The Advantages of Implementing Cloud Computing in the Health Industry of Iran: A Qualitative Study

Leila Erfannia[1], Farahnaz Sadoughi[2], Abbas Sheikhtaheri[3]

1. PhD candidate of health information management, Health information management department, School of health management and information sciences, Iran University of Medical Sciences, Tehran, Iran

2. Professor of health information management, Health management and economics research center, School of health management and information sciences, Iran University of Medical Sciences. (Corresponded author) Address: Number 6, Rashid Yasemi St., Vali-e-Asr Ave., Tehran, 1996713883, Iran.

3. Assistant Professor of health information management, health information management department, School of health management and information sciences, Iran University of Medical Sciences, Tehran, Iran

Abstract

Cloud computing as a modern technology has brought various benefits to the healthcare industry. The purpose of the present study is to introduce the advantages of implementing cloud computing in the health industry of Iran, which was conducted through a qualitative methodology by interviewing 12 experts in the field of health and cloud computing in Iran. Data were analyzed through qualitative content analysis and open coding. At the end, four sub-themes were extracted under the main theme of the advantages of cloud implementation in the health industry of Iran. The sub-themes included technical, organizational, economic, and security advantages which encompassed the following categories: specific health capabilities, technical support, high-level and hospital capabilities in the organizational area, relative benefits and organizational cost reduction in economic field, and security opportunity in the area of security. Considering the novelty of cloud computing in the health industry of Iran, recognizing its benefits and opportunities plays a significant role in using this technology successfully. Health programmers and administrators will take firm steps in the both areas of planning and implementation with the knowledge of what opportunities migrating to the cloud computing could have.

Key Words:

Cloud computing, Implementation, advantages, opportunities

1. Introduction

In recent years, health industry has had significant growth in Information Technology (IT) solutions, which has led to an increase in hardware infrastructure and advanced medical software that will accelerate the processing of information and speed up the delivery of health services. The growth of data produced by medical and clinical communities requires the use of advanced resources and techniques in the field of storage and computing; therefore, in order to meet the needs of different medical units and hospitals, systems levels have to be improved through the use of advanced science and technology.(1) Cloud computing is one of the novel technologies which can provide various benefits to the healthcare industry.(2) Cloud computing could be defined as hardware and software computing sources which are provided as services through a network such as the internet.(3)

Using cloud computing prevents various primary infrastructure expenses; such savings can be invested in the implementation of new systems. Maintenance costs are reduced as well since hospitals no longer need to hire employees for maintaining the systems. In addition, through the use of cloud computing, the efficiency of medical staff will increase as they will be able to perform faster and more efficiently.(4)

Cloud computing has provided a proper opportunity for clinics, insurance and pharmaceutical companies, and other healthcare groups to create collaboration and transfer data, which will lead to improved service quality and cost reduction. (5) The existence of national information sharing platforms based on cloud creates the possibility for the personnel of different health system departments to access electronic medical records, copies, and laboratory results from anywhere throughout the world; consequently, the risk of incorrect diagnosis or prescriptions will reduce through the existence of a central source of information.(6)

Various studies have been conducted so far to introduce the benefits of cloud to the health industry, in which the cloud's advantages have been generally examined. Fernandez introduces the benefits of cloud in a study to improve communication with patients, scalability and flexibility, economic savings, ease of use and high accessibility.(7) Ahujay believes that the collaboration and information transfer between clinics, hospitals, insurance and pharmaceutical companies, and other healthcare groups lead to improve the quality of services and introduces the reduction of service costs by cloud providers as the most significant advantages of the cloud.(5) Kuo in a study, classifies these advantages and introduces the reduction of organization costs, elimination of new infrastructure costs and their maintenance,

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transferring the maintenance responsibility and managing programs to the provider, more efficient use of computer resources to help the environment and promoting energy storage, the accumulation of hardware, software and human resources and reduction of costs as well as multiple backups as the most important cloud potentials in the health system.(8)

Regarding the fact that cloud computing is a relatively new phenomenon in the health industry especially in developing countries, more investigation is required to be carried out in this area.(9) On the other hand, most studies were conducted quantitatively, while managing qualitative and exploratory studies in terms of modern phenomena leads to better understanding of the subject.

Electronic health programs and the implementation of systems such as hospital information system and the electronic health record in Iran have been launched since 2001.(10-13) The majority of public and private hospitals have been using hospital data systems so far and the SEPAS Plan is being performed in line with the electronic health case; nevertheless, some problems have been identified by the evaluation studies of such systems. The isolated and separated hospital information systems are the most important problems in this area, making it very difficult to communicate between systems; on the other hand, it has made it difficult to collect data so that hospitals sometimes have to prepare hard copy and report statistics separately.(14-18) Lack of sufficient hardware in hospitals and outdated equipment has created various problems for the users.(15, 19-21) Since security management is performed separately, various problems have been observed in the systems leading to their infections and not using encryption tools.(14, 15) Cloud computing capabilities in the collection of information, and central hardware, software, and security management appear to be able to address problems encountering health information system in Iran.

Nonetheless, one of the obstacles encountering health data systems mentioned in recent studies (19, 20) is the lack of sufficient knowledge on the side of managers and providers of health services regarding the benefits of Electronic Health. Since the introduction of a new technology and the benefits it can bring about have effective roles in decision makings of managers and providers to whether apply the technology; therefore, the purpose of the present study is to examine advantages and opportunities that cloud computing can have for health information systems in Iran, being conducted through a qualitative and exploratory study.

2. Material and Methods

The present study was conducted in qualitative approach and through in-depth interviews in order to identify factors affecting the use of cloud in the health system of Iran. Since cloud computing is a novel phenomenon in Iran's health industry, the use of qualitative methodology is the most related approach in order to have a deep understanding regarding the issue. The series of interviews were carried out with 12 people between May to August 2017. All participants in the research were specialized and had work experience in two fields of information technology and health cloud computing. The subjects included four PhDs in Medical Informatics, three PhDs in Computer Science, five master's degrees in the fields of Medical Informatics, Computer Science, Information Technology Management, Artificial Intelligence and Health Information Management. The selection of these people was conducted through snowball sampling method and continued to reach saturation.

Interviews were carried out using an interview guide designed by researchers; this guide included five open questions which were designed based on a review of the texts related to the research and the opinions of the research team. These questions were used during the interviews to collect the required information; the subject was attempted to be developed in order to collect more information related to the questions. The interviews were conducted in an average of 40 minutes through face-to-face (9 case) and telephone interviews (3 case).

The interviewees were coordinated with before the interviews through emails or phone calls along with general explanations and the purpose of the interview, and then, in coordination with the interviewees, the interviewer visited them at the interviewee's place of work and asked questions based on the interview guide. Telephone and online interviews were carried out as well in coordination with the interviewees at the time suggested by them; their voices were recorded and important notes were taken with their permission through the interviews. Since the interviews were accomplished through snowball sampling methodology, at the end of the interviews, interviewees were asked to introduce other individuals with at least two areas of experience and proficiency in health and information technology; however, 12 interviews were collected totally.

The texts were implemented in Word 2013 software and were carefully studied by the research team after accomplishing each interview. After a complete study of each of the interviews, the initial coding of the texts was carried out; the codes extracted from the interview texts were sent to the participants through e-mails so that they could add or remove some points if necessary. In conclusion, in order to increase the quality control of the data and to enhance the scientific accuracy, member checking was taken into account.

The implemented texts were carefully studied in order to analyze data through qualitative content analysis method and open encoding approach was used to achieve the

primary concepts which were extracted from the interview texts. In the next step, axial coding was used to create communication between extracted concepts; however, 10 categories and 40 sub-categories were extracted. Finally, the categories were merged together and their relationships were extracted through selective coding technique; accordingly, four sub-themes were extracted under the main theme of 'the advantages of cloud implementation in the health industry of Iran'.

3. Results

Table 1 displays demographic characteristics of respondents alongside with their work experience and their area of work

Table 1: Demographic characteristics of research participants

Number	Code	Sex	Age	Work Experience	Education
1	P1	Male	34	10	PhD in computer engineering
2	P2	Male	29	6	MSc in software engineering
3	P3	Male	35	10	MSc in medical informatics
4	P4	Male	35	12	MSc in Artificial intelligence
5	P5	Male	36	11	PhD in Medical Informatics
6	P6	Male	42	23	PhD in Medical Informatics
7	P7	Male	34	10	PhD in Medical Informatics
8	P8	Female	39	14	PhD in computer engineering
9	P9	Female	39	16	PhD in Medical Informatics
10	P10	Male	52	25	PhD in health information management
11	P11	Male	36	10	PhD in Electrical engineering and computer science
12	P12	Male	36	10	PhD in information technology management

In this section, the analysis results of respondents' opinions are presented in four categories of technical, organizational, economic and security advantages. These categories were extracted based on the concepts and themes achieved from the interviews.

Technical advantages: From the participants' point of view, three sets of specific health, support and basic capabilities were introduced in the field of technical factors (Table 2).

Table 2: Technical advantages of implementing cloud computing in Iran's Health Industry

Theme	Subtheme	Category	Sub-category	Frequency
Advantages	Technical advantages	Specific technical capabilities in the health area	Reducing the time of software installation and selection using the cloud	P1, P4
			Facilitating data mining and analysis of health data using the cloud	P2
			Forecasting and planning for the future in the health system using the cloud	P2
			Finding demographic patterns with high resource storage and analysis in cloud computing	P2
			Upgrading storage capacity for analyzing health data	P9, P3, P2
		Support capabilities	Easier support in the cloud	P7, P8
			The concentration of software production companies on software development instead of support	P6
			Concentration on managing resources and software by the provider	P2, P7, P8
			Improving software change management and not needing infrastructure management inside the hospital	P8, P7, P6
			The feature of multiple copy of data in cloud mode (redundancy) and multiple backups	P1, P4
			Not losing data in time of problem for one or more data centers in the cloud	P1
			Resuming service in case of service drop	P1
		Basic capabilities	High accessibility	P4, P6, P8, P3
			The feature of cloud elasticity and flexibility upgrade of IT infrastructure in the organization	P8, P9
			Service upgrading in the cloud	P7, P8, P12 , P4
			Accelerating software upgrading	P9, P12, P7, P6, P8, P2
			Simplicity of using cloud systems	P10 , P4
			Trust ability of cloud systems	P10, P12, P6
			Enhancing permanency of cloud service	P12, P6, P4, P7

3.1 Specific technical capabilities in the health area

One of the most significant opportunities that cloud provides for the health system of the country is reducing the time of software selection and installation. *"One of the problems that exist in most hospitals in the country, especially in HIS (Hospital Information System), which is the heart of information systems, is the longtime of software selection and installation, especially if new software is to be installed. Launching of software normally takes 2 or 3 years due to the lack of infrastructure and hardware, while software expenses are charged long before their installations; however, cloud has eliminated such problems."* (P1)

On the other hand, by increasing the storage and processing capacity of data, considerable progress will be made in the analysis of health information. *"Of course, in information systems as well, we will encounter a large amount of data over time. Suppose that we follow someone from the very birth to the time of his/her death or to any other time, and want to store and analyze all of this data; we will positively require a strong platform, and cloud is a good solution. We do not just do the storing, as more work could be done on data such as data mining, which can be used to predict the future of an individual as well as to discover a trend or a pattern while collecting data of a population. In conclusion, we will have much better plans for the health of the society and we can realize how much advantage the cloud could bring for us."* (P2)

3.2 Support capability

One of the most important features of cloud is multiple copying of data, which reduces data loss. *"Even if the service is down somewhere, due to the high redundancy of cloud you can quickly upgrade it again."* (p1)

Centralized management and software modifications are facilitated through the collection of resources and services. *"The most important motivation is the convenience of the service, as if when you have a home power plant or receive power from an electricity station, services are updated and easy to upgrade. This service is more comprehensive and you can apply any changes you desire through cloud easily. As an example, suppose the insurance percentage we took from a patient has changed, if you have island software, you have to refer to all hospitals one by one to apply changes, but through the cloud service, only the service provider suffices to apply those changes."* (p8)

"Using clouds, companies which desire to produce software can focus on development, as many HIS companies now focus on support rather than development. With the mentioned technology, more affordable changes can be made." (P6)

"The process of support in the cloud is much better and easier; on the other hand, software management is easier due to its centralization, and software upgrades and modifications will be faster and better. All of these are because of cloud features since software management will only be the provider's responsibility." (P7)

3.3 Basic capabilities

Respondents considered the availability of the service as an important factor. *"The cloud's winning card could be discovered in its cost and time reduction, high accessibility, and an increase of overall productivity."* (P4)

"The first aspect is the accessibility, which we provide while the system gets more available; this is one of the benefits of the cloud, alongside its hardware, software, and service capabilities. As an example, when the number of users increases, cloud systems are usually more saleable; by adding hardware and multiple distributions, we can provide services to more users, but this is not the case in local systems, so high availability is considered to be an important benefit of the cloud." (P6)

The reliability of cloud services was another factor influencing respondents' viewpoints. *"For example, in some cases, most hospitals are connected to the Vital Records Services through the Ministry of Health and seek information or personal identities of individuals by entering just an ID number. Two issues happen here: first, we are confident that the data is valid; second, the speed of filling the submission forms increases and people do not need to type. This is a service which could be placed on the cloud and HIS so that a copy of the information would be saved in HIS; therefore, the security and trust ability of the systems are assured as they are determined based on the cloud."* (P6)

In addition, participants believed in increasing the stability of services using cloud computing. *"When you manage the data center of 15 hospitals as a cloud provider, you definitely consider more security management, and since this is a central issue, it will be better conducted and it has a higher stability as well."* (p7)

They also believed in the ease of use of cloud-based systems as an effective factor. *"Factors such as expenses, compatibility with previous systems and the complexity of technology are also involved. Complexity means how much more difficult it is to use the new system in comparison with the systems available in the organization; the more difficult it gets, the lower the admission rate goes, and at the time of transferring the technology, the ease of use and the factor of being user-friendly have to be considered."* (P4)

3.4 Organizational advantages

In terms of organizational advantages, two categories of high-performance and hospital capabilities were identified (Table 3).

Table 3: Organizational advantages of implementing cloud computing in the health industry of Iran

Theme	Sub-theme	Category	Sub-category	Frequency
Advantages	Organizational advantages	High-performance capabilities	Cloud assistance to the policies of the Ministry of Health in collecting data	P1, P6
			Cloud's usefulness for providers due to the collection of services	P1, p6
			The focus of the organization on key processes	P9, P7
			The existence of internal cloud data centers in Iran	P12, P4, P1
		Hospital capabilities	Increase in the efficiency of IT-related processes in the hospitals	P3, P2, P4, P7
			Time-saving and quick handling of system problems	P3, P4
			Expecting to increase the quality of services using the cloud	P3
			Upgrading the management of resources and access to information in the organization	P3
			Accelerating hospital services	P6
			No need for full-time specialists in the hospital	P7

3.5 High-level capabilities

The participants believed that cloud could be useful at macro-level administration in the Ministry of Health. *"If our hospitals and our hospital systems do not need to provide hardware and data centers, the particular emphasis is to provide services as HIS, which will make a shortcut of all the steps, and on the other hand, since the policy of the Ministry of Health is moving towards collecting information, such as the electronic health record system, it could be regarded as great help and should happen."* (P1)

In addition, the organization will be able to rely on its key activities by transferring the responsibility of IT department to the provider. *"An organization can easily provide a rational and cost-effective IT solution through cloud computing without the need to purchase or upgrade hardware and software, or hire IT staff to maintain its internal infrastructure. The result is the organization can focus on vital tasks with no extra expenses on employment and training."* (p9)

3.6 Hospital capabilities

Regarding hospital capabilities, respondents believed in the acceleration of processes and quality of their activities through cloud computing. *"Concerning the motivation, cloud makes the data concentrate, so our data management will be better and faster; on the other hand, updating is done much better and quicker. Most of the work can be carried out by healthcare software companies without having to be present at the hospital; therefore, IT-dependent tasks and internal hospital processes are conducted better and faster, for example, companies could easily deal with any problems, if there is any, concerning hospital software with no waste of time."* (P2)

"Suppose that we have assigned all our IT responsibilities to a specialist in our hospital; there will certainly be no problems such as system interruptions due to software or hardware problems or occasional inability of internal staff to solve them. Considering the fact that all management is external, possible problems are managed and monitored regularly and you can witness the improvement of IT services in the hospital." (p. 3)

3.7 Economic advantages

In terms of economic advantages, all participants believed that cloud computing would bring relative advantages to the health industry. *"The most important advantage of the cloud is the economic benefit. Hospitals take annual subscriptions and pay money for that, so their expenses are remarkably reduced."* (P7) *"The main advantage of cloud computing is its low-cost feature; inexpensive hardware and software, fast and permanent software upgrades, and unlimited storage capacity are among other benefits of cloud computing."* (p9)

Table 4: The economic advantages of implementing cloud computing in the health industry of Iran

Theme	Sub-theme	Category	Sub-category	Frequency
Benefits	Economic benefits	Relative advantage	Cost reduction as an economic benefit of cloud for provider and customer	P1-P12
			Support of high-rank organizations of the cloud due to economic and technical advantages	P1, P6
			The cost-effectiveness of cloud for small hospitals and those not having infrastructure	P1
		Reducing organizational costs	Payment model versus service	P3, P2, P7
			No need to spend on maintenance and support of cloud automation	P4, P9
			Reducing direct financial and hardware management expenses in the cloud	P7, P9
			No need for the employment of internal staff for maintenance and support	P9, P7, P1

In addition, participants believed that cloud services should be taken into account due to the size of the hospitals. *"In fact, regarding the size of the hospitals, using SaaS is suggested for private and small hospitals. Installation and maintaining a data center is not cost-effective at all; on the other hand, most of the hospitals and universities in the country have data centers. Since it is not justifiable for the mentioned organizations to use SaaS instead of datacenters, they had better collect their hardware in one place until cloud is launched and SaaS be given to the internal sub-categories; therefore, they have to collect their infrastructures."* (P1)
"Cloud will reduce the need to support expenses and full-time specialists in hospitals; this will cause the service providers to earn more and work less and hospitals to have better service quality at a lower cost." (p7)
"One of the problems existing in most of our hospitals is the shortage of IT specialists; cloud will be of great help since without the need to hire such forces, central managing of sources could be conducted through provider companies." (p1)

3.8 Security

There are three different views in terms of security with regard to cloud the security opportunity of which is presented as an advantage in the table. (Table 5)

Table 5: The economic advantages of implementing cloud computing in the health industry of Iran

Theme	Sub-theme	category	Sub-category	Frequency
Benefits	Security	Security as an opportunity	Increasing data security in cloud due to the concentration of data and definition of security protocols in each layer	P6, P7, P12
			Upgrading the identification and security problems in the cloud	P6
			Centralization of software development and security testing	P6

According to some respondents' opinions, security in the cloud is considered as an opportunity. *"We have to know that, with regard to security in the cloud, even hospital data centers are not secure at this time, but the more important issue is that due to the lack of knowledge in the field of cloud, there are a number of imaginary risks in people's minds in this regard; they suppose that provider companies use their data, while this is not true at all, in summary, it could be said that cloud is safer. Generally, I have to say that cloud is much more secure; when you manage the data center of 15 hospitals as a cloud provider, you definitely consider more security management, and it will be carried out better since it is a central issue."* (P7) *"Due to centralized management of the cloud, identifying and updating security problems in cloud systems and preventing 'mal usage' are much easier. It could be concluded that, cloud security is technically an advantage, though not culturally due to the lack of knowledge in this area."* (P6)

In contrary, a large number of respondents considered security in the cloud as a threat. *"Security and confidentiality are the main challenges of the cloud; if the service provider is not an expert, our data security may be endangered, which means that if our data is hacked through strong security mechanisms, and we will not be able to do anything, since our data management is all entrusted to the provider. In summary cloud security could not be regarded as an opportunity, as the first failure of grid and cloud system was because of security issues."* (p8)
"Another important factor is security and privacy issues, especially in the health unit where there are data related to patients; the confidentiality of such data is definitely indispensable, and cloud should be taken into consideration due to the security challenges it has." (p2)
Some consider security in cloud as a relative issue. *"Security should be classified based on threats: Threats based on natural disaster, or technical threats; most disaster consequences could be managed easily if services*

are provided based on clouds. Regarding privacy and confidentiality as well, we have security threats, so we have to classify the risks; some of the risks decrease by using the cloud, though concerning confidentiality they might increase." (p5)

4. Discussion

Based on the research findings and respondents' views, the future of information technology is progressing toward cloud computing, and this technology can address the challenges encountering electronic systems in health organizations. Currently, most of the public and private hospitals in Iran are equipped with hospital information systems and the Electronic Health Program is being followed and established by the Ministry of Health; however, there are still various problems encountering such systems. For example, there is no standardized strategy in system selection and due to the availability of companies, hospitals purchase systems, which leads to incongruity and lack of appropriate communication; on the other hand, the very systems in hospitals have various problems.(14)

As an example, working with the software is difficult for the users due to hardware problems and they have limitations in entering the data as well.(15) Shortage of necessary hardware due to the lack of adequate allocation of funds in hospitals is another major problem, which causes some departments have no system at all. (19, 20) In addition to the mentioned points, according to research participants, one of the major problems with hospital information systems in the country is the prolongation of software selection and installation. Furthermore, software problems can be seen as well, such as the lack of necessary software and harmony. Given such problems, all the research participants believed that cloud computing could be a good solution to these problems. One of the most important motivations for the cloud is that hospitals no longer need to buy software, hardware, and their related management, and all of these are transferred to the provider. The flexibility of the cloud allows users to rent services based on their needs; thus, hospitals and primary care centers are able to rent the amount of services they require, and if, after some time, the organization needed more resources, the provider would be able to increase the amount of services.(4) Accordingly, they can reduce their costs significantly, and transfer maintenance responsibilities as well. From the participants' point of view, the Ministry of Health is seeking to collect data in the Electronic Health Record Program and therefore, it will support cloud programs both technically and economically, and hence, this kind of support will provide an appropriate opportunity to follow up such programs.

Island-based feature of the systems make management difficult for providers in different hospitals, while if all the hospitals under the supervision of a university use a cloud provider, it will be easier and more cost-effective to have support, and it will be easier and less costly for the provider to manage updates and make changes. On the other hand, lack of uniformity of the systems has forced hospitals to submit their reports independently and, as a consequence, the universities cannot access collected data easily; that being the case, uniformity in hospital systems allows data collection and update to be conducted faster and easier.(14)

Cloud computing has provided a good opportunity for the analysis of produced data in the health system through providing storage and computing resources, as a result of which, more possibilities have been created for data mining and analysis of patterns derived from the health data. High volume of generated data in Bioinformatics area and Clinical Informatics has led to the creation of big data and subsequently computing tools associated with these data, which cloud computing plays a major role in analyzing, storing, sharing and transmitting such data.(22) Valuable resources are available for analyzing and programming society health due to the increasing growth of electronic health record files, hospital information systems and health-based domain data. Researchers believed that cloud computing would provide an appropriate platform for analyzing such volumes of data. As a consequence, if health organizations of the country could create a common source of health data through cheap and integrated cloud platforms, they will be able to make valuable use of such data along with identifying patterns and health status of the society, forecasting, programming and allocating resources.

According to the research participants, the presence of cloud data centers will have an influential role in using cloud in the health field of the country. Using such infrastructures, hospitals do not need to have major investment on infrastructures; hence, they will be able to save hardware and data center expenses and pay only for the operations while transferring data management responsibility to the providers.(23) In addition, support services are provided to users within the hospital through internet access without the need to full-time support staff inside the organization. A central database will be created using cloud computing architecture, which in addition to collecting information, enables the integration of information and by having multiple data copies, leads to support data and preventing their loss. (24) The existence of such feature makes it possible for health institutions to be integrated with each other and as a result exchange information efficiently. (25) Increasing organizational and group collaboration leads to faster and more efficient responses alongside with improving the quality of services provided to patients. Acceleration in data transmission

between health institutions results in increasing access to information by qualified individuals and consequently, better decision making, more accurate diagnosis and more efficient treatment will be achievable for patients.(5) In conclusion, using the cloud infrastructure, which is growing in the country, it will be possible to provide cloud computing in the health area of the country.

All of the participants in the present study believed in the cost-effectiveness of cloud for health care organizations and therefore considered this as the most important factor in using cloud in health organizations. In addition, another opportunity for using cloud in the health industry of Iran was the support of organizations due to the cost-effectiveness of the cloud. In fact, reducing the company's direct expenses in purchasing hardware, software and support staff will enable the organization to focus on its key activities. On the other hand, since small hospitals and health care organizations usually do not have internal personnel for maintaining key programs such as EHR (Electronic Health Record), removing new expenses on infrastructure and IT maintenance will eliminate various obstacles in using EHR.(8) Such financial savings could be highly valuable for care organizations as they will be able to concentrate more on their key activities of patient care, which will in turn improve the quality of applying cloud computing.

Research participants regard cloud computing as an opportunity due to the concentration of resources and central management of cloud security. One of the current problems with electronic systems is that hospitals themselves are responsible for the security management of systems resulting in some systems to be infected with viruses and processing speed to reduce due to the lack of proper antivirus coverage.(15) In some hospitals, even the main server is infected(14) while if the responsibility of security management of the systems and data is conveyed to cloud providers, number of system virus infections will reduce as a result of the latest security strategies, regular upgrade, and centralized security management. On the other hand, since there is no physical server in cloud computing, physical security is enhanced, which makes the organization have more efficient performance in most security management processes.

5. Conclusion

Considering the fact that cloud computing is recent in the health industry of Iran, recognizing the benefits and the resulting opportunities will play a significant role in the successful application of this technology. Administrators and health planners will be able to take firmer steps in both planning and administrative areas by recognizing what opportunities migrating to the clouds could have. The advantages introduced in the present study, which can be considered as motivations and stimuli, have provided health managers the necessary knowledge of the cloud and have helped them make better decisions regarding the technology.

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References

[1] Pino C, Di Salvo R, editors. A survey of cloud computing architecture and applications in health. International Conference on Computer Science and Electronics Engineering; 2013.

[2] SADOUGHI F, ERFANNIA L, editors. Health Information System in a Cloud Computing Context. Health Informatics Meets EHealth: Digital Insight–Information-Driven Health & Care Proceedings of the 11th EHealth2017 Conference; 2017: IOS Press.

[3] Seddon JJ, Currie WL. Cloud computing and trans-border health data: Unpacking US and EU healthcare regulation and compliance. Health policy and technology. 2013;2(4):229-41.

[4] Fern'ndez G, De La Torre-díez I, Rodrigues JJ, editors. Analysis of the cloud computing paradigm on Mobile Health Records Systems. Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS), 2012 Sixth International Conference on; 2012: IEEE.

[5] Ahuja SP, Mani S, Zambrano J. A survey of the state of cloud computing in healthcare. Network and Communication Technologies. 2012;1(2):12.

[6] Ratnam KA, Dominic P, Ramayah T. A structural equation modeling approach for the adoption of cloud computing to enhance the Malaysian healthcare sector. Journal of medical systems. 2014;38(8):82.

[7] Fernández-Cardeñosa G, de la Torre-Díez I, López-Coronado M, Rodrigues JJ. Analysis of cloud-based solutions on EHRs systems in different scenarios. Journal of medical systems. 2012;36(6):3777-82.

[8] Kuo AM-H. Opportunities and challenges of cloud computing to improve health care services. Journal of medical Internet research. 2011;13(3).

[9] Sulaiman H, Magaireah AI, editors. Factors affecting the adoption of integrated cloudbased e-health record in healthcare organizations: A case study of Jordan. Information Technology and Multimedia (ICIMU), 2014 International Conference on; 2014: IEEE.

[10] Alipour J, Erfannia L, Karimi A, Aliabadi A. Electronic health record acceptance: A descriptive study in Zahedan. Southeast Iran J Health Med Inform. 2013;4(120):2.

[11] Alipour J, Safari Lafti S, Askari Majdabadi H, Yazdiyani A, Valinejadi A. Factors affecting hospital information system acceptance by caregivers of educational hospitals based on technology acceptance model (TAM): A study in Iran. IIOAB Journal. 2016:119-23.

[12] Ghoochani M, Kahouei M, Hemmat M, Majdabadi HA, Valinejadi A. Health information technology and health

care activists: Where is the place of Iranians? Electronic physician. 2017;9(10):5657.
[13] Mohammadi A, Valinejadi A, Sakipour S, Hemmat M, Zarei J, Askari Majdabadi H. Improving the Distribution of Rural Health Houses Using Elicitation and GIS in Khuzestan Province (the Southwest of Iran). International Journal of Health Policy and Management. 2017:-.
[14] Jahanbakhsh M, Sharifi M, Ayat M. The status of hospital information systems in Iranian hospitals. Acta Informatica Medica. 2014;22(4):268.
[15] Moghadam MAA, Fayaz-Bakhsh A. Hospital Information System Utilization in Iran: a Qualitative Study. Acta Medica Iranica. 2014;52(11):855.
[16] Sadoughi F, Hemmat M, Valinejadi A, Mohammadi A, Majdabadi HA. Assessment of Health Information Technology Knowledge, Attitude, and Practice among Healthcare Activists in Tehran Hospitals. International Journal of Computer Science and Network Security (IJCSNS). 2017;17(1):155.
[17] Safdari R, Saeedi MG, Valinejadi A, Bouraghi H, Shahnavazi H. Factors Affecting on Deployment of Speech Recognition Technology in Health Care Organizations of Iran. International Journal of Computer Science and Network Security (IJCSNS). 2017;17(1):35.
[18] Safdari R, Saeedi MG, Valinejadi A, Bouraghi H, Shahnavazi H. Technology Acceptance Model in health care centers of Iran. International Journal of Computer Science and Network Security (IJCSNS). 2017;17(1):42.
[19] Jebraeily M, Piri Z, Rahimi B, Ghasemzade N, Ghasemirad M, Mahmodi A. Barriers of electronic health records implementation. Director General. 2012;8(6).
[20] Mirani N, Ayatollahi H, Haghani H. A survey on barriers to the development and adoption of electronic health records in Iran. Journal of Health Administration. 2013;15(50):65-75.
[21] Ahmadi M, Valinejadi A, Goodarzi A, Safari A, Hemmat M, Majdabadi HA, et al. Geographic Information System (GIS) capabilities in traffic accident information management: a qualitative approach. Electronic physician. 2017;9(6):4533.
[22] Luo J, Wu M, Gopukumar D, Zhao Y. Big data application in biomedical research and health care: A literature review. Biomedical informatics insights. 2016;8:1.
[23] Bahga A, Madisetti VK. A cloud-based approach for interoperable electronic health records (EHRs). IEEE Journal of Biomedical and Health Informatics. 2013;17(5):894-906.
[24] Poppe O, Jolliffe B, Adaletey DL, Braa J, Manya AS. Cloud computing for health information in Africa? Comparing the case of Ghana to Kenya. Journal of Health Informatics in Africa. 2013;1(1).
[25] Hmeidi I, Yatim M, Ibrahim A, Abujazouh M, editors. Survey of Cloud Computing Web Services for Healthcare Information Retrieval Systems. The International Conference on Computing Technology and Information Management (ICCTIM); 2014: Society of Digital Information and Wireless Communication.