A Survey of Physicians' Viewpoints on Effective Factors in Internet of Things-Based Smart Hospitals Succes

Soghra Mahmoodi [1], Mohammad Ali Afshar Kazemi [1, *], Abbas Toloie Eshlaghy [2] and Nosratollah Shadnoosh [1]

[1]Department of Industrial Management, Central Tehran Branch, Islamic Azad University, Tehran, Iran
[2]Department of Industrial Management, Science and Research, Tehran Branch, Islamic Azad University, Tehran, Iran

[*] *Corresponding author*: Department of Industrial Management, Central Tehran Branch, Islamic Azad University, Tehran, Iran. Email: dr.mafshar@gmail.com

Abstract

Background: The Internet of Things (IOT) plays an important role in health care applications and is a system of interoperating computing devices, mechanical and digital machines.

Methods: This descriptive study was carried out in 2017 using a pre-designed questionnaire, using Brender and Richards Heeks information system. It contains managerial, cultural, functional, technical, organizational, political and human factors relating to smart hospital based on internet of things. The questionnaire was completed by all 230 physicians working at university hospitals. Validity of the questionnaire was determined using content validity and its reliability was determined by test-retest method with 95% correlation coefficient. Data were analyzed by SPSS statistical software, using descriptive statistics as well as t-test and analysis of variance.

Results: In this study, 149 (79.5%) males and 38 (20.5%) females participated. Based on the physicians' viewpoints, percentage of agreement for managerial, cultural and organizational factors in creating a smart hospital was higher than other studied factors. Moreover, the viewpoint of male and female physicians on managerial, functional, organizational and human factors in implementing a smart hospital was significantly different.

Conclusions: It seems that the management, organizational, and cultural factors are the most important factors in the implementation of smart hospital in Hormozgan University of Medical Sciences. It is necessary for planners and system owners to pay more attention to these factors.

Keywords: Smart Hospital, Internet of Things, Implementation, Information Technology

1. Background

As a result of recent advances in information and communication technologies, a large amount of health and healthcare information has been created in the healthcare organization, and an enormous amount of new information is collected and recorded every day by healthcare providers and medical equipment (1). Health information technology provides access to advanced healthcare services for patients and medical personnel (2).

Hospital is one of the most important systems that, for various reasons, the proper use of its information is of particular importance. However, rather than being information-based, in many hospitals, patient management is based on experience. The reason for this is that the production, distribution, and use of information in the hospital are not efficient. Most of the information is not obtained in a timely fashion and much of the information, which is needed by managers and the treatment team, is not appropriate enough for decision making. Therefore, they do not usually use the generated information. These defects have created new thoughts about the Internet of Things (3). Smart hospitals use wireless technology to facilitate internal and external communication (4).

The Internet of Things can be used in various medical cases such as patient care, chronic diseases, elderly care, emergency cases, and heart rate and blood pressure measurement (5). Internet of Things software for healthcare consists of glucose level monitoring, electrocardiogram monitoring, blood pressure monitoring, and body temperature monitoring (6). In some studies, effective factors for the success and failure of health information systems were categorized as functional, organizational, behavioral, technical, managerial, cultural, political, legal, strategic, economic, and educational factors (7, 8).

Gichoya listed the factors that influence the success of

ICT projects on organizational strategy, government support, external pressure, organizational support, meeting users' expectations, and technological changes (9). Success and failure factors in implementation of information systems such as adequate managerial and technical skills as well as adequate training of team members and staff are regarded as the influential factors in the success of information systems (10). Heeks in 2002 explained "The most important factors known in this model include management, technical, and human" (11).

2. Objectives

The purpose of this study was to examine physicians' viewpoint on the internet of things. This can help us to create a smart system for physician's and management system to improve diagnosis and treatment of the diseases.

3. Methods

In this descriptive-analytic study, the statistical population includes all clinical faculty members of Hormozgan University of Medical Sciences. The data were collected using a questionnaire, which was obtained from international research papers as well as consulting the experts of Brender and Richards Heeks information systems. The questionnaire consists of two parts: the first part was demographic information and the second part was related to the questions that were based on the objectives of managerial factors (13 questions), cultural factors (10 questions), functional factors (10 questions), technical factors (9 questions), organizational factors (10 questions), political factors (10 questions), and human factors (9 questions). Responses were rated as 1 to 5 based on the Likert scale (1 strongly disagree, 2 disagree, 3 neither agree nor disagree, 4 agree, 5 strongly agree). Validity of the questionnaire was evaluated using the opinions of experts in this field and the reliability of the questionnaire was calculated 78%, which was measured through test-retest method. Data were analyzed by SPSS statistical software using descriptive statistics as well as *t*-test and analysis of variance.

4. Results

Of the total population of 230 physicians, 148 (79.5%) male, and 38 (20.5%) females participated in this study. The results showed that there was a significant difference between opinion of males of females on managerial, functional, organizational, and human factors that were related to smart hospitals, based on Internet of Things (Table 1). Moreover, of 186 (93%) individuals participated in the

study, 164 (88.2%) agreed or strongly agreed with the managerial factor, 158 (84.1%) with the cultural factor, 145 (77.1%) with the functional factor, 149 (80.1%) with technical factor, 159 (85.5%) with the organizational factor, 112 (60.2%) with the political factor, and 150 (80.6%) with the human factor, of the smart hospital system. According to physicians, managerial, cultural and organizational factors were more effective than other factors in setting up a successful smart hospital. Figure 1 shows the percentages of the impact of each of the factors that appear to be effective in setting up a smart hospital.

Table 1. Comparison of Male and Female on Factors Related to Smart Hospital

Factors	T Value	Degree of Freedom	P Value
Managerial	2.19	186	0.029
Cultural	1.43	186	0.154
Functional	2.25	186	0.025
Technical	0.72	186	0.46
Organizational	1.91	186	0.05
Political	1.71	186	0.08
Human	2.6	186	0.01

5. Discussion

Research has shown that the most important factors for implementation of health information systems are the satisfaction of staffing requirements, the suitability of the system with employees' work, adaptation to changes, and the creation of the motivation in users (12). The findings of this study showed that functional factors in the implementation of smart hospitals include system conformance with standard work processes, system compliance with day-to-day operations of the organization, empowering users to provide services using the system, motivating users, and analyzing the stakeholders. The results of the present study are consistent with the results of the other studies and indicate that motivating users to have system compliance with work processes, system compliance with day-to-day operations, and stakeholder analysis are the most important functional factors.

In his research, Staccini et al. noted that interviews with users, managers, and stakeholders of the information system are essential for determining the requirements and models for smart hospitals (13). According to Brender et al., the most important cultural factors are understanding local culture, satisfying users' expectations, adapting to changes, inducing new ways of providing care, and understanding the national culture (Table 1) (8).
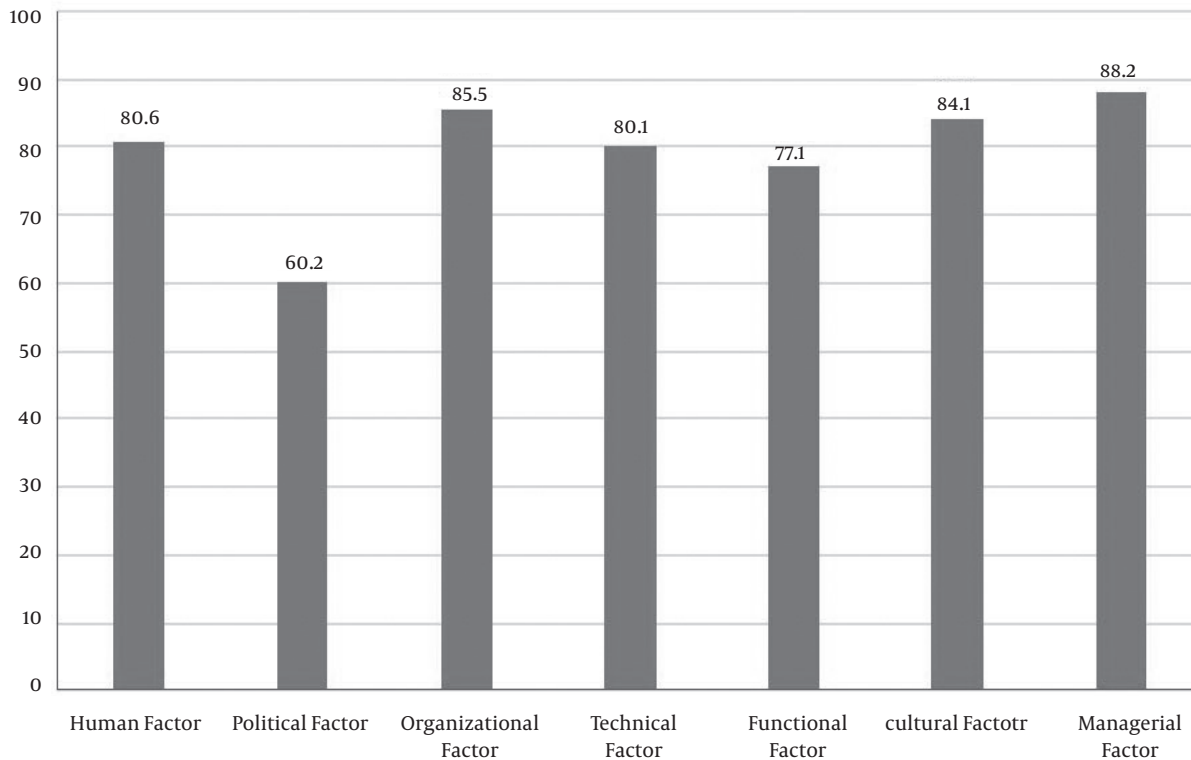
Figure 1. Percentage of impact of factors in setting up a smart hospital, based on physicians' viewpoints

Research has also shown that the most important cultural factors were employee satisfaction from organizational information, acceptance of employee roles, and empowering employees to make organizational changes (14). The results of Hunang and Trauth study in Shanghai shows that the most important cultural factors are understanding culture at different levels, communicating styles and work behaviors, paying attention to the subject of language work, and making the culture uniform (15).

According to Stylianides, understanding the scope of organizational culture and the ability to adapt to changes are the most important cultural factors (12). The findings of this study showed that culture-building in relation to adaptation to changes, the adoption of standardized methods of providing care by the system, the ability to accept new ways of providing care, and the ability to meet high expectations of users by the system are the most important cultural factors affecting the implementation of a smart hospital system. The results of this research support the mentioned studies and indicate that meeting the high requirements of users, accepting new ways of providing health care, understanding culture, and adapting to changes are the most important cultural factors. Measures

should also be taken to meet user requirements and system compatibility with changes as these are the most important criteria for implementing information systems.

Based on the results of Brender et al. study, the most important organizational factors are supporting workflow, transparency of organizational processes, employee participation and cooperation, and preventing over-changes in work processes (8). Based on Cresswell et al. study, the most important organizational factors are outcome of the changes, inter-organization relations, and workflow (12).

This study reveals that the most important organizational factors in the implementation of a smart hospital are the participation and cooperation of all personnel in the implementation of the system, the correct and logical analysis of the organizational analysts of the system, the ability to meet the needs of the user by the system and supporting the workflow. This contradicts the results of the mentioned study and suggests that the participation and cooperation of all personnel and the flow of work should be considered the most important organizational factor. Therefore, to accelerate the successful implementation of a smart hospital, it is necessary to create the necessary plat-

form to support the workflow and collaborate with the staff.

Brender has highlighted the most important managerial factors as, planning, realistic expectations, creating goals and guidelines, providing access to adequate findings, program flexibility, managerial support, user engagement, and active control (8). Our study showed that the existence of realistic planning and expectations, the existence of measures to increase efficiency, adequate funding for implementation, program flexibility, executive support, and the establishment of goals and guidelines are the most important management factors in implementing a smart hospital. This is in line with the results of the research, indicating that planning, realistic expectations, and program flexibility as the most important management factors. Therefore, for successful implementation of a smart hospital, enough time has to be devoted to planning in the organization.

Some studies have shown that the most important technical factors are network technology, security and accuracy of technology, and system development (14). Brender et al. indicated communication standards, technical capability, integrated activity, the ability to interact with other systems, comply with technical requirements, observation of the standards of communication and data exchange as the most important technical factors (8). Based on the findings of the present study, technical factors include compliance with communication and data exchange standards, system flexibility and its ability to adapt, and the ability of the system to respond and report are the most important technical factors affecting the successful implementation of smart hospitals.

The results coincide with the results of the Brender study indicate that compliance with the standards of communication and exchange of data as the most important technical factors. Therefore, in the technical field, it addresses requirements such as the utility and application of technology as well as hardware requirements. However, the present study examines the technical factors before implementing the electronic health record and this can be the reason for the inconsistency of results. In relation to human factors, Brender stated that active involvement of users in the system's work cycle, arranging organized visits, identifying the reasons for accepting the system from users, identifying the internal communications of the organization, identifying the organization's external communications, preparing the users, assessing users' skill levels, evaluating the causes of user acceptance, and reviewing users' viewpoints are the important human factors (7).

The results of Ramos and Mota outlined the most important human factors as: trust, training, communication, empowerment, strong project leadership, and staff preparation for change (16). Findings of the present study showed that issues such as education, the presence of influential and capable leaders, active cooperation of users at all levels, and empowerment of users at all levels are the most important human factors that influence the implementation of systems. The results of this study coincide with the mentioned study, indicating that active user interaction at all levels, training, empowering users, and the presence of influential and capable leaders are considered the most important human factors.

Brender et al. study indicated the most important political factors are the co-operation and focus of the country's policy on providing new solutions, political clarity, sharing concepts and models of regional or national data, high level of commitment to the national strategy, willingness to invest, and political awareness (8). Based on the findings of the present study, the most important political factors are: high level of commitment to the national strategy, the coherence of various national policies, the cooperation and political concentration of the country in providing new solutions and making various decisions, especially in the budget. The results support the Brender's study, indicating that the country's political cooperation and focus on providing new solutions and high-level commitment to the national strategy are the most important political factors and require a system review by the implementing agency. There should also be arrangements for cooperation, focus, and commitment to accelerate the implementation of the system.

Supplementary Material

Supplementary material(s) is available here [To read supplementary materials, please refer to the journal website and open PDF/HTML].

Footnotes

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