

# Factors Affecting Successful Implementation of Hospital Information Systems

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## ABSTRACT

**Background:** Today, the use of information systems in health environments, like any other fields, is necessary and organizational managers are convinced to use these systems. However, managers' satisfaction is not the only factor in successfully implementing these systems and failed information technology projects (IT) are reported despite the consent of the directors. Therefore, this study aims to determine the factors affecting the successful implementation of a hospital information system.

**Methods:** The study was carried out as a descriptive method in 20 clinical hospitals that the hospital information system (HIS) was conducted in them. The clinical and paraclinical users of mentioned hospitals are the study group. 400 people were chosen as samples in scientific method and the data was collected using a questionnaire consisted of three main human, managerial and organizational, and technological factors, by questionnaire and interview. Then the data was scored in Likert scale (score of 1 to 5) and were analyzed using the SPSS software. **Results:** About 75 percent of the population were female, with average work experience of 10 years and the mean age was 30 years. The human factors affecting the success of hospital information system implementation achieved the mean score of 3.5, both organizational and managerial factors 2.9 and technological factors the mean of 3. **Conclusion:** Human factors including computer skills, perceiving usefulness and perceiving the ease of a hospital information system use are more effective on the acceptance and successful implementation of hospital information systems; then the technological factors play a greater role. It is recommended that for the successful implementation of hospital information systems, most of these factors to be considered

**Key words:** Effective factors, hospital information systems, hospital, information technology, successful.

## 1. INTRODUCTION

Today, the use of information systems in health environments, like any other fields, is necessary and managers these areas are convinced to use these systems. However, managers' satisfaction is not the only factor in successfully implementing these systems and failed information technology projects (IT) are reported despite the consent of the directors; therefore, to run such projects a set of factors affecting the success and failure of information systems should be considered (1).

Numerous studies show that a significant number of large scale information system projects are faced with failure because of various reasons. Although, the project management and software have improved, but at the same time each year, tens of billion dollars are spent on failed projects. Based on re-

search findings of the Standish Group International Inc., 49 percent of very large projects that cost over ten million dollars, rejected before the end and only 51 percent have been implemented, which spend more time and money, without any special attention or having to be involved all comments that were defined and predicted for the project basis (2).

Failure of information systems projects cannot be easily defined, because success and failure factors of projects are diverse. Every person has a different understanding of the meaning of failure, but from the overall view, a project is failed when not being an optimum qualified to meet the goals and expectations as well as the project specification (2). Studies showed that the factors affecting the acceptance of HIS have been identified as human,

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organizational and technology categories. In these studies, the ease of use, the benefits and continuing education are as human factors, end users' corporation, economic factors and planning are the organizational factors, and finally privacy, system development, and support the system are as technological factors (1, 3).

Many studies have been done about the user role in the success of information systems. In most of these studies, human factors, either individually or as a group, are very important and decisive. Actually, neglect or inadequate care to human factors that may lead to defects in proper communication with users and an inability to develop a sense of ownership of the system for the user is known as the biggest factor in the failure of information systems to achieve their goals (4).

A study in Istanbul has shown that the end-users have experienced the general computer use, but most of them did not want to use a computer. According to a study in Finland, people who had more experience in general use of computer applications, were more used the hospital information system (3, 5), which refers to the role of human factors in the adoption of hospital information systems; while, Ping Yu in a research on the acceptance factors of IT in long-term care institutions, stats that demographic factors such as age and experience have no effect on acceptance of IT in health care field, by health providers (6). However, studies conducted in Turkey and Finland have determined the age and work experience as effective factors in the adoption of hospital information system (5).

In this regard, reports by users have shown that most satisfied people are those who believe the benefits of system and are more motivated to use IT. It seems that the tendency to IT can be a key factor towards the success or failure of information systems' operation (7).

A study conducted in the United States of America is reported 50% failure for clinical information systems (CIS) implemented in healthcare organizations. These findings are generalizable to many industrialized countries (8).

## 2. OBJECTIVES

Studies show that some of health information providers are not fully convinced to implement HIS in their institutions. This study assesses the factors that may affect the adoption of HIS technology by users of health information systems (7, 9, 10). Therefore, the project managers and professionals with a complete list of the factors influencing the adoption and success of information systems, will be able to better support the project, and according to them, by every moment evaluation provide solutions (3). Hence, the present study aims to determine the factors affecting the successful implementation of hospital information systems in clinical hospitals in Iran.

## 3. METHODS

This study was conducted as cross-sectional descriptive research. The study group is consists of members of the nursing unit, department secretaries, reception and medical records, clinical laboratory, radiology, pharmacy, and finance department of hospitals with comprehensive hospital information system for at least two years of implementation in their centers. The sample size was determined as 400 people in scientific method. First of all, 20 companies that provide enterprise hospital information systems were identified through the Office of Statistics and Information Technology, Ministry of Health and Medical Education. Then randomly a hospital that uses the software of each company and a total of 20 hospitals (preferably in Tehran) was selected. Comments of members of departments and units, including nurses, pharmacists, and paramedics were examined. In order to determine the number of users of separate units, for the total sample size and number of units under study (400 samples and 20 hospitals) 20 people in each hospital were selected by simple random sampling. The number of samples for eligible users in the categories of nurses, reception and medical records, laboratory, radiology, pharmacy, finance department and clinic was calculated for each hospital, and the average between 2 to 3 people in each job category was randomly selected.

To gather information from questionnaires, the Davis standard was used by adding technical and organizational factors from reliable sources (11, 12). The questionnaire contains 28 questions (9 questions for human factors, 12 for organizational factors, and 5 for technical factors). For validity of the data gathering tool, the initial questionnaire was given to two of professors, and after reforms were concerned, the validity was confirmed. The reliability of the questionnaire was confirmed by test-retest through the completion of it by 10 members of the study group, twice a week, and the Cronbach's alpha coefficient of 95%. The questionnaires were completed by visiting researchers in health centers as questioning method. Following the completion of questionnaires, the data was entered into the SPSS software for the analysis.

Factors:		Option:					Mean of Scores	Total N (%)	
		Very High (Score 5) N (%)	High (Score 4) N (%)	Medium (Score 3) N (%)	Low (Score 2) N (%)	Very Low (Score 1) N (%)			
skill	General knowledge in using computer	55 13.8	185 46.5	128 32.2	19 4.8	10 2.5	3.6	397 100	
	Understanding the Usefulness	Increase the speed of user by HIS	45 11.7	170 42.2	122 31.8	34 8.8	13 3.4	3.5	384 100
		Improving the work process using HIS	39 10.2	178 46.7	127 33.3	27 7.1	10 2.6	3.5	381 100
		Increasing the productivity of user using HIS	37 9.7	171 46.6	125 32.6	40 10.4	10 2.6	3.5	383 100
		Reduce user workload using HIS	29 7.8	136 36.7	139 37.6	38 10.3	28 7.6	3.3	370 100
Understanding the ease of use	Ease of using HIS	41 10.7	183 47.6	131 34.1	21 5.5	8 2.1	3.6	384 100	
	Ease of learning how to use HIS	39 10.1	99 51.3	114 29.4	32 8.2	4 1.0	3.6	388 100	
	Time consuming of using computer in HIS	27 7.1	99 26	182 47.9	58 15.3	14 3.7	3.2	380 100	
	Quick access to data in HIS	40 10.3	170 43.7	140 36	34 8.7	5 1.3	3.5	389 100	
Total		352 10.2	1491 43.1	1208 35	303 8.8	102 2.9	3.5	3456 100	

Table 1. The Impact of Human Factors on the Adoption of HIS

Factors:	Option:					Mean of Scores	Total N (%)
	Very High (Score 5) N (%)	High (Score 4) N (%)	Medium (Score 3) N (%)	Low (Score 2) N (%)	Very Low (Score 1) N (%)		
Project management	Clear definition of the objectives of the HIS	24 6.3	115 30.1	181 47.4	50 13.1	12 3.1	382 100
	Predefined user tasks in the HIS	24 6.1	166 42.4	147 37.6	43 11	11 2.8	391 100
	Proper plan for HIS implementation by the project manager	20 5.2	118 30.7	161 42	65 16.9	20 5.2	384 100
Training	Initial training for using HIS	16 4.1	120 30.8	180 46.1	59 15.1	15 3.8	390 100
	Adaptation of educational content and skills needed for the use of HIS	14 3.7	123 32.2	185 48.4	50 13.1	10 2.6	382 100
Cost	Reducing unit labour costs using HIS	21 5.8	114 31.5	138 38.1	59 16.3	30 8.3	362 100
Users participation	User participation in system development and implementation	20 5.5	88 24	114 31.1	77 21	67 18.3	366 100
	Non-compliance of HIS project with the needs and work expectations	11 2.9	58 15.5	170 45.4	89 23.8	46 12.3	374 100
	Fear of losing their jobs because of the HIS	13 3.4	29 7.7	82 21.7	107 28.4	146 38.7	377 100
	Fear of new technology due to lack of skill in using it	9 2.3	45 11.7	98 25.6	90 23.5	141 36.8	383 100
	Unwillingness to change	5 1.3	51 13.7	117 31.5	88 23.7	110 39.6	371 100
Confidentiality	Protect the confidentiality of patient information	41 11	105 28.2	151 40.6	44 11.8	31 8.3	372 100
Total		218 5.7	1105 30	1235 32.3	663 17.4	596 15.6	3817 100

Table 2. The Impact of Managerial and Organizational Factors in the Adoption of HIS

Each response rated from 1 to 5 and unanswered questions was considered zero, and during the calculation, the average was subtracted from the total respondents and at the end, the total score of the questionnaires in the areas of human factors, organizational and management factors and technical factors were calculated; then, using cut-off point on each areas, the factors affecting adoption among users have set as 1-1.8 very low, 1.8-2.6 low, 2.6-3.4 medium, 3.4-4.2 high, and 4.2-5 very high.

#### 4. RESULTS

Based on the findings, 302 (75%) of the study group are women. The mean experience of respondents' was 10 years and the average of age was 30 years. 243 (2/61%) people were bachelor's degree, and 252 (63%) people had ICDL certification. The average of human factors effectiveness was 3.5 points. Table 1. The average of organizational and managerial factors 2.9 point Table 2 and the average of technical factors was 3 points. Table 3.

#### 5. DISCUSSION

In general, human factors have the most influence on successful implementation of hospital information systems and then technological factors, and finally organizational and managerial factors. Among components of human factors, the general knowledge and skills in the use of computer, ease of using HIS and ease of learning how to use it were more effective on successful implementation of the system than other

human factors.

Koivunen, in a study in 2009 found that, there is a significant relationship between motivation to use computers and have experience in using computers. Those with more experience in using computers, compared with those with less experience in this field, use hospital information systems more and are motivated to perform computational processes (5). Anderson also, in a study in 2007 in eHealth suggests that more than half of the population, have been mentioned the lack of knowledge about the use of computers and information technology as a barrier to use the Information Technology (13). The study by Sheikh Shoaie and Olumi also in 2007, shows that whenever a system depended on information technology be more useful and easier to learn, it will be used more (11).

In numerous studies, research findings indicate that the system that the user can easily work with and trust it, and in-

Factors:	Option:					Mean of Scores	Total N (%)
	Very High (Score 5) N (%)	High (Score 4) N (%)	Medium (Score 3) N (%)	Low (Score 2) N (%)	Very Low (Score 1) N (%)		
Support : Tracking and resolving technical problems of HIS	14 3.6	102 26	159 40.6	78 19.9	39 9.9	2.9	392 100
Development: Future development of the HIS	25 6.5	120 31.3	155 40.5	63 16.4	20 5.2	3.2	383 100
Safety : Prevent the destruction, alteration or loss of information in the current HIS system	18 4.7	99 25.9	172 45	57 14.9	36 9.4	3	382 100
HIS reliability of the information maintenance	28 7.3	121 31.4	160 41.5	47 12.2	29 7.5	3.2	385 100
Communication: Exchange the data of existing HIS with HIS of other hospitals	20 5.9	68 20.2	100 29.8	60 17.8	88 26.2	2.6	336 100
Total	105 5.6	510 27.1	746 39.7	305 16.2	212 11.3	3	1878 100

Table 3. Technological Factors Affecting on the Adoption of HIS

crease data availability will be accepted more and its implementation will be successful (3, 14, 15, 16). These findings indicate that the knowledge and skills to use computers and the users' understanding of the ease of use of hospital information systems are the main human factors affecting the successful implementation HIS as well as a greater tendency for users to use the system. Ease of learning how to use HIS will lead users to be familiar with the system and in addition to saving time and cost, will cause the successful adoption and implementation of systems by end users.

The effect of technological factors on the successful implementation of the HIS is after the human factor, in the second grade. Amongst, the impact of the factor the system development capability and HIS reliability in safe keeping of infor-

mation have gained higher score than other factors. In Andersen's study, the inability of suppliers to deliver acceptable products has been described as a major obstacle to the application of information technology (13). In some studies, technical concerns such as the ability to communicate systems are the biggest obstacles to the implementation of health information systems, and electronic interchange and communication facilities have been mentioned as the biggest benefit of systems (13, 16, 17).

It seems that this priority difference, in the effect of technological factors in the adoption and successful implementation of a hospital information system in this study, compared to other studies, arising from the nascent state of implementation and running hospital information systems in the country, so that these systems are in the early stages of the installation and implementation and still have not reached the stage of complete implementation and installing necessary infrastructures in all health-care centers, and the exchange of information between the centers is not of their priorities.

Therefore, the ability to develop the hospital information systems to ensure the safety of information are important factors for adopting and implementing a successful information system by users, since, the increasing development of technology and high speed of entering new and efficient products as well as more developed paraclinic systems, and the different requirements of hospitals, have created a complex and variable environment in the hospitals. On the other hand, because health care providers will have no chance to re-run HIS (9), the health information systems must be able to coordinate with these changes, and with the development and change of use of the system could meet the user's needs and increase their motivations and tendency to use the system.

Based on the results, organizational and managerial factors have less influence than other factors for successful implementation of HIS. Meanwhile, project management, training the use of the system, and maintaining the confidentiality of the information in hospital information system are more effective in the successful implementation of organizational and management HIS than other factors. In a study by Kimiafar et al, most users have considered the lack of related and sufficient education as the primary cause of low quality of HIS (18).

In another study by Sagioglu et al, the problems in the use of an integrated hospital information system are reported as causes for educational problems of the systems (1) which is consistent with current research. In the study by Minal in 2005, the biggest barriers to adoption of electronic health records in the United States are reported as the cost of software, hardware and physician participation (17). In another study in 2009, the end-user participation in implementation strategy was the main factor associated with successful adoption of HIS/CIS (16) that is at variance with the findings of the study. Part of this difference is due to the lack of appropriate policies and incentives for users to participate in the system training courses, as well as the lack of written policies and procedures about the confidentiality of information. On the other hand, because most of hospitals in the country are public, and therefore the implementation of HIS needs the budget approved by the state which is not the major barrier to the adoption and implementation HIS in the country. Therefore, it is rec-

ommended that the necessary guidelines to be codified and the projects be managed by skilled and competent people and some mechanisms be considered for training and participation of users.

## 6. CONCLUSIONS

The human factors, generally, and then the technological factors and the organizational and managerial factors have an important role in the adoption and successful implementation of hospital information systems. Among human factors, general knowledge in using computer, ease of using HIS, and ease of learning how to use HIS, among technological factors, the future development of the hospital information system and reliability of the system in protecting the information, and among the organizational and managerial factors, training users, project management and information confidentiality have the greater influence on the acceptance and successful implementation of hospital information systems. Given the nascent state of hospital information systems of country, and the inability of design and implementation of many of these systems, by both providers and users, and sometimes, the problems in the use of these systems, it is expected to see the successful implementation of these systems in the country by the increase in experience and capabilities of both groups, while strengthening the human and technological factors during the installation and implementation of these systems and leading the project by empower individuals and professionals.

- Clinical Relevance Statement: To improve the general knowledge and skills of users in using computers, it is recommended that the ICDL courses for users should be taken seriously, and during the implementation of hospital information systems, comprehensive educational programs should be developed and implemented for users. Software vendors also should provide software that is designed to facilitate the users' tasks, and be easy to learn and use. The software development companies should improve their ability to deliver acceptable and feasible products in accordance with changes and needs of health-care variable environment.
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