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A Model to Accepting the Internet of Things by Health Managers in Iran: A Mixed Approach

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Abstract: **Development along with internet technology and related applications, a new paradigm like the Internet of Things (IoT) in the field of wireless communication in the modern world has been introduced. This paradigm allows billions of electronic devices around the world to connect to the internet to collect and share data. Health has known as one of the main applications of this technology in this regard. By utilising the IoT, managers of hospitals can monitor patients' conditions day and night, check their vital signs, prevent acute illness and drug interactions, and ultimately reduce the cost of treatments. According to the importance of establishing acceptance in users before implementing any technology, this study found a way to identify and prioritise the factors affecting the acceptance of the IoT among health managers by using mixed methods. The qualitative methodology used in this study is known as grounded theory, and the quantitative methodology a descriptive-survey method. However, this research article aims to establish a model for accepting the Internet of Things by health managers in Iran. Finally, this research article recommends establishing technical infrastructure appropriate in the context of the Internet of Things.**

Keywords: The Internet of Things, Grounded Theory, Smart Health, Technology Acceptance.

I. Introduction

In the present era, smart health is known as one of the vital concepts that have been given more attention in both academic and industrial areas. While health situations are monitored in the context of Information and Communications Technology (ICT), most medical problems are reduced [1]. There are many different ways to control, monitor, and diagnose the disease of individuals. One of the vital platforms in this regard is called the Internet of Things which has grown patient health monitoring systems in hospitals, and improved real-time responsiveness. In fact, one of the most significant roles of the IoT providing a reassuring atmosphere in the health industry [2].

At the first, communicating and exchanging data between two computers were the idea of creating the internet, but with the time passing by and progressions in various fields and industries, the idea of establishing communication among things, without human intervention through the internet was formed. The concept of the Internet of Things was introduced and developed in 2009 by Kevin Ashton, a pioneer in technology [3]. The Internet of Things has several positive benefits in the field of health and healthcare. Reducing mortality rate and increasing longevity, especially for patients, is the purpose of using the IoT in healthcare, like monitoring and controlling patients' vital signs all day and night by sensors connected to the internet [4]. These facilitate the exchange of information over the internet between medical devices and physicians' access to the information at a given time [5]. The most research articles and projects in the healthcare field in the context of the Internet of Things have been done because of chronic diseases and monitoring the patients. In fact, analysing health data using Artificial Intelligence (AI) is possible by using the Internet of Things [6]. The significance and potential of implementing the IoT in Iran are not well understood, and its use is limited to machine-to-machine communication and RFID technologies. Providing an appropriate context to facilitate business processes, thereby improving the quality of work and performance, is the purpose of all technological advances. Hence, the perspective of policymakers, managers, and end-users determines the applicability of technology, in the context of the Internet of Things. Healthcare professionals and patients can benefit from the acceptance and utilisation of the IoT during the diagnosis and treatment process [7].

Realisation and awareness of healthcare managers are crucial in the successful implementation of the IoT so if these managers are reluctant to use this technology, it is quite difficult to establish the conditions for its implementation and use of it. According to the research findings above and observed deficiencies in consideration of the IoT in Iranian research in various fields, especially in the healthcare field, in the present study, the aforementioned technology from Iran's healthcare managers.

Also, attempts to identify the factors that affect their decision to adopt the IoT has been examined. By identifying the effective factors, it is likely to provide the possibility to implement and use the Internet of Things in health among managers in Iran. This one has been argued as the gap in this research. In addition, the goal of using the Internet of Things between clinics and hospitals includes decreasing the death of different ages of ones, increasing the quality of treatment and other services, real-time responsiveness using remote care of patients, and so on [8].

The point of view among policymakers, managers, and end users determines the applicability of a specific technology. Therefore, the main goal of conducting this study has been to provide a suitable platform for the ease of carrying out work processes and increase the quality of performance and work and personal life of people. It has also been mentioned the goal of conducting this research article in the literature review section.

All in all, the literature review has been prepared as the second part of this research article, the third section named conceptual framework, research methods are presented in the fourth part of this paper, and results have been presented in the fifth section of this study, and the conclusion has been sorted as the sixth part of this research, managerial implications are discussed in the seventh section and finally limitations and future research it has been presented in the eighth part of this research article.

II. LITERATURE REVIEW

The term the Internet of Things was argued in 1999 by Ashton [3], a system that is able to communicate things through sensors to the internet. The concept of the Internet of Things was introduced, after the explosion of the wireless devices market, the and introduction of the Radio Frequency Identification (RFID) and Wireless Sensor Networks (WSN) technologies. The IoT concept seeks to connect objects like cameras, sensors, wearables, and so on with people at any time and everywhere. Using objects, such as sensors, actuators, RFID tags, and readers, makes the IoT interaction between the physical and the virtual world possible [9].

In particular, the Internet of Things has combined a wide range of technologies, as well as sensors, actuators, the internet, cloud computing, and many communication infrastructures [10]. However, the most accepted definition of the IoT is a technology in which numerous smart devices are used to provide communication services by internet standards. These smart devices have been able to operate without human intervention [11]. From the consumer perspective, being available every time - everywhere is the most important feature of this technology. From the business user's viewpoint, automation of various processes such as logistics, intelligent transformation of goods, and monitoring staff, which cause saving time and wealth and therefore make managers' decisions more effective, are the most important features [12]. Among all the substantial features of the IoT to address users' needs, the following can be noted: localisation and tracking capabilities; establishing security mechanisms to protect privacy; meaningful collaboration, and data management [12, 13]; energy-optimised solutions and saving energy (battery longevity) [12, 14]; scalability; heterogeneity [15] [12, 16]; self-organisation capabilities [17]; and data exchange through wireless technologies [18, 19].

Many companies have benefited the Internet of Things to automate their daily processes and operations also monitoring and securing for various industrial sectors, processes, devices, and individuals [20]. More intelligent app applications for the smart office, smart hospital, intelligent transformation systems, smart homes, and factories can be expected in the future [21]. The Internet of Things has changed the role of ICT as empowering innovations in different markets [22]. Generally, IoT applications could be used in the following areas: environment scanning and monitoring, intelligent city, business, inventory management, and product management, smart building, healthcare, and smart security.

A. The Internet of Things in healthcare

Research findings that have shown the Internet of Things has several benefits and potential solutions to alleviate the pressures on healthcare systems [23]. Therefore, a substantial amount of work has been focused on using IoT applications in the field of healthcare that had been monitored patients with specific conditions such as Parkinson [24], cancer treatment [25], continuous glucose monitoring (CGM) [26] or diabetes [27]. Even though this technology can be used in the internet environment and sometimes without human interventions, its successful implementation needs users' acceptance.

Research findings confirm that the Internet of Things technology can measure physical parameters by Wi-Fi for an alert message via E-Mail and so on, which can be sent to the doctors or Electronic Health Record (EHR). The Internet of Things platform has helped researchers to measure blood pressure, oxygen, heart rate, glucose level and so on using Node MCU [2]. Integrating the Internet of Things and Deep Learning algorithms has created a strong remote health monitoring system for analysing data. Also, in this condition, evaluating the process in real-time has been possible, because real-time responsiveness is one of common issues in healthcare systems in hospitals [6]. Accordingly, and according to the evidence from research findings that have shown, monitoring the health condition based on the IoT and analysing health data on it have added more electronic devices and sensors to the smart city [28].

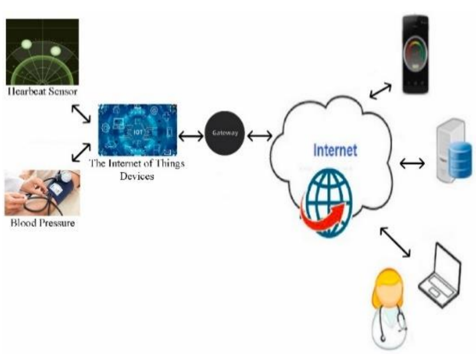

Figure 1. A healthcare system model in the context of the Internet of Things [28].

AI-driven IoT has been adopted by hospitals for years, and devices of the Internet of Things have also been playing vital roles in electronic medical records and patient rooms. Approximately 30% of the U.S. people have serious diseases like diabetes, blood pressure, or heart disease these technologies can have more benefits of treating with real-time responsiveness [28].

All in all, studying affective factors on the acceptance of the Internet of Things among healthcare managers is the first step in implementing this technology.

B. Security and privacy in the Internet of Things

Before using the vision of the Internet of Things and expanding it into reality, many challenging security issues must be addressed. It is necessary to answer quite difficult questions about enabling the IoT while guaranteeing aspects like trust, security, and privacy [9]. Due to the variety of devices and multiple communication protocols in IoT systems as well as diverse user interfaces and services, IoT systems security and abandoning traditional IoT network solutions should be considered [29].

In fact, in the IoT systems, security and privacy errors have always been on the rise, and that is why these issues were common reasons for the prevention of the Internet of Things' growth. The Internet of Things is one of the key puzzles to creating an intelligent city that can reduce the cost of living, privacy, and security were able to be established to eliminate vulnerabilities [30]. On the other hand, privacy and security were addressed on the Internet of Medical Things (IoMT). Traditional health and healthcare platforms have supported it. In these platforms, privacy and security have always been vulnerable because of the limited resources etc. Moreover, privacy and security challenges in IoMT have been classified, and a strong attack taxonomy had been provided against different algorithms and devices [31]. In addition to the privacy and security, confidentiality and data integrity and the quality of data obtained from the Internet of Things, because of the impact of different people's access to personal information and error prevention, are especially important [32].

C. Acceptance of the key factors of the IoT-based healthcare systems

After reviewing the literature review and models on information technology acceptance, various factors influencing technology acceptance, particularly in the Internet of Things are identified. Some of these factors have been mentioned in Table 1.

There are rather difficult challenges that have become to getting approval from patients' security, privacy, trust, and accessibility in healthcare centres. Research findings confirm that the integration of AI and the Internet of Things provided high accuracy in data analysis of healthcare, and that is why security and real-time responsiveness are playing a vital role in healthcare data analysis [6]. In addition, research findings confirm that the perceived usefulness, perceived ease of use, trust, and attitude have positive performances on the acceptance of IoT-based healthcare systems. In particular, the aim of every smart healthcare project has been to achieve the loyalty of healthcare end-user. Besides trust, perceived ease of use, and perceived usefulness, the patient's conditions should control [33].

Acceptance factors	Resource
Security	[34]; [35];[36]; [9]; [37]; [6]; [30]
Privacy	[38]; [39]; [40]; [37]; [6]; [30]
Accessibility	[38]; [7]; [41]; [6]
Trust	[42]; [43]; [44]; [33]; [45]; [37]; [6]
Attitude	[46]; [47]; [43]; [33]
Perceived ease of use	[48]; [7]; [33]; [49]; [50]
Perceived usefulness	[48]; [7]; [33]; [49]; [50]

Table 1. Key factors affecting the acceptance of the Internet of Things in the field of healthcare obtained from previous studies.

Furthermore, due to the previous research, security, privacy, and trust have been argued as key factors in the acceptance of IoT-based healthcare systems and growing them. Although there are more factors in this regard, this study has reviewed seven important key factors affecting the acceptance of the Internet of Things in the field of healthcare obtained from previous studies.

Finally, the purpose of this research was not to cover all significant factors which made had an impact on hospital managers and so on, but a few vital factors (Table 1) were investigated. Assessing managers of hospitals and policymakers' familiarity and their point of view with this field was an important aim of this research.

III. CONCEPTUAL FRAMEWORK

Generally, technology usage is the result of its acceptance [51]. Acceptance has two dimensions: the first one is based on rationality and maximising using tools; the second one is based on irrational behaviours due to social pressure and imitation of one's behaviour [52]. Fishbein and Ajzen introduced the Theory of Reasoned Action (TRA), which suggests that the performance or non-performance of a given behaviour is determined by the strength of a person's intention to perform or to not perform that behaviour [53]. Also, Ajzen introduced the Theory of Planned Behaviour (TPB) which postulates that intentions to engage in healthy behaviour are directly influenced by a person's attitude toward the behaviour and perception of subjective norms concerning the behaviour [54]. But the most well-known model in this context is the Technology Acceptance Model (TAM) developed by Davis with two primary factors affecting an individual's intention to use new technology: perceived ease of use and perceived usefulness [48]. Research findings confirm that factors which influence IT implementation and acceptance in healthcare are the same factors in the Davis model [55]. Another research conducted examined the existing literature on the acceptance model in the healthcare industry. The study evaluated the barriers to IT adoption and classified them as subjective and objective. This model is mainly subjective and mostly consists of subjective factors, including perceived ease of use and usefulness [56]. Given categories resulted from coding in grounded theory, research framework, in the form of a paradigm model suggested. In this model, the main categories are depicted around the core category and the relationships between them. Each paradigm model has three components: context, interactions, strategies or processes, and consequences. Figure 2 has explained the conceptual framework.

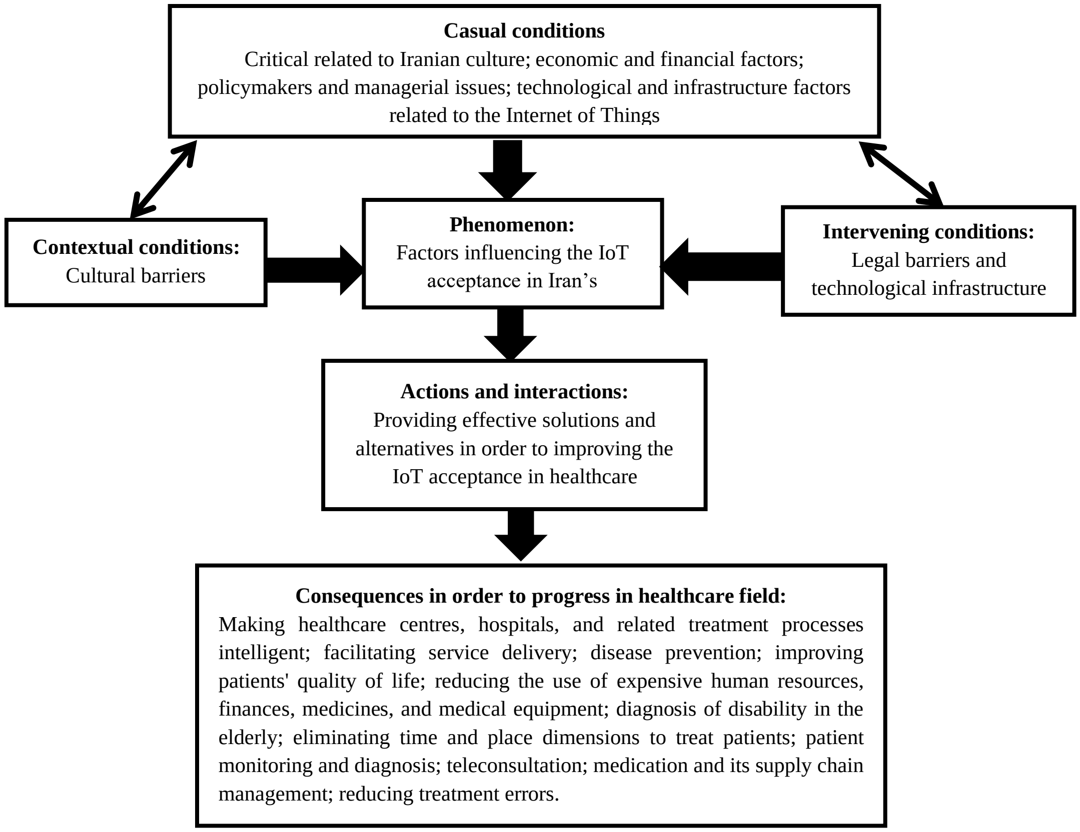

Figure 2. The conceptual framework.

Based on open coding and interviews analysis and literature review, generally, four main categories were selected. These categories are Iranian cultural, traditional factors, financial and economic factors, policymaking and managers-related factors, infrastructure, and technical factors, all related to the IoT. In axial coding, relationships among open codes were identified. Based on relations among main components and elements from axial coding about factors influencing healthcare managers' acceptance of the Internet of Things in Iran, figure 3 is introduced.

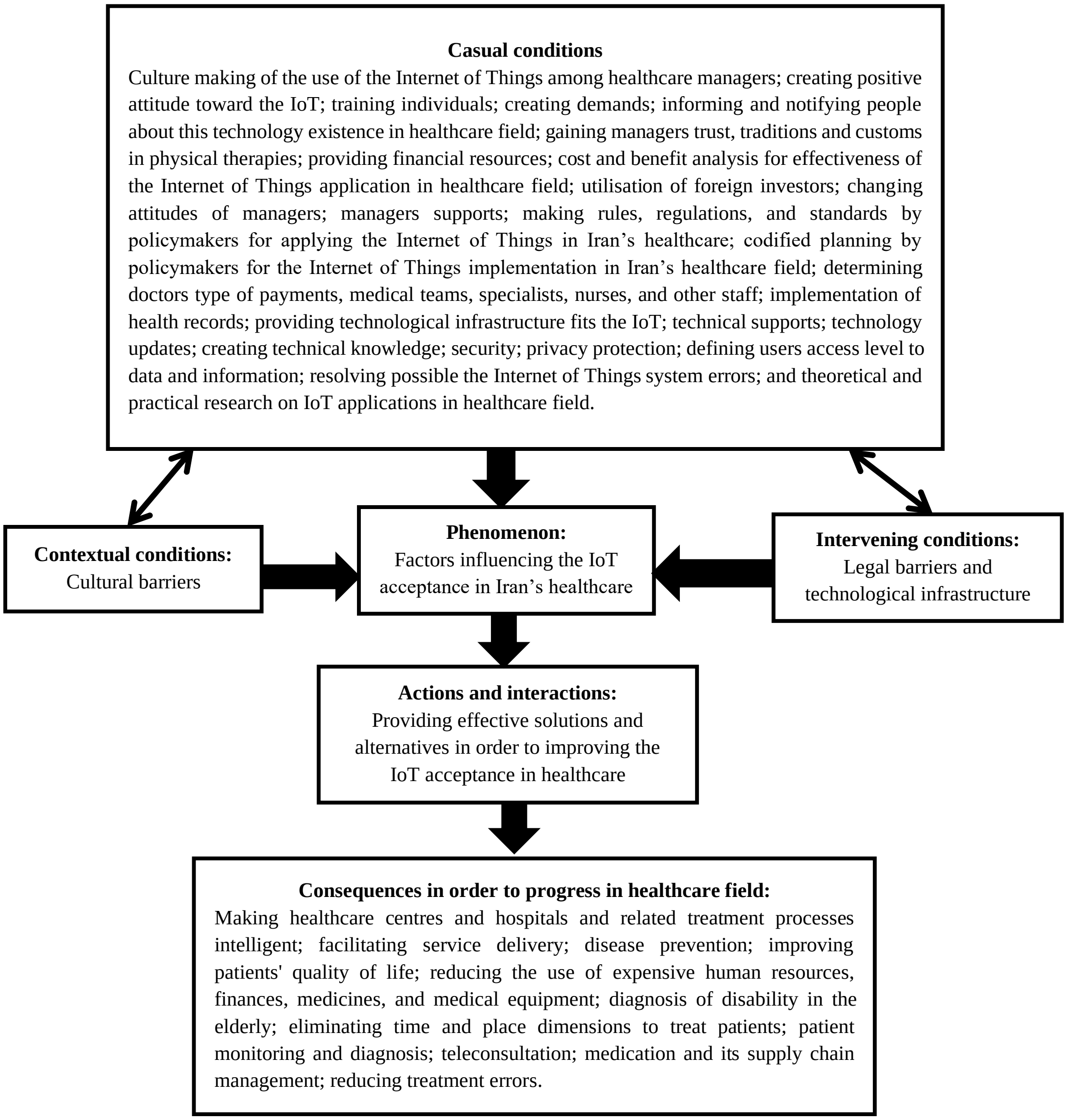

Figure 3. Axial coding based on the paradigm model.

In this paradigm model, conditions can exist as causal, intervening, contextual, or all of these. *Causal conditions* refer to the factors that lead to the occurrence of the phenomenon, the subject under study, or the central idea [57]. Among the identified categories, issues related to "Iranian cultural and traditional factors, financial and economic factors, policymaking and managers related factors and infrastructure and technical factors" are casual conditions. *Intervening conditions* refer to those conditions that "mitigate or otherwise impact causal conditions on phenomena" [57]. In this study, "legal barriers" is an intervening condition. Contextual conditions are the "specific set of conditions or patterns of conditions that intersect dimensionally at this time and place to create a set of circumstances or problems to which persons respond through actions/interactions" [57]. Cultural barriers resulting from open coding in this study, are the contextual condition, which are conditions in society, the Ministry of Health, hospitals and medical centres environment, and medical universities and are capable of affecting the Internet of Things acceptance in healthcare. Actions and interactions are processes facilitated and constrained under given conditions [57]. Offering effective solutions to positively affect the IoT acceptance and factors influencing it have been suggested actions in this study. Finally, consequences referred to the outcome of the phenomena as they are engaged through action and interaction [57]. In fact, and in this study, achievements resulted from implementing and using the Internet of Things in healthcare. These consequences are already shown in figure 3.

Selective coding, is about figuring out the core variable that includes all of the data. Then, rereading the transcripts and selectively coding any data that relates to the core variable that is identified in this study. In this study selective coding, factors were investigated which are necessary for implementing and using the Internet of Things in healthcare, so that by considering these factors while using the Internet of Things, the project's fail percentage will decrease or the likelihood of success will rise. Accordingly, the research hypothesis, indicating the main categories as affective factors in the IoT acceptance by healthcare managers in Iran, are as follows:

H1: Critical related to Iranian culture are one of the affective factors in the IoT acceptance from healthcare managers' viewpoint.

H2: Financial and economic are as affective factors in the IoT acceptance from the healthcare managers' perspective.

H3: Policymaking and managerial issues related factors are one of the affective factors in the IoT acceptance from healthcare managers' standpoint.

H4: Infrastructure and technology-related factors are one of the affective factors in the IoT acceptance from healthcare managers' perspective.

These hypotheses are all formed after going through ground theory steps and, in the following section, quantitative methods were used to prove and prioritise them.

IV. RESEARCH METHODS

Mixed methods research is the use of quantitative and qualitative methods in a single study or series of studies; which is increasingly used by health researchers, especially within health services research [58]. In this section, the researcher has collected, analysed, and integrated both quantitative and qualitative research and data within a single study. By doing so, the researcher gained the benefit of a deep understanding while avoiding the weaknesses inherent in each research approach. Regarding the research methods, the study population included two parts. First, from the qualitative perspective, experts on the subject have constituted the statistical population to extract concepts and theoretical criteria. Snowball sampling was used to select these experts. Eventually, 8 experts were selected to interview and complete the research process. Second, from the quantitative perspective, the statistical population comprises 60 key experts in the healthcare field including professors, policymakers and hospital managers in Tehran, Iran. Familiarity with the Internet of Things and its applications criterion helped to restrict experts in the healthcare field to qualified ones. Also, these experts were selected by the snowball sampling method.

A. Qualitative Methodology

Identifying some important factors by using qualitative methodology to use the Internet of Things in health was one of this section's goals. Grounded Theory was chosen as the qualitative methodology for the interview process in this study. Grounded theory has been known as a systematic methodology so that involved the construction of hypotheses [57]. In the second stage, according to the findings of the first stage of the research, a qualitative questionnaire was prepared with factors obtained from previous studies and the opinion of experts in this field. In the present study, the number of interviewees was 8 experts in the field of health who were familiar with the field of the Internet of Things. Seven experts include university professors who were teaching informatics and health information systems with more than 7 years of experience, and the end person was working in the health industry with more than 10 years of experience. So, experts got acquainted with the subject of the Internet of Things and its application in the field of healthcare. In-depth interviews were conducted with these participants until the saturation point was reached. Finally, with this information obtained from interviews, factors affecting acceptance were determined.

B. Quantitative Methodology

In the quantitative section, a questionnaire was used as a tool for identifying the importance and priority of factors influencing healthcare managers' acceptance of the IoT. The questionnaire has been constituted of 7 categories and 25 questions; each question measures the degree of factors' importance based on the Likert scale (1 = very low; 5 = very high). Given the results of interviews, as well as the literature review, obtained indicators (i.e. concepts and categories resulting from open coding) were extracted. The questionnaire reliability was confirmed through Cronbach's alpha ($\alpha = 0.71$). Content validity was also confirmed by a survey of experts who are both experts in healthcare and IT.

Finally, Friedman test and theoretical coding (based on grounded theory) were used, respectively, in quantitative and qualitative sections as analytical methods.

Category	**Concept**
Issues related to Iran culture	Culture making to encourage the use of the IoT among healthcare managers
	Creating a positive attitude among top managers in the healthcare field
	Individual training
	Making demands
	Informing and notifying managers about the Internet of Things existence in the healthcare field
	Gaining managers trust
	Tradition and customs in treatment methods
Economic and financial factors Policymakers and managers factors	Cost and benefit analysis in using the IoT effectively
	Using foreign investors
	Establishing financial platform
	Changing managers attitudes
	Managers support
	Creating bylaws, standards, rules, and regulations by policymakers to apply the IoT in the healthcare field
	Making written plans by policymakers and managers to apply the Internet of Things in the healthcare
	Determining physicians, medical teams, experts, nurses, and other staff types of payment
	Electronic health record
Technological and infrastructure factors related to the Internet of Things	Establishing technical infrastructure appropriate to the IoT
	Technical supports
	Technological updates
	Creating technical knowledge
	Providing security
	Protecting privacy
	Defining users accessibility level to data and information
	Resolving possible errors in the IoT systems
	Theoretical and practical research on the IoT applications in the healthcare field

Table 2. Questionnaire indicators of factors influencing the acceptance of the IoT in healthcare.

C. Data collection and analysis

Initially, 75% of the respondents had PhD degrees and 20% were PhD students and the last 5% had a master's degree. In addition, 61% of the participants were experienced with the Internet of Things at inadequate levels (41% average and 20% high). Therefore, the respondents had rather the knowledge of the study subject. Based on data statistical analysis methods applied in this study, "providing infrastructure appropriate to the Internet of Things" received the highest score, and "implementing e-health records" received the lowest score.

V. RESULTS

The statistical tests used in this section are the one-sample t-test and the Friedman test. In a one-sample t-test, this quite a difficult question was answered, “Which one of the identified factors has more significance?” The significance score is 0.0001 for all constructs except for “implementing e-health records” (sig = 0.245; sig> 0.05). Hence, this factor doesn’t have average significance. Table 3 represents the test results for all factors influencing the Internet of Things acceptance by healthcare managers. The assumptions of this test are as follows:

H0: The difference between the true mean and the comparison value is equal to zero. (x≠3 μ)

H1: The difference between the true mean and the comparison value is not equal to zero. (x=3 μ)

Concept	**Mean**	**SD**	**Mean difference**	**Sig.**	**T**	**Mean rank**
Culture making to encourage the use of the Internet of Things among healthcare managers	4.43	0.767	1.433	0.000	14.470	15.39
Creating a positive attitude among top managers in the healthcare field	4.20	0.732	1.200	0.000	12.701	13.19
Individual training	4.58	0.561	1.583	0.000	21.853	16.34
Making demands	3.47	0.791	0.467	0.000	4.569	8.08
Informing and notifying managers about the Internet of Things existence in the healthcare	4.10	0.752	1.100	0.000	11.325	12.96
Gaining managers trust	4.37	0.843	1.367	0.000	12.557	15.14
Tradition and customs in treatment methods	3.70	0.926	0.700	0.000	5.855	9.58
Cost and benefit analysis with using the IoT effectively	4.18	0.813	1.183	0.000	11.276	13.24
Using foreign investors	3.40	1.012	0.400	0.003	3.062	7.78
Establishing financial platform	4.75	0.541	1.750	0.000	25.069	17.74
Changing managers attitudes	4.72	0.454	1.717	0.000	29.262	17.28
Managers support	4.77	0.465	1.767	0.000	29.457	17.91
Creating bylaws, standards, rules and regulations by policymakers to apply the Internet of Things in the healthcare	4.25	0.704	1.250	0.000	13.751	13.46
Making written plans by policymakers and managers to apply the Internet of Things in healthcare	4.23	0.647	1.233	0.000	14.755	13.05
Determining physicians, medical teams, experts, nurses, and other staff types of payment	3.77	0.927	0.767	0.000	6.404	10.10
Electronic health record (EHR)	3.15	0.988	0.150	0.245	1.175	6.61
Establishing technical infrastructure appropriate to the Internet of Things	4.82	0.431	1.817	0.000	32.614	18.42

Technical supports	4.42	0.497	1.417	0.000	22.072	15.08
Technological updates	3.72	1.059	0.717	0.000	5.241	10.64
Creating technical knowledge	3.65	1.087	0.650	0.000	4.634	10.27
Providing security	3.93	1.163	0.933	0.000	6.219	12.03
Protecting privacy	4.10	0.796	1.100	0.000	10.702	12.78
Defining users' accessibility level to data and information	3.63	1.057	0.633	0.000	4.641	9.84
Resolving possible errors in the Internet of Things systems	4.13	1.142	1.133	0.000	7.688	13.73
Theoretical and practical research on the IoT applications in the healthcare field	4.37	0.663	1.367	0.000	15.967	14.36

Table 3. Variable descriptive indicators; One-sample t-test results to investigate all the study variables based on their importance for the Internet of Things acceptance by health managers; and Friedman test results to prioritise factors influencing the Internet of Things acceptance by healthcare managers.

To prioritise factors influencing the acceptance of the Internet of Things among Iran's healthcare managers, the Friedman test is used. Friedman test results show if the original variables have a similar distribution and whether the population distribution of rating variables is identical (null hypothesis). According to results from this test (Chi-Square = 347.639; df = 24; Asymp. Sig. = 0.001), at least one pair of factors mean ranks are not equal (Table 3).

VI. Conclusion

In this study, 25 factors were identified as influencing factors on the Internet of Things acceptance among Iran healthcare managers. These factors are: culture making the use of the Internet of Things among healthcare managers, creating a positive attitude toward the Internet of Things, training individuals, creating demands, informing and notifying people about this technology exists in healthcare, gaining managers' trust, traditions and customs in physical therapies, and providing financial resources, cost and benefit analysis for the effectiveness of the Internet of Things application in the healthcare field. In addition to these factors, utilisation of foreign investors, changing attitudes of managers, managers' support, making rules, regulations, and standards by policymakers for applying the Internet of Things in Iran's healthcare were used.

One of the purposes of the current research was about expanding the knowledge of the researchers in this regard. It is obvious that the findings of this study can develop the reader's knowledge in this field. Also, codified planning by policymakers for the IoT implementation in Iran's healthcare field, determining doctor type of payments, medical teams, specialists, nurses, and other staff, implementation of health records, and providing technological infrastructure that fits the Internet of Things have been mentioned.

Finally, technical support, technology updates, creating technical knowledge, security, privacy protection, defining users' access level to data and information, resolving possible Internet of Things system errors, and theoretical and practical research on the IoT applications in healthcare.

According to the study results, identified factors prioritised and "providing technological infrastructure appropriate for the Internet of Things" placed at the top (mean rank = 18.42), and "Electronic Health Record" got last on the list (mean rank = 6.61). Based on the conceptual framework proposed in this study, identified factors influencing the acceptance of the IoT in Iran's healthcare field can be categorised as follows:

1. Intervening conditions: legal barriers and technological infrastructure.
2. Contextual conditions: cultural barriers.
3. Casual conditions: all 25 factors were identified as influencing factors on the Internet of Things acceptance among Iran's healthcare managers.

Reviewing existing literature revealed that the most discussed subjects are challenges, applications, and influencing factors on information technology and the Internet of Things from the users' viewpoint. One not discussed topic is the Internet of Things acceptance from healthcare managers' perspective.

According to the research findings that have shown, an integrated model included three affective factors on technology acceptance (perceived usefulness, perceived ease of use and trust) [59], understanding the model is too important to the prediction of the adoption behaviour. In fact, people's perceived privacy in the acceptance model has the effect of trust on behavioural intention [60]. The difference between their study and the present one is the statistical population, in their study end-users' acceptance was discussed while in the present study acceptance of managers is considered. Also, in their study, they have a general look and did not pick a special field or industry to investigate. In addition, key factors such as economic, technological and infrastructure are not considered. It has been argued that there are quite impacts of monitoring diabetes via high-tech wearables as well as smartphones on this technology acceptance. For this purpose, researchers used both virtual (in the lab) and the Internet of Things systems in the real-world [61, 62]. Unlike the present study, they used laboratory methods and different statistical population (doctors and patients).

On the other hand, another study reviewed the Internet of Things architecture and its challenges and applications. They suggested key challenges related to the Internet of Things such as identity management, meaningful collaboration and standardisation, information privacy, object security, and green IoT management [34]. Research findings have also shown health analysis and data integration in this regard are associated with modern technologies like machine learning technology so that this research had been argued these points [63]. This study has not been pay attention to economic and financial, cultural, policymaking and managerial factors in the Internet of Things. It has been noticed that perceived ease of use, trust, and social influences are factors influencing end-users acceptance of the Internet of Things [36, 64]. The present study because of the use of a mixed methodology has more comprehensiveness and preciseness.

VII. MANAGERIAL IMPLICATIONS

Based on the study results, providing technological infrastructure appropriate to the Internet of Things is the priority. Therefore, this research suggestion establishing improved communication infrastructure, sufficient bandwidth, increasing internet speed and its landscape covering the entire country. Because of managerial support's importance in technology implementation success, creating a positive attitude, collaboration willingness, encouraging staff to use new technology and practical field research might influence the IoT acceptance among health ministry policymakers and managers in Iran. To gain managers' trust on the Internet of Things, holding domestic and international workshops might be useful.

The financial platform in any industry plays a vital role in the industry development. Moreover, given the high annual spending in healthcare for individuals' treatments, it has been recommended that these costs be invested in technologies like the IoT. In the long term, not only will reduce financial and human resources costs but also will help improve the quality of healthcare services. Culture making and informing people at different managerial levels (policymakers, senior executives, middle managers, operational managers, physicians, medical teams and nurses) are to improve acceptance of technology and its applications. As a result, a combination of new therapeutic approaches with traditional methods can be expected to provide better quality and faster healthcare services. Creating by-laws, standards, written rules and regulations that require managers to use the Internet of Things in healthcare in Iran will lead to raising transparency and trust. Therefore, due to the complexity of the Internet of Things devices and the high volume of data acquired from these devices, we suggest that rules should be set out to prevent potential misuse and opportunistic behaviours when referring to such issues.

It is also important to consider technological and technical considerations related to technology usage, including technical knowledge creation, security, privacy, and support for the IoT systems. It would be better to increase the level of technical knowledge in this field by taking the necessary measures to provide an academic curriculum to develop specialists.

VIII. LIMITATIONS AND FUTURE RESEARCH

Despite the best effort, this study had some limitations. First, there were some limitations in conducting interviews, including lack of easy access to healthcare experts, lack of familiarity with the Internet of Things among some of these experts, and lack of interest in collaborating with interviewers. Also, in the quantitative part of this study, finding 60 individual experts familiar with the study subject was quite the difficult. The field of healthcare has its particular extent, on the other hand, the IoT is a rather new and complex field, which makes the need for the combination of these two fields more interesting and more important. Since we have now tested our model, future works might consider other constructs and examine more complex relationships. In addition, because of cultural considerations, some of the experts were not willing to collaborate, therefore generalising this study's results face some limitations. The list of issues that have been covered, while not arbitrary, is surely incomplete. For instance, it has also not discussed gender, educational levels and related criteria. In fact, there is much work still to be done, and this study encourages ones to continue and expand the conversation in this regard. The aim has not been to be comprehensive, but rather to indicate some ways in which the Internet of Things applications in healthcare at the managerial level, specifically in Iran can be triggered.

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