Decision Support , may have Document Imaging; health information exchange capable	7	10	10	12	12	17
Stage 1	Ancillaries - Lab, Rad, Pharmacy - All Installed	9	9	8	6	6	1
Stage 0	All Three Ancillaries Not Installed	5	3	1	3	2	2
	No. of participating hospitals	23	27	28	29	32	33

Source: HIMSS Analytics [23]

Score of 6.0 and has been nominated for Stage 6. Ratification of this status is awaited.

Discussion

The ultimate purpose of tracking EMR adoption among public and private sector healthcare providers is to effectively support the implementation of e-health capability. The results of Dubai EMRAM has shown that a substantial number of hospitals in the Emirate are making good progress with their automation journey. This could highlight the educational value of EMRAM in raising awareness of EMR implementation and fostering support for e-health capacity building.

The EMRAM staged methodology along with the survey results have allowed DHA to devise an evidence-based dissemination plan for the Health Information Exchange (HIE) platform. Based on the current EMRAM situation and the measured progress, DHA has set Stage 2 as the minimum requirement for healthcare facilities who wish to join HIE. Additionally, DHA has outlined a plan to leverage all facilities to stage 6 and to be able to effectively engage with the fully-fledged HIE platform which will be completed by the end of 2016. By that time, all patients in Dubai will enjoy continuity of care no matter which facility they visit.

It is notable that 30% of Dubai hospitals have reached Stage 5 but only one (having attained an EMRAM score of six) has been nominated for Stage 6. Stage 6 is among the most difficult to achieve because of the technical requirements for closed loop medication administration. Also, the stages above stage 5 have the highest impact on clinicians' workload and so require very careful implementation to ensure patient care is not disrupted. These are also the stages that have the greatest potential for return on investment, so for Dubai hospitals, as they contemplate the move to Stage 6, the future will be both challenging and rewarding.

The EMRAM surveys have the potential to improve the relationship between chief information officers (CIO) and chief executive officers (CEO). In our opinion there are three reasons for this improvement: CIOs become able to clearly communicate the hospital automation situation with international and local benchmarks; both parties receive expert third-party feedback and assistance (from HIMSS Analytics) on how to improve their automation using tools such as gap analysis; and finally CEOs are able to exploit their hospitals' automation achievement in promoting services and winning market share.

In addition to tracking EMR implementation, EMRAM data has also allowed the benchmarking of Dubai hospitals against those in other countries with comparable health systems that participate in the HIMSS scheme. Dubai's median EMRAM score in 2016 (2.5) was higher than the scores reported from Australia (2.2), New Zealand (2.3), Malaysia (0.06), the Philippines (0.06) and Thailand (0.5). When using the "proportion of hospitals at each EMRAM stage" as the comparator, Dubai's performance is similar to that of Spain and Italy but exceeds Germany's. Compared to neighbor Saudi Arabia, the mean EMRAM score is similar but Dubai has a greater proportion of hospitals at Stage 5, albeit a smaller proportion at Stage 3.

There are limitations to the use of EMRAM. Firstly, EMRAM surveys do not report the expected improvements in achieved clinical outcomes within participating facilities which could follow the technological advances that are being made. Secondly, the self-reported approach is open to error unless validation procedures are carried out. These are resource intensive. Finally, from the eHealth planning point of view, questions seeking information about EMR integration capabilities within the survey are limited. To combat this, DHA uses a supplementary set of data collection to bridge this information gap.

Conclusion

Conducting EMRAM surveys within an active social network that comprises CIOs of Dubai's public and private hospitals has created a healthy environment for engagement between leading healthcare providers and the main healthcare regulator in the

Emirate, namely DHA. DHA has set standards for eHealth capacity, which hospitals are increasingly achieving. The goal is that all hospitals will have the capacity to join the Dubai Health Information Exchange so that health information will be shared between health providers to improve continuity of care, clinical outcomes and the patient experience.

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Address for correspondence

Iain Blair (iain_blair@uaeu.ac.ae)