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An investigation of factors affecting Electronic Health Record (EHR) in Health Care Centers

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Abstract: Technology application in health care in the form of Electronic Health Record (EHR) is the most important factor to improve the quality of health care and a technique to integrate information. The purpose of the present study is to determine the factors affecting EHR system`s acceptance in health care centers based on TTF and UTAUT models. The research has been conducted as a descriptive-survey study investigating a population of 136 staffs working in the health care centers of Lorestan`s cities. The statistical sample includes 101 people selected using stratified random sampling. The data has been gathered using questionnaire. The ranking of the factors affecting EHR indicates the facilitating conditions or technology features in the first place, the social effects in the second place, the task features or performance expectancy in the third place, the effort expectancy in the fourth place, and the task appropriateness in the fifth place. The comparison of the affecting factors` mean reveals that there is a significant difference between the means of task appropriateness based on users' educational level (P=0.0032) but in other areas, there is no significant relation between the means of responses based on gender, education and work experience of users and their skill to use technology. Considering the fact that technology features or facilitating condition is a main factor affecting EHR acceptance among users, it seems necessary to take the information technology infrastructures and facilities associated with this process into consideration to guarantee the proper attitude of users towards the system.
Keywords: Electronic Health Record (EHR), TTF model, UTAUT model, health care center

INTRODUCTION

Development of information technology has provided a large potential to improve health, quality and efficiency of health care. The diagnoses done by computers and management programs of health care improve clinical decisions and health system. The history of EHR dates back to the presence of computers in human activities. The first effort to set up EHR was done in 1969. By developing electronic health technologies during the 20 past years, technology has found an importance place in health section increasingly. In 2001, American medical institute mentioned EHR as the most critical factor to improve health care qualities[1].

EHR present the background of the events associated with each person`s health. The overall objectives of this record are as follow:

- Providing health information of individuals for physicians and health team to present better medical and health services
- Saving, processing and retrieving individuals` health to improve the health level of society, provide better services and participating to supply personal health
- Establishing supporting systems for senior mangers` decision making in health system based on real evidences and accurate information, and increasing access speed to required statistical information.
- Creating a virtual space for research and educational affairs in health area.
- Creating a tool to evaluate health services and help the providers of these services and the principles undertaken by health system of country [2].
- An electronic health record is a collection of patient health information generated by one or more meetings in any care delivery setting. An EHR typically includes patient demographics, progress notes, problems, and medications, vital signs, past medical history, immunizations, laboratory data and radiology reports. It's said to streamline clinicians' workflow, and it has the ability to generate a complete record of a clinical patient encounter. EHRs focus on the total health of the patient. They go beyond standard clinical data collected in the provider's office and include a broader view of the patient's care. EHRs are designed to reach beyond the health organization that originally collected the data and are built to share information with other providers. EHRs' most notable benefit include

a secure sharing of data, which, in turn, results in more open communication and more involvement on the patient's part [3].

TTF is a model investigating the appropriateness level between technology and expected task of technology and discussing the factors affecting technology acceptance [3]. It includes three indices including task features, technology features and task appropriateness [4].
UTAUT theory investigates the factors affecting technology, regardless of the technology investigation [4]. To evaluate this parameter, four indices are presented: Performance expectancy ,Effort expectancy, Social effect and Facilitating conditions.

Silow-Carroll *et al* found in a study Successful implementation of electronic health records depended on: strong leadership, full involvement of clinical staff in design and implementation, mandatory staff training, and strict adherence to timeline and budget. The EHR systems facilitate patient safety and quality improvement through: use of checklists, alerts, and predictive tools; embedded clinical guidelines that promote standardized, evidence-based practices; electronic prescribing and test-ordering that reduces errors and redundancy; and discrete data fields that foster use of performance dashboards and compliance reports [5].

Fakhr Zade based on his study on the role of electronic health record in presenting health information, concluded that electronic health record allows health and care section to save time and cost and improves care of patients by organizing their records. He also found that it make the process of treatment and diagnosis easier [6]. These records combine conventional paper reports with new facilities of technology to increase the accuracy and speed of EHR completion. While using paper records will be followed by some problems such as unreadablity, prescribing, wrong writings of words, increasing costs to print forms, files, cards, buying and selling files, and importantly, the place of archiving and specialist human force (for each of them high costs have been paid). Therefore, EHR is suggested to be used to solve such problems. Nasiri pour *et al* studied the countries of austrulia , germany , Sweden , england , turkey , and iran using quasi qualitative study method. The results this research showed that, The priorities of electronic health establishment include the electronic profile of personal health , paitient ID , electronic health card , the increase of investments in IT industry , electronic registration of appointments for treating patients , electronic prescription , and eventually tele – medicine. The common goal of all these strategics is using IT in presenting patient – oriented health services [7].

In the study on the effect of EHR in raising productivity, Khuban *et al* also found that implementing EHR needs to spend high costs and supports as well as the coordination of all related executors [1].

In a study on selection and successful implementation of EHR in American small institutes conducted by Lorenzi, it was revealed that the experience of EHR implementation depends on various factors such as technology, education, change management process, and unique characteristic of the environment [8]. Also, Lorenzi introduced endangering their job position, lack of learning computer skills, tolerated work discipline, their time waste, increasing responsibility, lack of competition and efficiency as the main factors of resistance of health services providers against medical informatics [9].

In another study, Nies *et al* asserted that using information technology can decrease costs, especially regarding prescribing medicine, double working and reduplicating experiments [10].

In America, a study has been done regarding the effect of HIS in decreasing costs in hospitals recording a decrease of 26% to 30% in costs after adjusting HIS in hospitals.

The holistic system of citizens` health information has been provided in 2007 focusing on creating and applying EHR and Health Ministry has been assigned to implement it. But implementing this plan depends on various factors needed to be investigated. Therefore, the present study attempts to find the factors affecting EHR acceptance in health care centers of Lorestan based on UTAUT and TTF.

MATERIAL AND METHODS

The research has been conducted as a descriptive-survey study investigating a population of 136 physicians and staffs working in the hospitals and health care centers of Lorestan`s cities. The statistical sample includes 101 people selected using stratified random sampling. The data has been gathered using questionnaire. The questionnaire has been designed in two sections. The first section includes demographic information of respondents and the second part involves 47 items (8 items of technology features or facilitating conditions, 10 items of task features or performance expectancy, 8 items of effort expectation, 13 items of social effects, and 7 items of task appropriateness). The content validity of the questionnaire has been measured. After confirming the validity, the questionnaires have been distributed among 30 people of the population. The gathered data has been processed using the reliability coefficient of alpha Cronbach (0/82) in SPSS software.

Data has been analyzed using descriptive (frequency table, mean percentage, standard deviation, and charts) and referential statistics (single variable t test, Friedman test, independent T test, and one-way variance analysis test).

RESULTS

Among 101 participants of the study, 71 people was female (70.3%) and 30 people was male (29.7%). In terms of education, 5% was below diploma, 26.7% was diploma, 34.7% was associates of degree, 22.8% was bachelor, and 10.9% was master.

The value of T statistic computed with 100 degree of freedom in the variables of facilitating conditions or technology features, performance expectancies or task features, effort expectancy, and social effects is greater and significant compared to the table vale. Thus, there is a significant difference between the mean value of sample and population(3). With respect to the column of "mean difference", facilitating conditions or technology features is of high importance in using EHR. Performance expectancies or task features has an average application in using EHR. The roles of effort expectancy and social effects also have average effect in using EHR (Table 1).

But considering the value of T statistic computed with 100 degree of freedom in the variables of task appropriateness (1.44), it can be concluded that there is no significant difference between the mean of sample and population; and it indicates an average role of task appropriateness (table 1).

Table 1- the comparison of means related to the role of the components of TTF and UTAUT in EHR application with the supposed mean of 3

	Average	T	Degrees of freedom	Significant level	mean difference
technology features or facilitating conditions	4.03	20.53	100	0.000	1.03
task features or performance expectancy	3.65	10	100	0.000	0.65
effort expectancy	3.56	7.7	100	0.000	0.564
social effect	3.71	15.89	100	0.000	0.711
Functional Fitness	3.14	1.44	100	0.151	0.141

In the ranking of the factors affecting EHR application, the facilitating conditions or technology features in the first place (mean of 4.17), the social effects in the second place (mean of 3.14), the task features or performance expectancy in the third place (mean of 3.11), the effort expectancy in the fourth place (mean of 2.69), and the task appropriateness in the fifth place (mean of 1.88). See table 2.

Table 2- descriptive statistics of non-parametric test of Friedman for the first hypothesis

Factors	Average	Standard deviation	Minimum	Maximum	Average Rating
facilitating conditions	4.03	0.505	3	4.88	4.17
performance expectancy	3.6	0.653	2	4.73	3.11
effort expectancy	3.56	0.736	1.62	4.88	2.69
social effect	3.71	0.449	2.77	4.92	3.14
Functional Fitness	3.14	0.982	1.29	4.71	1.88

The value of computed T statistic for the factors affecting EHR application based on users' gender in 99 degree of freedom in all factors is smaller and non significant compared with the critical value of the table. In other words, there is no significant relation between the mean of male and female users (table 3).

Table 3- the comparison of the means of variables in EHR application based on gender for the second hypothesis

Factors	Groups	N	$\overline{X}$	SD	T	Df	Sig
technology features or facilitating conditions	Woman	71	4.08	0.473	1.78	99	0.078
	Man	30	3.89	0.558			
task features or performance expectancy	Woman	71	3.68	0.66	0.809	99	0.421
	Man	30	3.56	0.641			
effort expectancy	Woman	71	3.63	0.74	1.42	99	0.456
	Man	30	3.4	0.714			
social effect	Woman	71	3.72	0.473	0.461	99	0.646
	man	30	3.67	0.397			
Functional Fitness	Woman	71	3.19	0.954	0.812	99	0.419
	Man	30	3	1.05			

The value of computed F statistic (F= 2.76) in the variable of task appropriateness with 4 and 96 degree of freedom is greater than the critical value of the table and is significant. Therefore, there is a significant difference between task appropriateness in HER application based on users' education ($p<0.05$). On the contrary, in other studied variables, there is no significant difference. Comparing each two pair of users` score means (***Tukey follow-up test) based on users` education reveals that the resulted significance is related to master degree more compared to associate of degrees (0.171) (table 4).***

Table 4- the comparison of the means of variables in EHR application based on education for the second hypothesis

Index	Source of change	S.S	d.f	M.S	F	Sig
technology features or facilitating conditions	Between groups	1.8	4	0.451	1.82	0.13
	The Groups	23.71	96	0.247		
	Total	25.52	100			
task features or performance expectancy	Between groups	2.22	4	0.557	1.31	0.269
	The Groups	40.53	96	0.422		
	Total	42.75	100			
effort expectancy	Between groups	3.32	4	0.832	1.56	0.189
	The Groups	50.91	96	0.53		
	Total	54.23	100			
social effect	Between groups	0.823	4	0.206	1.02	0.401
	The Groups	19.41	96	0.202		
	Total	20.24	100			
Functional Fitness	Between groups	9.96	4	2.49	2.76	0.032
	The Groups	86.58	96	0.902		
	Total	96.55	100			
Tukey test						
Education				M.D	S.E	Sig
associates of degree	Masters and more			-0.171	0.454	0.044

The value of computed F statistic in all variables with 4 and 96 degree of freedom is less than the critical value of the table and is not significant. Therefore, there is no significant difference between the variables in EHR application based on users' education (table 5).

Table 5- the comparison of the means of variables in EHR application based on work experience

Index	Source of change	S.S	d.f	M.S	F	Sig
technology features or facilitating conditions	Between groups	0.425	4	0.106	0.406	0.804
	The Groups	25.09	96	0.261		
	Total	25.52	100			
task features or performance expectancy	Between groups	1.47	4	0.368	0.856	0.493
	The Groups	41.28	96	0.43		
	Total	42.75	100			
effort expectancy	Between groups	0.309	4	0.077	0.138	0.968
	The Groups	53.92	96	0.562		
	Total	54.23	100			
social effect	Between groups	0.711	4	0.178	0.874	0.483
	The Groups	19.5	96	0.203		
	Total	20.24	100			
Functional Fitness	Between groups	3.33	4	0.833	0.858	0.492
	The Groups	93.22	96	0.971		
	Total	96.55	100			

The value of computed F statistic for the variable of users` skill to use technology in all the variables with 4 and 96 degree of freedom is less than the critical value of the table and is not significant. Therefore, there is no significant difference between the studied variables in EHR application based on users` skill to use technology (table 6).

Table 6- the comparison of the means of variables in EHR application based on users` skill to use technology

Index	Source of change	S.S	d.f	M.S	F	Sig
technology features or facilitating conditions	Between groups	0.915	4	0.229	0.892	0.472
	The Groups	24.6	96	0.256		
task features or performance expectancy	Between groups	1.71	4	0.428	1	0.411
	The Groups	41	96	0.428		
effort expectancy	Between groups	3.8	4	0.95	1.8	0.133
	The Groups	50.43	96	0.525		
social effect	Between groups	1.07	4	0.268	1.34	0.261
	The Groups	19.17	96	0.2		
Functional Fitness	Between groups	4.05	4	1.01	1.05	0.384
	The Groups	92.49	96	0.963		

DISCUSSION AND CONCLUSION

To ensure the users` acceptance and proper attitude towards EHR application, it is necessary to consider information technology infrastructures, facilities and equipments associated with this process. In this regards, it can be focused on increasing the number of hospitals and health care centers, improving covering level of Telecommunication organization and setting up high speed internet, creating health software appropriate with needs, allocating credit to develop information technology, setting up and reinforcing communicative network between inter-hospital relations, designing professional structure appropriate to present services such as hospital size and providing required space as the main infrastructural factors in EHR application [7,8,11,12].

Along with infrastructural factors, the role of social factors should be taken into consideration and the system implementation is supported with required activities. These supports can include forming necessary committees to determine proper standards and principles, create adjustment in information system to make mutual relation with each other, being supported by senior managers, stating the advantages of EHR application, modifying financial policy making, creating supporting systems, producing TV programs, holding conferences, and so forth [13,14]. Other factors such as decreasing the opportunities of participation in private section, designing simple and up dated system, using users in components` designing, reviewing users` tasks, creating stability in managements, and preventing favoritism can be helpful for users in EHR application. Extending information technology application in the world and in Iran indicates that mangers and

participants should provide the necessary opportunity to develop this technology by supplying financial resources and required planning [7,8,13].

In this regards, the followings are recommended to increase EHR application:

- Equipping hospitals, health centers, physicians' clinics, insurance centers, and so forth with appropriate facilities of technology such as wideband internet and building appropriate spaces in hospitals and health centers under construction to set up this system.
- Providing the facilities for various care centers, especially non-state centers to set up electronic health records.
- Providing required standards and instructions regarding organizing electronic health records for users and health authorities.
- Employing specialist forces and selecting people to support the system in various centers to solve any problem. In this area, private companies can contribute to support the system and some health care centers being allocated to a company.
- Holding justification classes for authorities, managers and users regarding the importance, features, advantages and application of electronic health records.
- Coordinating the responsible sections and organizations, especially legal organizations to accept electronic documents.
- Proving enough knowledge about the system to prevent their resistance to implement the system.

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