Factors Affecting on Deployment of Speech Recognition Technology in Health Care Organizations of Iran

Reza Safdari[1], Marjan Ghazi Saeedi[1], Ali Valinejadi[2], Hamid Bouraghi [1, 3*], Hossein Shahnavazi[4]

[1]Department of Health Information Management, School of Allied Medical Sciences, Tehran University of Medical Sciences, Tehran, Iran.

[2]Department of Health Information Technology, School of Allied Medical Sciences, Semnan University of Medical Sciences, Semnan, Iran.

[3]Department of Health Information Management, Hamedan University of Medical Sciences, Hamedan, Iran.

[4]Medical Records Department, Iranian Forensic Medicine Organization, Tehran, Iran

* Corresponding author: Hamid Bouraghi, Department of Health Information Management, School of Allied Medical Sciences, Tehran University of Medical Sciences, Tehran, Iran.

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Abstract

Background: Speech recognition technology and its capabilities to create a positive change and increase efficiency and reduce costs and effectiveness and increase the quality of services in hospitals cause to increase the attention to this technology and provide more functions and effects. The aim of this study is to answer the question that what are the factors affecting the development of speech recognition technology in the healthcare organizations?

Methods: A question quantitative method was used. Information and required data of participants in this study were obtained by using a researchers' questionnaire containing 39 questions which was based on Davis questionnaire that was set in nine sections. The statistical society consisted of doctors, nurses and staff in studied hospitals who work directly with the hospital information system and simple random sampling method was used.

Results: The findings suggest that the situation of social factors, organizational factors, attitude toward technology, support for change and innovation, Human resources, technical and technological dimension and tend to use technology are at desirable level to deploy speech recognition infrastructure. But both individual factors and financial resources are not in good condition for deployment of this technology.

Conclusion: Due to the desire to implement speech recognition technology and a positive attitude and support at the centers to seek financing equipment, we can get financing equipment to deployment of speech recognition technology infrastructure in healthcare centers. Also, by training people and creating a platform for experience this system and encourage users, we can step in strengthening individual factors.

Keywords:
Technology adoption, Technology infrastructure, Speech Recognition, Hospitals

1. Introduction

Today, information is one of the main sources of power in the world. Managers will not be able to make effective decisions without having complete information about a topic (1). In recent years, due to the growth and increasing development and application of computer facilities and the transfer of data and creating worldwide networks, such as the Internet and a variety of services, information technology has severely changed information exchange environments. In the health sector, the use of efficient information systems, for achieving performance goals, effectiveness and quality of service and satisfaction of patients considered an undeniable necessity. Access to information increases human intelligence, awareness and knowledge, in other words, information and communication make up the lifeblood of the system (2).

In Iran, information technology and hospital systems are not serving, as it should be in the hospital medical records documentation. Incomplete documentation of medical records by doctors, in addition to the loss of patient information, has adverse effects on the healing process (3) and imposes large costs into the system (4). The lack of computerized record is one of the medical records defective reasons in medical centers (5).

As the penetration of information technology in various sectors, hospitals and health centers have faced with great changes in the performance of its activities. Changes and technology, rising competition, rising advertising costs and changing customer demand for health services will change health care organizational structures (6). In this situation, the most important issue for healthcare organizations is their ability to provide innovation, organizational technology, design, equipment and system and market processes. The impact of information technology on the medical knowledge and practice have destroyed the internal constraints and working process to create innovation in providing services (7).

Despite the inclination of most clinical staffs to the use of information systems, most of the staffs have been faced with challenges to enter data into the computer, and the

spending time is more than the time required for the manuscript or dictate (8). For this reason, embedding a solution that requires no computer data or time to help documentation would complete the case and ultimately improve care. Recently, a number of technologies have been created for clinical documentation and ease of file completion, such as bar coding system, scanning, light pen, personal digital assistants and speech-to-text system (9), of which speech-to-text system has been developed rapidly in recent years (10).

Speech recognition technology can contribute to the medical field from a variety of methods. Storage systems of patient information, drug information systems, surgical and treatment systems, follow-up treatment systems, telemedicine systems, steering nurse systems, surgical robots and patient admission systems and many others that behind all of them, there is a common goal and it is facilitating the work of therapy. By using these systems, the patient receives the best service in the shortest time. Reducing health care costs and providing high quality health care services have become a global priority. Technology and automation are the potential factors to reduce these costs (11).

Technology Acceptance Model also deals with the factors at the individual level. This model has been used in many researches in different countries and its applicability is investigated. "Davis" has introduced the Technology Acceptance Model in 1986 based on "Theory of Reasoned Action (TRA)" to model the issue of ICT Adoption by users. This model has provided an explanation of the factors affects the computer acceptance by the user and it is a model at the level of individual factors (12).

Numerous individual, organizational and outside the organization factors affect the implementation and deployment of technology. Due to various factors important role in improving efficiency of hospitals, study of these factors can help to increase the systematic use of information technology of various dimensions and thus the efficiency and the progress of the organization. This model has been used in many researches in different countries and its applicability has been studied (13).

Using speech as input data has a significant impact on the speed, and the interaction of humans on the environment. Although, at present, there are many systems for speech recognition, but, all these achievements tow a set of simplification limits in a way, which removing these limitations can add remarkably in the complexity of these systems. The ultimate goal of "speech recognition" systems is creating systems that can hear as humans and respond effectively. So far, different areas have used this technology, according to their needs in their activities. However, physicians and hospital personnel rarely use this technology in practice in the country's hospitals that can be because of lack of knowledge about the capabilities of this technology. To achieve the optimum and better performance in the hospital, the deployment of speech recognition technology is considered a necessity. Despite the growing advances in medical technologies, including speech recognition technology in the world, yet the technology has not entered the hospitals in the country.

A delay in the adoption of new technologies in the health care sector has deprived the health care system, especially patients of the potential benefits of technologies that its cost effectiveness has been proven (6). Problems that we face in the adoption of new technologies and ways of overcoming these problems has been the subject of many recent studies (14).

Ali Alikhani and Amir Bahrami, in a research entitled "identify barriers to the implementation of electronic insurance in the Iran insurance industry and providing proper solutions. insurance industry", have concluded that, for the successful implementation of e-insurance strategy, cases such as, leadership and strategic thinking, creating the technological infrastructure, organizational infrastructure readiness, expert and aware manpower should be considered. In this study, the most important constraints that hinder the successful implementation of the technology are described as three main groups of environmental barriers (background), organizational barriers (structural) and behavioral barriers (content) that the most notable was the limitations of skilled workers in the field of new technology, inappropriate technical infrastructure (15).

Azadi and Mousavi in their research entitled "barriers to implementing paperless technology in government organizations" by using the acceptance technology model have studied six groups of factors: acceptance behavioral intention, attitude towards acceptance, technological benefits, economic benefits, ease of acceptance and adaptation of technology. The results showed that the respondents have evaluated high adaptation of technology and the technology benefits, which itself lead to the proper attitude to the acceptance of technology. However, its economic benefits are considered minimal and too difficult in terms of implementation and so in summary, behavioral intention was estimated to be low. By ranking the items of these set obstacles, it was revealed that making the culture in the field of implementation, and providing the necessary training to learn how to use new technology can help users to adopt the technology (16).

Sanayei and colleagues have analyzed obstacles to the deployment of information technology in Fars province's Office of Youth and Sports by using fuzzy multi-criteria decision-making approach. In this study, at first, 21 obstacles to the deployment of information technology were identified by using experts or professionals' opinions, and they were classified in four categories. The results showed that technical, financial, behavioral barriers and in

the end, organizational obstacles have more importance respectively from the identified barriers. According to the identified priorities, obstacles in using information technology can be one of the strategies to improve the use and development of information technology in the Office of Youth and Sports in Fars province. Among behavioral factors, the employees' resistance to change was considered as an obstacle for IT application that the resistance can be reduced in various ways, including training, informing, recruiting enough expertise in the fields of information technology and other training actions (17). Whitaker has examined common causes of failure of IT projects in Canada with quantitative research and survey methods. Based on the results, three key factors were involved, including weak project planning, poor communication project with the needs of the organization, and the lack of support and commitment of senior management in the failure of IT projects (18).

Brooks and Kunda have studied the existing research, and have considered four major barriers to the use of information technology in developing countries. These four factors are the lack of skilled human resources, economic constraints, shortcomings in infrastructure and improper applications of these technologies (19). Heidari et al, in a study entitled "Factors Effective factors in Information Technology (IT) acceptance in the view of the nurses working in ICU " have concluded that the education level of nurses has a relation with their reliance on information technology, and there was a strong correlation between trust and perceiving the ease of use. There is no correlation between the structures of attitude, behavioral control and subjective norm, with nurses' intention to use information technology, and behavioral intention to use the technology will be affected by the perception of ease of use to some extent.

Then, they have suggested that, educational planners and information technology managers can improve the intention to use technology by nurses by strengthening the structures of perceived ease of use, subjective norm and trust (20).

Mohammad Hassan Seif and colleagues have done a study entitled "Factors Associated With Accepting and Using Information and Communication Technology among Faculty Members of Payam-e Noor University, Fars Province". They concluded that, in the initial research model, which was formulated by using the existing research background, perceived technology, ease of use has the greatest impact on willingness to use technology, in Fars province of Payam-e Noor University faculty members compared to other variables. Moreover, the application of IT system variables and perceived usefulness of the technology have an impact either directly or indirectly through an attitude toward technology. In addition, it was observed that, self-taught, by using a computer of faculty members directly has a direct and significant impact on the perceived ease of use of technology (21).

Therefore, the main issue of this study is to determine the factors affecting the deployment of speech recognition technology infrastructure in health care centers.

2. Materials and Methods

The present study is applied and descriptive study and was conducted in 2016. Data collected from the survey. The statistical population of this study included all physicians, nurses and staffs involved with the hospital information system in specialized cardiology hospitals in Tehran that, given the importance of the provision of services and access to information, Shahid Rajaie cardiovascular center, Tehran heart center and Jamaran heart hospital were selected. The simple random sampling method is used that the statistical sample of the study was, according to the sample size estimation formula of population and was 115 people. Questionnaires distributed to these selected individuals and from this number, 105 questionnaires were returned (return rate = 86%). The necessary information and data were collected from the participants in this study by using a research-made questionnaire, which contains 39 questions and 9 sections and its basis is standard questionnaire of Davis' Technology Acceptance Model. Professors and experts assessed the validity of the questionnaire. The tool reliability in the research process was calculated through Cronbach's alpha test and was obtained 0.87 that shows the proper reliability of the research tool. For evaluation of speech recognition technology infrastructure components feasibility in the studied center, the mean test of a population or t-student tests were used. According to the statistical concepts, the information needed to test is as follows:

• The number of samples is 105 people. Consequently, the degree of freedom (df) is equal to 104.
• The basis of hypothesis measurement is considered equal to 3 because the test was five choices.
• According to the data of the test, the test statistic should be calculated. If the test statistic is greater than the critical point, H0 hypothesis is rejected at the 95% level and the opposite hypothesis is accepted.

$$H_0 : \mu \leq 3$$
$$H_1 : \mu > 3$$

3. Results

The findings related to demographic variables are listed in Table 1. The findings show that the number of male respondents is more than female respondents. In the field of respondents' frequency distribution according to age variable, the research findings indicate that, statistical

sample aged 36 to 45 years (37.14%) and aged 55 years above, (7.61%) were the lowest statistical sample.

Table1. Demographic Research findings

Variables	Frequency	Frequency Percentages
Gender		
Female	27	25.71
Male	78	74.29
Age		
25 to 35 years	29	27.61
36 to 45 years	39	37.14
46 to 55 years	29	27.61
55 years above	8	7.61

To check the status of the human resources category, structural and technical factors, social factors, monitoring, management factors, and the organizational feasibility factors of average speech recognition technological infrastructure deployment, one sample t test, and significant levels were listed in the following tables and its explanations are provided at the bottom of the tables. (Table 2)

Table2. Descriptive indicators of technological feasibility dimension of technology deployment

Variable	Average	The standard deviation	Average standard error
Individual factors	1.82	0.74	0.04

social factors	3.47	0.93	0.08
Organizational factors	3.59	0.84	0.09
Attitude towards Technology	3.63	0.98	0.05
Support of Change and Innovation	3.14	01.08	0.12
human resources	3.28	0.95	0.18
Technical and technological dimension	3.39	1.12	0.08
Financial dimension	1.56	0.85	0.10
Desire to use	3.21	0.86	0.09

According to Table 3, the social factors status of the technology establishment feasibility of speech recognition infrastructure is at the significant and positive level. In other words, the social factors status of the technology establishment feasibility of speech recognition infrastructure is properly and significantly higher than average. In addition, according to the organizational factors table of the technology establishment feasibility of speech recognition infrastructure is positive at 0.001 levels and significantly higher than average. In other words, organizational factors for the technology establishment feasibility of speech recognition infrastructure are desirable.

Table3: Univariate t-test to check the technological dimension status of technology establishment feasibility

Variable	T-statistic	Degrees of freedom	The significance level	The average difference	Sig.
Individual factors	1.656	104	-	0.28	0.154
social factors	5.754	104	0.001	0.30	0.0001
Organizational factors	6.254	104	0.001	0.34	0.0001
Attitude towards Technology	4.147	104	0.001	0.29	0.0001
Support of Change and Innovation	4.224	104	0.001	0.47	0.0001
human resources	6.450	104	0.001	0.32	0.0001
Technical and technological dimension	5.720	104	0.001	0.22	0.0001
Financial dimension	1.365	104	-	0.40	0.087
Desire to use	7.568	104	0.001	0.21	0.0001

In addition, attitudes towards technology Support of change and innovation to deploy speech recognition technological infrastructure, human resources, as well, in the studied hospitals are in proper position to deploy speech recognition technological infrastructure. As well as technical and technological dimension and willingness to use technology based on calculated t-statistic are in desirable level to deploy speech recognition technological infrastructure. Based on the above table, the calculated t-statistic for both individual factors and financial resources respectively (1.656) and (1.365) show non-significance of these two dimensions in the studied hospitals. This means that individual factors and financial resources to deploy speech recognition technological infrastructure is not in proper and desirable shape.

4. Discussion

Technology adoption is one of the major theoretical frameworks that has been used to extent in information technology and computer. This pattern is simplified interpretation of beliefs that affect the adoption of technology. The theoretical basis of this model is two kinds of belief in the name of perceived ease of use and perceived usefulness. Perceived ease of use refers to the belief of the person that the use of computer system does not need his physical and mental effort. In addition, the perceived usefulness means the individual believe that using a computer would be raising his work performance.

Conceptual Model of the present study is based on the model of "IT infrastructure ITIL» and the Technology Acceptance Model. These models explain the factors affecting the acceptance of computer by users and it is a model at the level of individual factors. Davis (1989) suggested that exogenous variables such as organizational factors, social factors, the training, method and other variables are included in the model of technology adoption and their effects on technology adoption will be examined (22).

The research results showed that social factors, organizational factors, attitude toward technology, support for change and innovation, human resources, technical and technological dimension and tend to use technology application to deploy speech recognition technological infrastructure are at a desirable level.

In addition, the research findings revealed that, both individual factors and financial resource dimensions to deploy speech recognition technological infrastructure are not at a desirable level. This finding confirmed the findings of Sanayei and Associates, who analyzed the obstacles to the use of technology, as well as the findings of Fahimi and Zare, who studied the factors affecting the adoption of new technologies in distance education using technology

adoption model (17, 23). Using speech recognition technology requires some people's skills and abilities, so that they could be well established in the studied hospitals. Given that, there is no previous experience of using this technology in the studied society, the previous knowledge, awareness of using this technology in the statistical sample is less, and there is no favorable condition for the deployment of this technology, in terms of individual factors.

In addition, one of the factors that are considered as an obstacle to the deployment of speech recognition technology infrastructure in the studied hospitals is financial resources. Azadi and Mousavi, in their study entitled "barriers to implementing paperless technology in government organizations" have considered economic and non-economic barriers as the main obstacles of the technology implementation. Given that, there is not necessary credit for the preparation and supply of necessary equipment for the hospital, and financial resources required for the different sections of the hospital (16). In addition, necessary credit for workforce training in the use of technology is not provided, financially, the studied hospitals are facing with difficulties to deploy speech recognition technological infrastructure and they are not at a desirable level.

For increasing healthcare professionals' intention to use the new technology, they rest assured that they can obtain adequate training and technical support to using new technology. Jose Asua et al. came to a similar conclusion in their research entitled "Healthcare professional acceptance of telemonitoring for chronic care patients in primary care" (24).

Based on the research findings, the following suggestions are offered:

1. According to the research findings in the field of actions and interactions, the attention of organizations should increase to set and adjust the five effective factors (human factors, structural and technical factors, monitoring and management factors, social factors and strategies of the organization) on IT infrastructure in hospitals. These factors should be involved in decisions of organization, and supportive policies should be made in this respect;

2. Paying attention to the importance of creating suitable technology infrastructure demands attention to experts, professional attitude to work and dedicating suitable and separate space to hospital wards, in this regard, it is suggested, through in-service training and holding workshops, the relevant staffs will be trained;

3. With regard to the undesirable situation of individual factors in the studied hospitals, it is recommended that measures should be taken so than the knowledge and awareness of people from speech recognition technology improve. In addition, a suitable space will be given to people to work with new technologies. In addition, with

educating people and creating a platform for experience this system and encouraging users, we can take steps to strengthen individual factors.

4. Given the poor state of financial resources for the development of new technologies, to the hospitals, it is suggested that the required credit to supply and provide the necessary equipment and adequate facilities for providing equipment to doctors will be allocated.

5. Conclusion

Due to the high volume of work and stressful working environment in health care centers, because of dealing with patients and their health, modify the existing workflow of personnel, and the introduction of new technologies will be difficult and time consuming.

In order to deploy the speech recognition technological infrastructure in health care centers, due to the desire to implement speech recognition technology and a positive attitude and support available in the centers, we can seek to facilitate the required financing. In addition, with educating people and creating a platform for experience this system and encouraging users, we can take steps in strengthening individual factors.

References

[1] Collen MF, Detmer DE. Multi-Hospital Information Systems (MHISs). In: Collen FM, Ball JM, editors. The History of Medical Informatics in the United States. London: Springer London; 2015. p. 459-502.

[2] Wang R, Gu D, Tao F, editors. A study on the construction and management of cloud-based patients accessible hospital information systems. Computer and Computational Sciences (ICCCS), 2015 International Conference on; 2015 27-29 Jan. 2015.

[3] Mashoufi M, Amani F, Rostami K, Mardi A. Evaluating Information Record in the Ardabil Medical Sciences University, 2002. Journal of Ardabil University of Medical Sciences. 2004;4(1):43-9. eng %@ 2228-7280 %[2004.

[4] Mansorian A, Dorodgar K. Designing a software for systematic registration of oral and maxillofacial diseases based on the latest update of the World Health Organization ICD-10 classification system in 2010. Journal of Dental Medicine. 2014;27(1):51-60. eng %@ 1024-641X %[2014.

[5] Ahmadzade F. Evaluation of the complete medical records in public hospitals of Shiraz University of Medical Sciences in 1998. Health Information Management. 2004;1(1):11.

[6] Asadi F, Mahmoodzadeh M. Role of information technology in improving the efficiency and effectiveness of health care organization. The fourth International Conference of Quality Managers; Tehran. Iran2004. p. 15.

[7] Simon A, Davey B, Flaiz B, Karpathiou V, Wickramasinghe N. A Multi-centred Empirical Study to Measure and Validate User Satisfaction with Hospital Information Services in Australia and Germany. In: Wickramasinghe N, Troshani I, Tan J, editors. Contemporary Consumer Health

Informatics. Cham: Springer International Publishing; 2016. p. 91-100.

[8] Sadoughi F GM, kimiafar KH, Ramezanghorbani N. Health information management technology. Tehran: Jafari. 52-259 p.

[9] Yen P-Y, Gorman PN, editors. Usability testing of a digital pen and paper system in nursing documentation. AMIA Annual Symposium Proceedings; 2005: American Medical Informatics Association.

[10] Mönnich G, Wetter T. Requirements for speech recognition to support medical documentation. Methods Inf Med. 2000;39(1):63-9.

[11] Creswell JW, Clark VLP. Designing and conducting mixed methods research. 2007.

[12] Conrad ED. WILLINGNESS TO USE IT INNOVATIONS: A HYBRID APPROACH EMPLOYING DIFFUSION OF INNOVATIONS AND TECHNOLOGY ACCEPTANCE MODELS: Southern Illinois University Carbondale; 2009.

[13] Ologeanu-Taddei R, Morquin D, Bourret R. Understanding the Perceived Usefulness and the Ease of Use of a Hospital Information System: the case of a French University Hospital. Studies in health technology and informatics. 2015;210:531-5. PubMed PMID: 25991204. Epub 2015/05/21. eng.

[14] T. G, Robert G, Bate P, Kyriakidou O, Macfarlane F, Peacock R. How to spread good ideas - A systematic review of literature on diffusion, dissemination and sustainability of innovations in health service delivery and organisation. Center on Knowledge Translation for Disability and Rehabilitation Research National Co-ordinating centre for NHS Service Delivery and Organisation R & D 2004.

[15] Alikhani A, Bahrami A. Identify barriers to the implementation of electronic insurance in the Iran insurance industry and providing proper solutions. insurance industry. 2007;2(86):26. Persian.

[16] Yazdi SA, Madani FM. Barriers to implementing paperless technology in government organizations. Tadbir. 2010;210:5. persian.

[17] Sanayei A, pool JK, Shamsi A, Soltanhoseini M. Analysis of Barriers to the use of information technology in the Office of Sports and Youth in Fars province.using Fuzzy multi-criteria decision-making approach Journal of sport management. 2014;6(2):15. Persian.

[18] Whittaker B. What went wrong? Unsuccessful information technology projects. Information Management & Computer Security. 1999 1999/03;7(1):23-30.

[19] Kunda D, Brooks L. Assessing important factors that support component-based development in developing countries. Inf Technol Dev. 2000;9(3,4):123-39.

[20] Heidari M, Norouzzadeh R, Salari M. Effective factors in Information Technology (IT) acceptance in the view of the nurses working in ICU. Iranian Journal of Critical Care Nursing. 2013;6(3):165-72. eng %@ 2008-3084 %[2013.

[21] Seif MH, Taleebi S, Alipour S. Factors Associated With Accepting and Using Information and Communication Technology among Faculty Members of Payam-e Noor University, Fars Province. The 5th National & 4th International Conference on Skill Training & Employment (ICSTE); Tehran, Iran2016.

[22] Davis FD, Bagozzi RP, Warshaw PR. User acceptance of computer technology: a comparison of two theoretical models. Management science. 1989;35(8):982-1003.

[23] Fahami R, Zare H. factors affecting the adoption of new technologies in distance education using technology adoption model. QUARTERLY JOURNAL OF NEW APPROACH IN EDUCATIONAL ADMINISTRATION. 2013;4(1):12. Persian.

[24] Asua J, Orruño E, Reviriego E, Gagnon MP. Healthcare professional acceptance of telemonitoring for chronic care patients in primary care. BMC Medical Informatics and Decision Making. 2012;12(1):139