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Investigating the Impact of Cloud Computing Platform Implementation on Improving the Quality of Prehospital Emergency Services Indicators for Patients in Remote Care

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Abstract

One of the reasons that the country's emergency organization continues to face challenges in providing desirable services to provide an acceptable level of stakeholder satisfaction is the lack of utilization of these existing capacities in the field of information and communication technology. In this regard, and for the first time in the country, this article examines the effect of implementing the "cloud computing" platform on improving the quality of pre-hospital emergency services indicators for patients in remote care. Finally, the data output of tacit knowledge of 39 experts of the country's emergency organization was analyzed using Delphi method and in three rounds in the form of a questionnaire, under one-sample t-test and Friedman inferential tests. The findings of this study show that the implementation of cloud computing platform in the process structure of pre-hospital emergency services, respectively, improves the quality of four indicators; The efficiency, safety, effectiveness and availability of these services are impressive. The results of this study show that the cloud computing platform, for reasons such as; High power in uninterrupted control and analysis of data flow from the perception layer, coexistence with intelligent agents, the ability to respond immediately to predefined emergency alerts and interact with the cloud, the ability to integrate pre-hospital emergency service processes and in this way, it will affect the improvement of all four mentioned indicators. Therefore, if there is a service-oriented architecture that can be developed to support the sharing of information required by the entities involved in the emergency medical service process in a distributed and ever-present platform, this process can have positive effects such as reducing mortality and Follow a disability.

Keywords: Cloud computing, IoT, prehospital emergency services, smart agent.

Introduction:

At its 58th meeting in 2005, the World Health Organization recommended the development of ICT infrastructure, the establishment of centers for better e-health performance, and the establishment of public health information systems. In hospitals, the super potential offers easy access to electronic medical records. Quick access to a person's medical history can accelerate treatment, help prevent complications, and even save lives [1]. In addition, the cloud can speed up the follow-up of patients' medical history. However, maintaining privacy and ensuring the security of health information is one of the most important issues ahead. Cloud computing can have significant benefits in providing medical services electronically by sharing patient information stored [2]. Cost reduction, ease of access for physicians to patient information, independence of device and location, and scalability are the most important factors in dealing with cloud computing in the discussion of e-health. The existence of this technology with internet infrastructure and new solutions, provides physicians with access to any medical information at any time and place, and this has made it a necessity in countries [3]. Cloud data can be stored and processed on servers around the world. The development and adoption of cloud computing for health care organizations depends on privacy and ownership issues. Healthcare organizations can develop policies for how they manage their data locally and external data centers. However, they are unable to develop policies that affect how data is managed in the cloud. Before cloud computing can be fully implemented as a health structure, cloud vendors must gain the trust of users. Today, many cloud computing technologies are expanding in the healthcare industry [4]. NEC and Fujitsu have proposed the use of cloud computing in Japanese hospitals as a solution, or in the United States, IBM has proposed the use of its cloud computing services based on hospital information systems in hospitals. Many of the world's largest software companies, such as Microsoft,

Oracle, or Amazon, have invested heavily in the cloud to provide computing services in the field of healthcare.

Emergency medical services (EMS):

The medical services required in the event of a serious and unexpected situation, including illness or injury, and the need for immediate action are called medical emergencies. Emergency cases are cases that can lead to organ, life or acute mental and psychological problems in the absence of immediate relief measures [5]. Due to the lack of timely provision of relief services, a system called the Emergency Medical System or EMS has been designed and deployed in many areas. Today, with the growing number of deaths due to cardiovascular diseases, traffic accidents, the frequency of accidents and natural and unnatural disasters, emergency emergencies are one of the most vital systems needed by any society [6]. And considering the great importance of the medical emergency system, one of the most basic needs of the community health system is to train people with special scientific and practical abilities and competencies to rush to the aid of the sick in the most sensitive moments [7]. The emergency medical system uses special equipment and skilled specialists around the clock and is ready to provide services to people in need and at risk. Due to the sensitivity of the category of emergency emergencies, all personnel working in the emergency medical system are required to undergo emergency medical training courses [8]. Due to the growing population in all regions of the world and the growing need to increase the amount of emergency medical services, the use of efficient personnel can reduce the amount of waste of time, energy and costs to some extent [9]. Due to the limited facilities, by employing trained people with appropriate experience and expertise, many unnecessary actions and spending money and energy can be avoided. For example, by using specialized operators who are responsible for answering incoming calls, in many cases it is possible to

prevent the unnecessary dispatch of ambulances and emergency medical forces to the place by providing the necessary instructions, or in very sensitive cases by Provide effective solutions and guidance until the arrival of emergency medical forces at the scene of the accident to prevent accidents [10]. Therefore, the task of medical emergencies is not just to send troops and equipment to the scene of an accident. In many cases, medical emergencies can prevent accidents by providing appropriate guidance and treatment strategies.

Challenges of urgent health care and e-health:

Information technology and new technologies have improved the quality and reduced the operating costs of jobs, and the healthcare industry is no exception. Health information networks, telemedicine networks, scientific cooperation networks, medicine, smart physician equipment and electronic records are examples of applications of information technology in healthcare [11]. E-health is a new field of integration of informatics, medicine, public health and e-commerce that is being promoted and developed through the World Wide Web and related technologies [12]. The World Health Organization defines e-health as the safe and cost-effective use of information and communication technology in support of health and health-related areas, including health services, monitoring, health education, knowledge and research. Electronic health was first introduced by NASA to provide medical advice to astronauts and their treatment by remote physicians [13]. E-health goals include improving the quality of health care providers, providing integrated health care, and improving access to services. Protecting the confidentiality of patient information and justice in e-health, regardless of color, language, geographical location, culture, and interoperability between information systems are features of e-health systems [14]. There are significant benefits to e-health through the use of information technology. In a survey of U.S. primary care physicians, about 75

percent said e-health reduced errors, 70 percent said it increased productivity, and more than 60 percent believed that IT tools reduced costs. host. In e-health, all patient data is stored in a single location, and physicians can easily access patient health information through electronic records [15]. E-health also faces challenges. Topics related to cloud computing have been widely discussed in the scientific and applied fields, and the healthcare industry is no exception. Many managers and experts believe that cloud computing can improve health services and dramatically change the adoption and application of information technology in the field of health. Many previous studies have reported the potential benefits of cloud computing and have proposed different models and frameworks for improving health services.

Quality of medical services:

The American Medical Association lists six dimensions to quality [16]:

1. Safety: Health services must first and foremost be safe, ie free from any side hazards that threaten the patient's health.

2. Effevtiveness: Medical services must be effective. Simply put, services should rely heavily on evidence and treatment guidelines to increase their effectiveness.

3. Efficiency: Services must be provided efficiently and not more or less than needed. Also, resources should be used properly

4. Timely: Services should be provided to patients without delay and at the earliest possible opportunity

5. Patient-centeredness: Patients' preferences, values, and priorities should be considered and respected by service providers.

6. Equity: Services should be provided regardless of the patient's socioeconomic status and individual characteristics

Wireless Body Area Sensor Network:

A wireless area sensor network is a system that constantly monitors patients' health and well-being to prevent and detect risks early by sharing information with physicians and caregivers. Depending on the operating environment, these networks can be categorized into two types [17]:

- A wearable body network that operates on the surface of the body
- An implanted body network that operates within the human body.

Physical Wireless Networking (WBAN) is a technology that uses wireless sensor nodes to implement real-time wearable health monitoring for patients. It is a radio frequency based wireless network technology. Here, the patient's health status can be monitored at any time and any place without restricting his mobility and movement. Therefore, the patient can have a normal daily activity. A WBAN can be used to help people with disabilities. For example, a paralyzed person may be equipped with sensors that detect the position of the legs or with sensors connected to nerves [18].

WBAN applications fall into two general categories:

- Medicine: In this application, important and sensitive information is collected from the patient and sent continuously to the stations for analysis. This information has a large volume, but can protect patients against dangerous diseases such as cancer, asthma, heart attack. Also people who have physical disabilities are useful. Example of this application: Insulin injection kits that are implanted in the body and automatically inject the insulin required by the body at specified times.
- Non-medical: Can be used for military applications, games and social networks. In military applications, the use of a WBAN in a combat situation can be mentioned. In this application, WBAN is used to connect

soldiers and their reports to commanders. In games, the WBAN sensor is used to indicate the position of each person in the game [19].

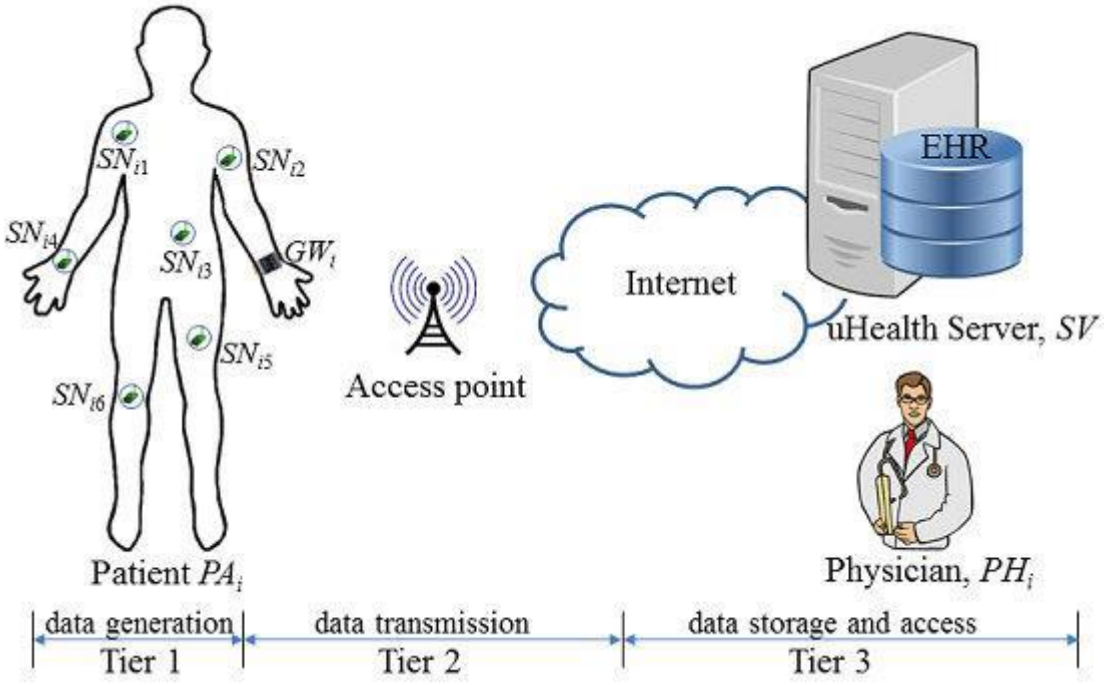

Figure 1. An example of a body wireless sensor network architecture (Custodio et al. 2014)

An important advantage of medical goals is [20]:

- Due to the nature of wireless WBAN networks, it makes the patient as comfortable as possible so that the patient can perform all his daily activities (despite the sensors) without any disturbance.
- Ease of monitoring the patient (observing the physiological signs of the patient's body) is due to being independent of the patient's position. In this way, a sick person, whether at home or at work, is constantly monitored, and the result of this practice is long-term monitoring.
- Some implanted wireless devices can reduce the patient's pain during diagnosis and treatment.
- The information collected from the patient plays an important role in the diagnosis and treatment of many diseases in the long run.

Cloud computing implementation models:

Cloud computing is usually categorized through two categories: cloud computing implementation model, cloud computing service delivery model (SaaS, Paas and IaaS). In the following, we will introduce the main models of implementing cloud computing [21].

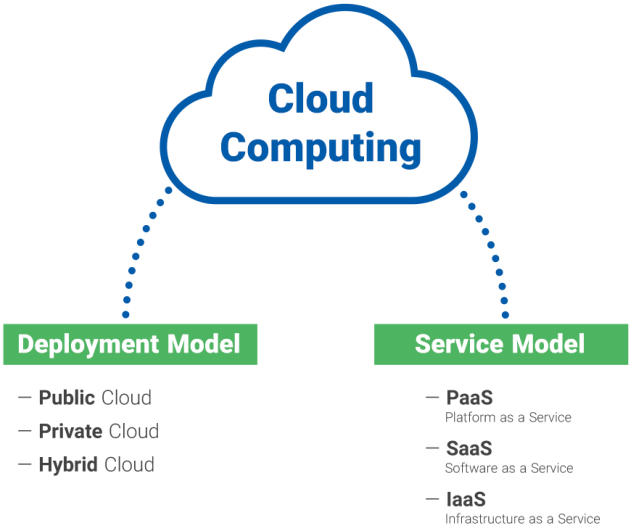

Figure 2: Cloud computing implementation models

Cloud computing implementation models is [22]:

Public Cloud: Public cloud is the most common model of implementing cloud computing. In this model, shared resources and infrastructure such as servers and storage space are hosted by a company providing cloud services and access to them through the World Wide Web is provided for applicants for this service. In the public cloud, all hardware, software and infrastructure equipment are maintained and managed by the company providing cloud services.

Private Cloud: Dedicated cloud is designed and implemented only for the private use of an organization. In other words, in this model of cloud computing, hardware and software resources are completely at the disposal of an organization. The equipment and infrastructure required for this cloud can be physically implemented and hosted on the premises of an organization, or in the data center of a cloud service provider. In a dedicated cloud, all services,

equipment, and infrastructure resources are maintained and managed by the organization itself through a dedicated internal data transmission network, and access to this cloud outside the dedicated network will not be possible. The private cloud is often used by government agencies, financial institutions, companies or organizations that are responsible for carrying out very important and sensitive operations and processes, and the need for full control and access to the data infrastructure is urgent for them.

Hybrid Cloud: Hybrid cloud, as the name implies, uses both types of cloud computing implementation models (public and private) and allows organizations to take advantage of both models, depending on the application. In the hybrid cloud model, network activities are split between private and public cloud to increase flexibility and take advantage of more diverse options. For example, an organization can use a public cloud platform for its high-demand and non-sensitive needs, and a dedicated cloud model for its sensitive and confidential needs.

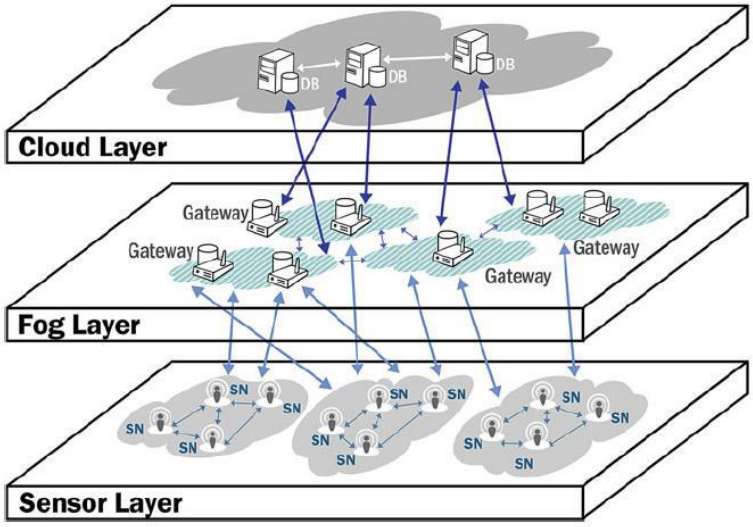

Figure 3. Location of fog with respect to cloud space (Rahmani et al. 2018)

Research Method:

Type of research: The present study is descriptive-correlational in terms of type and applied in terms of purpose, because the results of this study can be used to streamline the processes related to pre-hospital emergencies and partner organizations in the field of medical emergencies. Considering that the present study is a kind of futurism related to the effect of using a new platform on the quality of pre-hospital emergency services, so the classical Delphi method with a regular / systematic random approach to reach the consensus of experts to predict the outcome of the bridge. Cloud computing has been used to improve four quality indicators of pre-hospital emergency services. Also, due to the young age of the platform, the minimum acceptable value for the consensus of experts was 70%.

Statistical population: The statistical population of the present study are included employees and managers of the country's emergency organization (managers, heads and experts).

The sample size formulas and procedures used for categorical data are very similar, but some variations do exist. Since the data are qualitatively and the number of statistical community is unlimited, so the sample size calculation formula is as follows:

$$n = \frac{Z\alpha_{/2}^{\,2} p_0 (1-p_0)}{\varepsilon^2} \qquad (1)$$

In this study, researcher has set the alpha level a priori at .05, plans to use a proportional variable, has set the level of acceptable error at 5%, and has estimated the standard deviation of the scale as .5. Cochran's sample size formula for categorical data and an example of its use is presented here along with explanations as to how these decisions were made.

$$n = \frac{(1.96)^2 \times 0.5 \times 0.5}{(0.05)^2} = 384.16 \qquad (2)$$

Where $Z\alpha_{/2}$ = value for selected alpha level of .025 in each tail = 1.96.

(The alpha level of .05 indicates the level of risk the researcher is willing to take that true margin of error Cloud exceed the acceptable margin of error).

Where (p)(q) = estimate of variance = .25.

(Maximum possible proportion (.5) *1-Maximum possible proportion (.5) produces maximum possible sample size).

Where ε = acceptable margin of error for proportion being estimated = .1

Research hypotheses

1. Hypothesis 1: The use of cloud computing in hospital emergencies affects the privacy and privacy of hospital members and users.
2. Hypothesis 2: The use of cloud computing in hospital emergencies is effective in improving vulnerability in crisis situations.
3. Hypothesis 3: The use of cloud computing in hospital emergencies is effective in improving access to the server.
4. Hypothesis 4: The use of cloud computing in hospital emergencies has the effect of improving the configuration of hospital emergencies and reviewing management and business practices.

Analysis of information

SPSS software was used for statistical analysis and one-sample t-test was used to analyze the statistical hypotheses. We used SPSS 22 to analyze the data. In following the results of test hypotheses are offered:

Testing Hypothesis H1. The use of cloud computing in hospital emergencies affects the privacy and privacy of hospital members and users.

The results of SPSS are shown below:

Table. 1. One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
H1	385	6.7637	1.4361	.19835

Table. 2. One-Sample Test

	Test Value = 5					
				Mean	95% Confidence Interval of the Difference	
	T	df	Sig. (2-tailed)	Difference	Lower	Upper
H1	16.731	384	.000	1.7532	1.6732	1.9852

Testing Hypothesis H2. The use of cloud computing in hospital emergencies is effective in improving vulnerability in crisis situations.

The results of SPSS are shown below:

Table. 3. One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
H2	385	6.6342	1.0743	.19305

Table. 4. One-Sample Test

	Test Value = 5					
				Mean	95% Confidence Interval of the Difference	
	T	df	Sig. (2-tailed)	Difference	Lower	Upper
H2	16.7903	384	.000	1.9422	1.5831	2.0429

Testing Hypothesis H3. The use of cloud computing in hospital emergencies is effective in improving access to the server.

The results of SPSS are shown below:

Table. 5. One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
H3	385	6.7863	1.0964	.19732

Table. 6. One-Sample Test

	Test Value = 5					
				Mean	95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Difference	Lower	Upper
H3	15.07853	384	.000	1.9473	1.0487	1.9372

Testing Hypothesis H4. The use of cloud computing in hospital emergencies has the effect of improving the configuration of hospital emergencies and reviewing management and business practices.

The results of SPSS are shown below:

Table. 7. One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
H4	385	6.8644	1.0942	.21843

Table. 8. One-Sample Test

	Test Value = 5					
					95% Confidence Interval of the Difference	
	T	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
H4	17.8546	384	.000	1.98367	1.7836	1.9949

Conclusion:

In this article, we investigate the effect of implementing a cloud computing platform on improving the quality of pre-hospital emergency service indicators. The findings of this study show that the implementation of cloud computing platform in the process structure of pre-hospital emergency services, respectively, to improve the quality of four indicators of pre-hospital emergency services, including; The efficiency, safety, effectiveness and availability of these services are impressive. The results of this study show that the cloud computing platform, for reasons such as; High power in uninterrupted control and analysis of data flow received from the perception layer, coexistence with intelligent agents, the ability to respond immediately to predefined emergency warnings and interact with the cloud, the ability to integrate pre-hospital emergency service processes and In this way, it will affect the improvement of all four mentioned indicators. Also, the by-results of this study show that from the experts' point of view, the implementation of cloud computing platform in the process structure of pre-hospital emergency services will have a greater impact on which processes, including the components; "Intelligent routing to the scene for the ambulance driver", "Intelligent identification of the nearest ambulance suitable for the mission in the shortest possible time", "Intelligent routing to the appropriate medical center for the ambulance driver", "Automation of

emergency call 115 (quick report)" And "Instant monitoring of the patient's vital signs by the patient's physician remotely to assist the EMS technician in performing on-stage work" are ranked 1 to 5 in order of importance, respectively. Therefore, if there is a service-oriented architecture that can be developed to support the sharing of information required by the entities involved in the emergency medical service process in a distributed and ever-present platform, this process can have positive effects such as reducing mortality and Follow a disability.

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