



A Multiple Comparison Between Military Hospitals and Civilian Hospitals with a Look on the Maturity Situation of Hospital Information Systems in Iran

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Abstract

Background: Today, there are different benchmarks created to evaluate the maturity of hospital information systems, however, until very recently, there was no reference framework or model to evaluate these system. In the end, a universally famous model called the electronic medical record adoption model appeared as a cornerstone to assess the maturity rate of hospital information system applications in hospitals. However, many developing countries and even some developed nations have not yet been able to present it in countries around the globe.

Objectives: The purpose of this study was to assess and compare the maturity of military and civilian (governmental and private) hospitals with regards to electronic medical record adoption model in Isfahan and Tehran provinces of Iran.

Methods: This research was a descriptive analytical study to evaluate 2 military, 5 governmental, and 3 private hospitals in the provinces of Isfahan and Tehran in 2016. The selection method was simple random sampling for military hospitals and stratified sampling for civilian hospitals. The measurement tool was electronic medical record adoption model checklist.

Results: The findings showed that 100% of military and civilian hospitals reached the 1st stage requirements of EMRAM. However, 50% of all military hospitals, 60% of governmental and 66% of private hospitals have overcome the 2nd stage of HIS maturity. Consequently, these hospitals have the least suitable conditions and stages. However, the military hospitals' maturity was clearly diverse. Moreover, private hospitals showed more obvious immaturity of HISs than military and governmental hospitals. Also, the maturity of military and governmental hospitals was roughly similar.

Conclusions: By comparing the Iranian military and civilian hospitals, it was found that maturity of HISs was rather same. The HISs did not apply full potential benefits of HIS and were put up to the third stage of EMRAM in these hospitals. However, the governmental hospital was still standing against it. Eventually, there was no strategy to develop a HIS plan in these hospitals. However, more research is needed to investigate the military hospitals in Iran due to the fact that 2 different types of military along with police health care systems are operating in Iran.

Keywords: Information System, Military Hospital, Electronic Medical Records, private hospital, Iran

1. Background

Today, hospital information systems (HIS) are assisting hospital managers to overcome their extensive problems in different manners (1-4). E-health utilization importance in hospitals is highlighted when the complexity of health care environment accompanied by different characteristics of operation on each patient, causes a variety of mistakes in such environments (5). For instance, regarding the latest researches in this space in Iran, 19.5 per nurse per 3 months is the average mistakes of drug prescription by nurses that is greater than similar cases (6). Then again, the lack of a reference standard (7, 8), HIS implementation costs (7, 9), teaching costs (10) etc. has caused the health system to have the least developed e-technology compared with other e-technologies like e-banking, e-auction, e-learning and so on (11, 12). However, the application of different types of e-health tools in hospitals is vastly increasing (13) and many medical and non-medical experts have become keen to apply this new tech-

nology due to the mentioned advantages of e-Health (14, 15). For example, 46% of American hospitals, which are applying IT, are positioned at middle and/or high level of IT utilization within their hospitals (15).

However, different models and frameworks have been proposed to determine the advantages and disadvantages of HISs in health care organizations, particularly hospitals. Therefore, the healthcare information and management systems society (HIMSS) has focused on worldwide optimization of the operation of IT and HISs in hospitals, and has proposed an HIS maturity assessment model for HISs in hospitals. Electronic medical record adoption model (EMRAM) is a mutual model (16) and was applied in this research as the main conceptual framework.

In order to evaluate HIS capabilities and requirements, EMRAM ranks hospitals at different stages (17-19). This model is now being used all over the world (15). This model analyzes HIS capabilities in hospitals (20). Today, over 5800 hospitals around the world have applied this model (21, 22).

Nevertheless, only a limited number of hospitals in North America and Europe have reached the 7th stage (16).

In Iran, this model has been applied to both governmental and private hospitals (23-25). Regarding these results, civilian hospitals are ranked at different maturity levels starting from first to second level of EMRAM expectations. This model has also been applied to military hospitals (26) yet a comparison between these results was a matter of concern and could uncover interesting results, which has been presented here.

Notwithstanding these aptitudes, this reference model is still unknown around the world. Consequently, in this research, firstly EMRAM was introduced. The methodology of this research was then described. Next, the HIS maturity of selected military and civilian (private and governmental) hospitals in Iran was assessed.

2. Objectives

This study was designed to compare the operational HISs in military hospitals and civilian hospitals and to provide suggestions to enhance their HIS capabilities in the future.

3. Methods

To perform this study, at first the background of this research was investigated. Then, the conceptual framework of this study was provided and at the same time hospitals were selected for investigation. The next step was to investigate and extract the required information from selected hospitals. Finally, the results were gathered, compiled, and presented for this study.

Two military, 5 governmental, and 3 private hospitals were selected to perform this assessment in Tehran and Isfahan provinces of Iran. These 2 provinces were selected due to the fact that a number of famous medical doctors work in these areas and support patients. Also, very good quality hospitals have been built in these areas, which are among the most famous hospitals in Iran. The selection method for military hospitals was simple random sampling. This method was applied due to limitations to access military hospitals by other researchers, which was overcome by providing documents and verdicts to do this assessment. The first military hospital had 300 and the second had almost 100 beds. In addition, the stratified sampling method for both governmental and private hospitals was applied. These civilian hospitals normally had 80 to 1000 beds.

From IT staffs' management point of view, these hospitals followed different approaches. One military hospital was using 3 permanent staffs and one did not even use

one permanent hospital. On the other hand, governmental hospitals were using permanent IT staff to supervise their HISs. However, private hospitals were normally different. In some cases, there was only one permanent staff.

As mentioned earlier, the conceptual framework of this study was EMRAM. The purpose of this valuable model was to measure HIS maturity level in the respective hospitals (Table 1) (16).

Therefore, in order to evaluate hospitals, a checklist was provided. This checklist had two parts. The first part was descriptive information about HISs in each hospital, including the hospital name, HIS name, company provider, HIS administrator, and hospital network topology. The second part included a table, which was divided to 7 parts in accordance with EMRAM stages. In each stage, the EMRAM expectations were listed. To make sure the second part of the checklist reflected the EMRAM expectations, 6 different experts from universities and hospitals evaluated the checklist. There were four options to be selected by the respondents. They could claim that a particular option was available in their HIS and was operating, there was not such option in their HIS, they had planned to implement this option in their hospital in the future, or they did not have plans for the future. However, the third and fourth option could not have advantages for the hospital to reach a higher rank but could stress on their HIS capability to activate in future. The researchers normally helped with completion of the checklist.

In each hospital, a meeting with the IT department managed to fill the checklist. In one case, in which there was no permanent staff, the meeting was held at the contractor office. Therefore, the validity of results could be guaranteed due to selection of eligible IT staffs from each hospital, whom were normally the HIS administrators. The meeting sessions were appointed and held one time in each hospital and lasted between 30 and 50 minutes to reach the expected results. To reach the final results, the SPSS application, version 22, was used, yet there was no need to use advanced functions of this application due to simplicity of calculations. Finally, it should be noted that the civilian hospitals' assessment ended in 2015 and the military hospital's assessment in 2016. Therefore, the comparison of results showed the current stage of HIS maturity with minor plans to extend HIS capabilities.

4. Results

As a result of data analysis of the first part of the checklist and from HIS provider point of view, it was found that each military hospital was using different types of HISs. One major outcome of this result was that different HISs could not communicate with each other and cannot share

Table 1. Electronic Medical Record Adoption Model Stages and Specifications

| Stage | Cumulative Capabilities |
|---------|---|
| Stage 7 | Complete EMR; CCD transactions to share data; data warehousing; data continuity with ED, ambulatory, OP |
| Stage 6 | Physician documentation (structured templates), full CDSS (variance and compliance), full R-PACS |
| Stage 5 | Closed loop medication administration |
| Stage 4 | CPOE, clinical decision support (clinical protocols) |
| Stage 3 | Nursing/clinical documentation (flow sheets), CDSS (error checking), PACS available outside radiology |
| Stage 2 | CDR, controlled medical vocabulary, CDS, may have document imaging; HIE capable |
| Stage 1 | Ancillaries - lab, rad, pharmacy - all installed |
| Stage 0 | All three ancillaries not installed |

data and information. Moreover, the governmental hospitals used different HISs. Therefore, similar problems compared with military hospitals could occur for them. The private hospitals were also facing the same problem, although they did not need to share data with their competitors, as seven different HISs from different HIS providers were operating in these hospitals.

Regarding technology, one military hospital did not have WIFI in the hospital zone but the rest had this technology. Moreover, the Star network topology was common in all of these hospitals. The database repository of all HISs was Microsoft SQL server, but different development language, including C# and PHP, were used to develop these HISs.

The final results of the second part of this checklist are presented in Table 2. According to Table 2, two military along with all civilian hospitals passed the 1st stage expectations of EMRAM. Nevertheless, for maturity hospitals, the situation was different in the next stage. Referring to this table, 50% of military hospitals, 75% of governmental hospitals, and 66% of private hospitals have overcome the 2nd stage of HIS maturity. Referring to Table 2, some governmental and private hospitals had implemented some inadequate numbers of a complete HIS version. However, no military hospital implemented even one item of the necessary modules at this stage. Thus, no military and civilian hospitals passed this stage. Regarding the 4th stage, none of these hospitals reached this stage. For other stages, some scattered actions were done at different governmental hospitals but was not completed.

Regarding these findings, some strange facts were uncovered. First of all, it was uncovered that the overall HIS maturity stage of Iranian hospitals is not high. The second stage of EMRAM had the highest maturity level of all investigated cases in this research. Moreover, the diversity of HIS maturity at military hospitals was rather high. Finally, the results highlighted that the HIS maturity of private hospi-

tals was lower than governmental hospitals in Iran.

5. Discussion

Based on field analysis of the hospital cases in this research, at military hospital M, the computer centre was responsible for maintenance and enhancement of HIS. The HIS, which has been operating for seven years, was the third installed software. The previous HISs were not capable of covering all or major needs of users and operators. Thus, the hospital authorities decided to uninstall them one after another and finally, the third one was installed and operated adequately. This HIS included more than 20 subsystems (26). Almost all hospital areas, including the dental ward, pharmacy, laboratory, medical document, and blood laboratory were equipped with professional software tools, which were handling all activities adequately. At military hospital N, there was no specific centre or office to manage IT and computer-related activities. However, several computers were used at different offices to assist patients, managers, and staff in handling their activities and responsibilities. To meet their needs, different software tools were installed, which were operating routinely. Nevertheless, there was no person in charge of maintaining computers and HIS software at this hospital.

The hospital analysis revealed that both hospitals had some sort of operating information systems to facilitate hospital activities. It was evident that all units, wards, centres, and laboratories at hospital "M" were equipped with some sort of IT facilities. Thus, the influence of IT was high at hospital "M" but not at hospital "N", where some of the activities were done manually. More than 20 software tools were handling different responsibilities and major activities at hospital "M". Therefore, based on EMRAM, this hospital had satisfied some expectations of an ideal HIS

Table 2. Private, Governmental and Military HIS Maturity Hospitals^a

| Stage | Cumulative Capabilities | A | B | C | D | E | F | G | H | M | N |
|-------|--|---|---|---|---|---|---|---|---|---|---|
| 1 | All three ancillaries (laboratory, radiology, pharmacy) are installed | b | b | b | b | b | b | b | b | b | b |
| 2 | Clinical data repository (CDR) is available | b | b | b | b | b | b | b | b | b | d |
| | Controlled medical vocabulary and clinical decision support/rules (cds) engine (rudimentary) is there | b | b | b | c | b | b | b | b | b | d |
| | Document imaging (May be) is available | b | b | d | d | b | b | d | b | b | d |
| | Health information exchange (hie) capable with other health care providers (may be) is available | b | b | d | d | b | b | b | b | b | d |
| 3 | Nursing/clinical (vital signs, flow sheets, nursing notes) documentation is available | c | d | d | d | d | b | b | b | d | d |
| | The electronic medication administration record (EMAR) application is implemented | c | c | d | d | d | d | d | d | d | d |
| | CDSS (drug/drug, drug/ food, drug/lab conflict checking) is available | d | d | d | d | d | d | d | d | d | d |
| | PACS is available outside of radiology | b | b | d | d | d | d | d | d | d | d |
| 4 | Computerized practitioner order entry (CPOE) for use by any clinician is available | c | d | d | d | d | d | d | d | d | d |
| | Second level of clinical decision support (related to evidence based medicine protocols) is available | c | d | d | b | b | d | d | d | d | d |
| 5 | Closed loop medication administration (a full complement of radiology) PACS system is there | c | c | d | d | d | d | d | d | d | d |
| 6 | Full physician documentation with structured templates and discrete data (for at least one inpatient care service area) is implemented | c | d | d | d | d | d | d | d | d | d |
| | Full (level 3) of CDSS (protocols and outcomes) is available | c | c | d | d | d | d | d | d | d | d |
| | The closed loop medication administration is implemented | c | c | d | d | d | d | d | d | d | d |
| 7 | Complete EMR (mixture of discrete data, document images, and medical images) is available | c | c | d | d | d | d | d | d | d | d |
| | Data warehousing (patterns of clinical data to improve quality of care and patient safety and care delivery efficiency) is available | c | c | d | d | d | d | d | d | d | d |
| | Clinical information (i.e. CCD) can be readily shared | c | c | d | d | d | d | d | d | d | d |
| | The hospital demonstrates summary data continuity for all hospital services | c | d | d | d | d | d | d | d | d | d |

^aA-E refers to governmental hospitals; F, G, and H hospitals refers to private and M, N refers to military hospitals.
^bYes.
^cNo, but, it is in the plan.
^dNot, at all.

whereas hospital “N” lacked major expectations of an optimal HIS. It would be beneficial to introduce EMRAM expectations to such hospitals as a roadmap to HIS enhancement. Both hospitals were placed on elementary stages of EMRAM due to the major weaknesses of their HIS. Hospital “M” could be placed at stage 3 and hospital “N” could be placed at stage 2. However, the clarification of the HIS status of these hospitals suggested that firstly, their management authorities were always under human and non-human (technical) supervision that prevented them from paying attention, persisting, or emphasizing on important decisions made during their meetings or based on their development programs. The effect of such considerations would be the loss of the motivation of staff, particularly top and middle managers. Secondly, hospital “M” tended to explore possibilities of the use of e-health to improve the quality of patients’ and staff’s services while such efforts was not observed at hospital “N”. It seems that the dis-

tance of hospitals from the capital had a direct impact on management decisions, budgets, and technology access. The nearest cases to the capital benefited from more facilities and services from top authorities. Finally, both hospital cases lacked suitable and strategic-based decisions. The situation could be compared with the decisions made for patients. Whenever the patient was affected by some physical problem, the required prescription would be made. In these cases, for each problem related to hired IT technologies, the required short-term solution was provided. Such decisions were not suitable for IT-related activities. This area needs long-term and strategic approaches. However, none of the hospital cases used mid or long-term strategic plans for IT decisions (26).

Regarding the civilian hospitals, almost the same types of problems and issues were uncovered. The authorities at both private and governmental hospitals defined no strategy to improve HISs at these hospitals. This may result

in parallel activities, which may end in conflict between the staffs, higher cost expenses, and top management lack of satisfaction. Moreover, almost all hospitals benefitted from the complex infrastructure and equipment in governmental hospitals yet the situation was not good at private hospitals. The private hospitals did not invest much on IT infrastructure at their hospitals. Regarding the dedicated office for IT staff to manage their affairs, all governmental hospitals benefitted from one or two offices with enough space (24) yet private hospitals faced limitations to allocate an office for them. In one case, their office was on the roof of the hospital (25). Regarding the allocated staff for each IT office, the situation of governmental hospitals was better than private hospitals. All governmental hospitals benefitted from one to ten expert staff (employee of contract persons) yet in private hospitals the shortage of IT staff was sensible. Finally, investment on HIS development in the majority of hospitals both in private and governmental hospitals was regarded as a cost and not an investment (24, 25). They could not benefit from advantages of these data out of clinical information of patients. They could not detect the trends of illnesses between patients, cost expenses at hospitals and so on. Therefore, they are not expected to pay for such applications. In general, the final results which compared military and civilian hospitals are presented in Table 3.

The above results emphasize on the immaturity of HISs at Iranian hospitals. The diversity of equipment availability at military hospitals indicate the lack of professional strategic plan at the administration level. The governmental hospitals are also suffering from the same problem. The private hospitals are facing more problems compared with other hospital categories. Moreover, the EMRAM assessment tool was not introduced to the health care system in Iran. The introduction of such assessment tools can define a roadmap for professional experts and enhance their HISs at Iranian hospitals. Advantages of such efforts include cost saving of HISs, health tourism promotion, technology enhancement, etc. in the hospitals. Finally, the shortage or even lack of professional experts was visible at these hospitals. More experts should be employed at hospitals to overcome technology-related challenges.

Considering the above results, the following propositions were presented by experts, who were questioned in this research:

1) Some specialized teams of staff should be arranged at the ministry level in the ministry of defense and ministry of health and medical education to extend and emerge IT and HISs at hospitals.

2) The HIS requirements should be extracted in line with EMRAM expectations and then shared with stakeholders in this area.

3) A clear framework and related regulations should be defined in accordance with EMRAM expectations to follow IT experts in this area.

4) Educated and professional IT human resources should be employed at the hospitals.

5) There are some ambiguous regulations in this area in the country. These regulations should be defined clearly and then force the hospital managers to adhere.

However, more researches are needed to develop a comprehensive view of HIS maturity of other Iranian hospital provinces. The healthcare system of Iranian military is not an exception and the same issues are faced there. The HIS has a growing importance in hospitals management in the Iranian military healthcare system. The analysis of 2 military hospital showed the incremental use of different HISs in these hospitals same as other civilian hospitals, particularly governmental hospitals. The existence of different HIS providers warns the possibility of diversity on HIS development approaches at these hospitals. This is a fact that could extend to other military and civilian hospitals, as well. It is believed that the lack of strategic plan for the entire military healthcare system along with lack of professional experts, proper training, excellent HIS system, and inability of external parties to equip them with digital facilities have hampered progression of HIS systems at military hospitals. However, more research is needed to investigate the military hospitals of Iran due to the fact that 2 different types of military along with police health care systems are operating and serving their employees and staff. For this research, the researchers were not able to enter these 3 types of military health care systems yet other researchers could enter the other military health care systems to come up with a more complete view of HIS maturity in the Iranian military health care system.

It is notable that the use of EMRAM in this context will let chief information officers (CIOs) and top managers design a proper and well-defined strategy for HIS development and enhancement in military and civilian hospitals. However, to compensate for the use of immature HIS in military and civilian hospitals, some solutions were provided.

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Table 3. Overall Comparison of IT Status Between Military and Civilian Hospitals

| | EMRAM Maturity | Strategic Plan | IT Expert | IT Investment |
|---------------------------|----------------|----------------|--|------------------------------|
| Military hospitals | Low | Lack | Some yes, some no | Some yes, some no |
| Civilian hospitals | Low | Lack | Governmental yes, private some yes and some no | Governmental yes, private no |

Footnotes

Authors' Contribution: Masarat Ayat participated in three different projects; these projects were performed at military, governmental and private hospitals in Iran; she has participated in all aspects of these researches and the final outcome is demonstrated in this research paper.

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