Cloud-based e-health Applications in Palestine: Challenges and Success Opportunities

Mousa Abdoh[1], Nael Salman[2]

1. **Palestine Technical University- Kadoorie, Department of Business Management and E-Commerce,**
Emial: m.abdo@ptuk.edu.ps
2. **Palestine Technical University-Kadoorie, Department of Computer Systems Engineering,**
E-mail: n.salman@ptuk.edu.ps

ABSTRACT

Healthcare service costs are rising all over the world. That is mainly due to the lack of healthcare professionals and IT services. Cloud computing is an emerging trend that provides a robust infrastructure that enables delivering low-cost services over the internet. In this paper, we conducted an analytical study on the e-health services in Palestine to investigate the current state-of-art and examine all challenges and opportunities to benefit from this technology. Collected data has been analyzed and the results revealed that there is a clear gap between the IT service models provided by Palestinian healthcare service provider, and the potential models based on latest IT trends; mainly, cloud computing.

Keywords: **cloud computing, healthcare systems**

INTRODUCTION

The demand on healthcare services is increasing very rapidly everywhere. stakeholders of healthcare services vary from people working in healthcare service providing organizations to patients benefiting from these services [1]. it is quite clear that there is a shortage in the numbers of qualified professionals who can develop and support the management systems of healthcare services, and the associated costs of hardware and software systems create a serious overhead on the healthcare service provider's budgets. the reasons mentioned above have led to looking for alternatives based, mainly, on utilizing cloud computing to centralize the process of healthcare [2,3].

Cloud computing consists of broad network access and resource pooling in order to support big data sets healthcare databases. due to fast emerge of technology, these features facilitate the usage of computing resources by multiple consumers through different electronic devices. in order for cloud computing to provide clients with the desirable services, it should be built in a way that facilitates the expected functions. this may be done by combining hardware and software resources. it is referred to such infrastructure as physical and abstraction layers. the physical layer includes the server, storage and network components, whereas the abstraction layer consists of the software installed to carry out the service [4].

Consumers do not need to manage the infrastructure in the cloud system but they do have the privilege of controlling applications and configuration settings. planning to implement the latest technologies in the healthcare sector is an important strategy for many healthcare organizations to enhance their service quality and reduce costs and increase the numbers of beneficiaries from healthcare services.

In this paper, we present an overview of the "e-health based cloud computing" and the challenges in using cloud computing in the health organizations.

The remainder of this paper is organized as follows: section 2, presents a cloud computing system and its importance. in section 3, cloud based healthcare systems are discussed. healthcare systems in palestine are discussed in section 4. section 5 discusses the research methodology. results and discussions are introduced in section 6 and, finally, conclusions are drawn in section 7.

1. cloud computing

the national institute of standards and technology (nist) [5] provides a clear definition of cloud computing as: "cloud computing is defined as " —a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks,

servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction". cloud computing allows sharing of infrastructure, platforms and software as a service which is always abbreviated as iaas, paas, and saas.

cloud computing is getting a very rapid popularity and adoption in many organizations in different disciplines due to its advantages that range from reducing of system maintenance and support costs, its flexibility, availability, and optimal resource utilization. [5].

as described by the ibm cloud computing guide [6], cloud computing services can delivered in various models. these models are:

1- public clouds which are owned and operated by companies that offer rapid access over a public network to affordable computing resources. with public cloud services, users don't need to purchase hardware, software or supporting infrastructure, all of which is owned and managed by providers.

2- A private cloud is infrastructure operated solely for a single organization, whether managed internally or by a third party, and hosted either internally or externally. Private clouds can take advantage of cloud's efficiencies while providing more control of resources and allowing clients to steer clear of multitenancy.

3- A hybrid cloud uses a private cloud foundation combined with the strategic integration and use of public cloud services. The reality is that a private cloud can't exist in isolation from the rest of a company's IT resources and the public cloud. Most companies with private clouds will evolve to manage workloads across data centers, private clouds and public clouds, thereby creating hybrid clouds.

4- Many businesses employ various cloud services to drive innovation and aid business agility, such as creating new revenue streams, adding products and services and increasing margins. Because of such wide-ranging and valuable potential advantages, multicloud environments are essential to survival and success in the digital era.

Cloud computing allows you to store, access and retrieve files from anywhere using web-enabled interfaces which are easy to use and build. At any place and time, cloud-based systems are available at high speed, and secure channels. Furthermore cloud-based systems scalability is assured. [7].

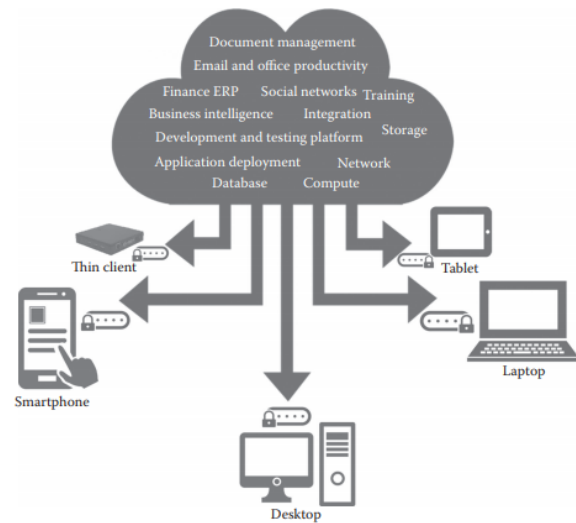Figure 1 depicted from [8] shows the structure and the different components of a cloud-based system.

Figure 1: Cloud-Based System Structure

Cloud computing architectures are classified into three different models: SaaS, PaaS, and IaaS.

1) SaaS gives user the ability to use services supplied by service provider.

2) PaaS gives user the ability to deploy consumer created applications created by some programming languages.

3) SaaS gives user the ability to use applications supplied by service provider in the cloud infrastructure.

Variant client devices can access the cloud based applications through web applications or other software systems. These clients can manage the cloud infrastructure including networks.

These management services include the following:

a- Enterprise services such as workflow management,.

b- Web 2.0 applications such as metadata management.

SaaS is not suitable for applications that need real time response [9].

2. CLOUD BASED HEALTHCARE SYSTEMS

Healthcare services can better be delivered if healthcare systems are integrated on cloud-based infrastructure. Chowdhury [9] shows the different advantages of integrating traditional health and cloud computing. Chowdhury showed that this integration will increase impact on all healthcare system stakeholders ranging from patients to doctors and other administrative staff involved in the process. The integration of cloud computing

into healthcare systems can achieved by many ways:

1- virtual machines (VMs), applications or storage, available to the general public over the internet which best maps to the public cloud model described in section 2.
2- a private cloud is aimed to the needs and goals of a single organization.
3- by social media [10].

Nigam and Bhatia [11] summarized the advantages of integrating cloud computing with healthcare systems mainly in the following:

• On-demand service: all services can be achieved without delay.

• Broad network access: any one can access the network from anywhere.

• Resource pooling: many users can access the same service at the same time. [11].

Recent communication and Telemedicine technologies e.g. telesurgery, and teleradiology facilitate providing patient care services beyond the medical centers through better collaboration and communication between different stakeholders [11].

Integrating cloud computing into healthcare systems can come up with several benefits to all stakeholders. These benefits result from the facilities provided by cloud computing that can be summarized in the followings:

• Enabling live interaction between the participants without being at the same site.

• Patient medical data can be shared in real time across the geographical boundaries.

• It is flexible model as patients don't need to visit the doctor for getting a medical advice. Moreover, surgeons can retrieve the archived patient files at their own time and place.

Doheir et. Al. [12] reviewed cloud computing architectures based on wireless and mobile applications. They found that the use of cloud in healthcare organizations and the integration of components can improve healthcare systems serviced delivered to clients. They also showed that most healthcare service providing organizations in the world realized the importance of cloud computing as a means to improve data management, and storage capabilities.

Doheir et. Al. [13] discussed the importance of cloud computing technology to improve performance in healthcare organizations and cloud issues for cloud mobility and API Management (CMAM).

3. Healthcare systems in Palestine:

There are many healthcare service providing organizations in Palestine that are classified to public – governmental organizations, private organizations and NGO's organizations. These organizations range from small (one doctor) private clinics to large multi-specialty private and public hospitals [14]. Unfortunately, there is no IT infrastructure that enables communication and data sharing between these organizations. The lack of connectivity between healthcare service providers limits the opportunities of benefiting from patient records, and increases the cost of further analysis and investigations.

4. Research Method

The aim of the work presented in this paper is benefits and challenges of using cloud-based systems In Palestine. It was inspired from the wide use of cloud-based systems in different disciplines. We conducted a study that covered healthcare service providing institutions in Palestine. A survey was used as the main validation means in this paper. The survey questions were designed in order to explore the challenges and issues hindering resorting to cloud-based healthcare management systems.

The survey was mainly based on a comprehensive questionnaire questionnaire consists of 6 main sections. First section has two questions that asks general information about the participant. Section 2 consists five questions that ask about the challenges that face IT applications. Section 3 contains 15 questions about communication and ease of using cloud computing and its features. Sections 4, 5 and 6 contain extra notes, acknowledgement and contact information, respectively.

All the fields and questions of the questionnaire were must to be filled by the participant. The questionnaire was designed online using Google documents. We have contacted many governmental and private hospitals, health centers, in person and by email to help us filling the questionnaire. The targeted groups of the questionnaire included IT services supporting staff, medical staff, and administrative staff. We received answers from 210 respondents. The questions aimed at detecting the concerns and the level of understanding of cloud based systems among the targeted groups. The results obtained from the responses revealed the following interesting points:

1- Security issues are among the most important concerns to all healthcare service providing system users.

2- The weakness of IT infrastructure (especially networking and internet access services) is a critical issue to the success of cloud based healthcare systems.
3- Around two thirds of responses show that healthcare system users believe that cloud based systems will lead to more effective data sharing and enhances system availability,
4- It was clear from the responses of Non-IT users that they have little background about the benefits of cloud based systems especially those related to system development and maintenance costs and.
5- The majority of non-IT users feel that more training on and information workshops are needed.

Besides the questionnaire and as a supporting tool for the sake of getting more information about the current situation in healthcare service providing organizations in Palestine we had some informal personal interviews with selected healthcare and IT professional working in the public sector.

5. Results and Discussion

The results obtained in this paper revealed that public sector health service providers in Palestine do not have in-house system development nor they know about the benefits of using cloud architectures in healthcare systems. Most of software services and systems used are developed at different eras by different teams. The individual analysis and discussion of selected questions of the questionnaire responses can be described as follows:
1- Targeted group profile: 57% of questionnaire respondents are working in administrative jobs including IT professionals (mainly technical support staff). and the rest are medical staff (doctors and nurses).
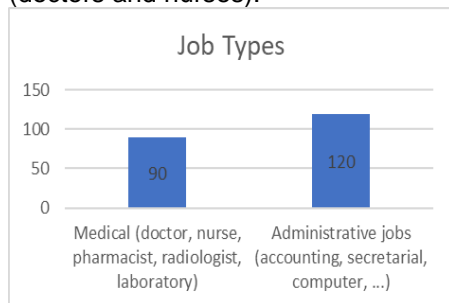

Figure 2: Job types in questionnaires' analysis

2- On a question about the security concern as a challenge towards adopting IT-based healthcare systems. 9%0 of examined group answered that security is the most important concern.

3- On a question about IT based healthcare systems, 57% Healthcare system users think that IT-based systems do not satisfy their needs. 43% fear that IT-based will not satisfy the user needs.
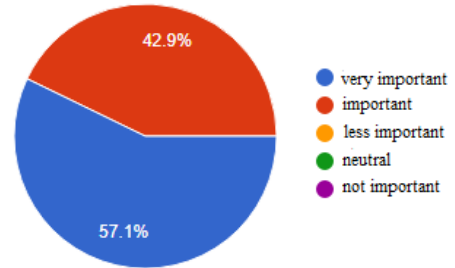

Figure 3: Information technology customers' needs

4- 57.1% of the employees have medical jobs, and 91% of them see that data security is very important issue, 57% of them see that information technology applications used in hospitals does not meet customers' needs
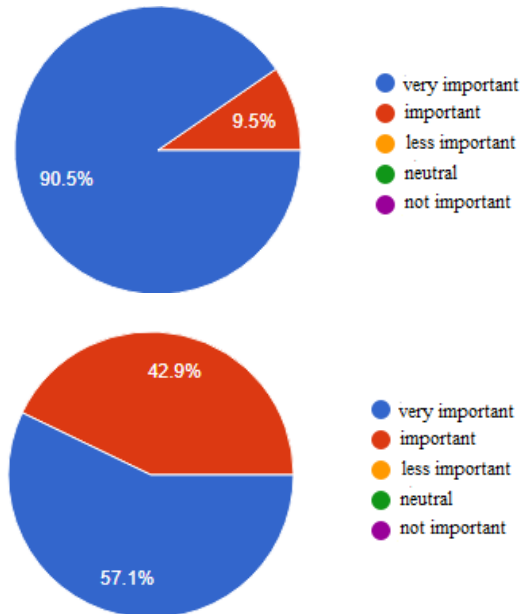

Figure 4: Data security importance and information technology applications of customers' needs

5 - 53% and 33% of the respondents see that is very important and important, respectively, that patients records should be followed as. Figure 5 shows the lack of such follow up.

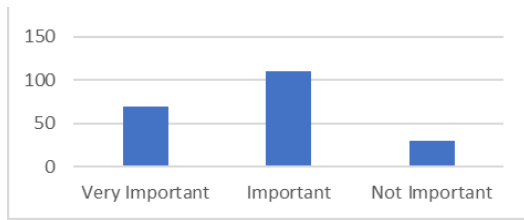**Figure 5: Lack of follow up**
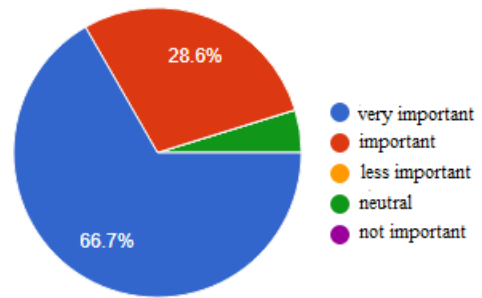
6 -All of them see that there is weakness in infrastructure to internet connection
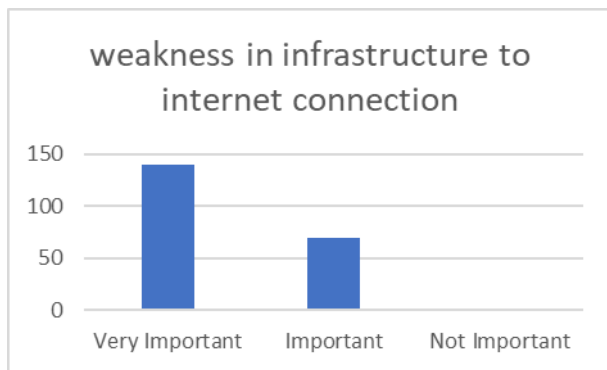
Figure 6: Weakness in infrastructure
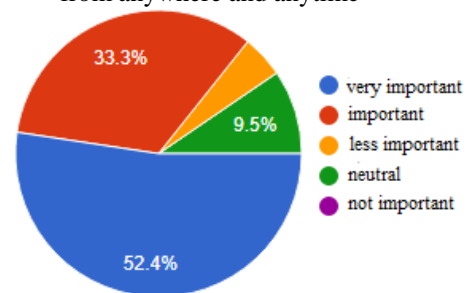
7 - 85% of them knew the advantages of cloud computing for data processing while 10% do not know the advantages.

Figure 7: Advantages of cloud

8 - 67% of them see Cloud computing enables effective data and information sharing between different branches of the same organization

Figure 8: Cloud effective

8 - 53% of them see Cloud computing enables availability and accessibility of IT services from anywhere and anytime
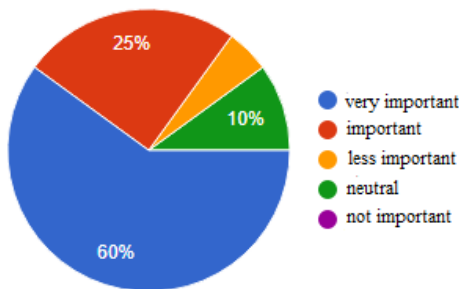

Figure 9: Cloud necessity of it services

10 - 39% of them see that Cloud computing helps in minimizing development and operational costs through "pay per use of service
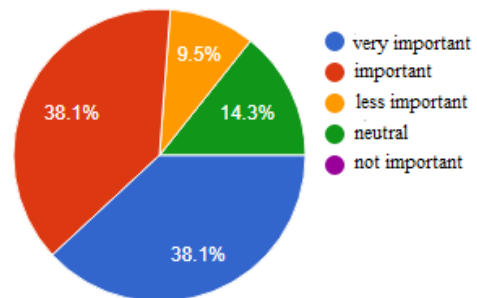43%

Figure 10: Cloud minimizing development

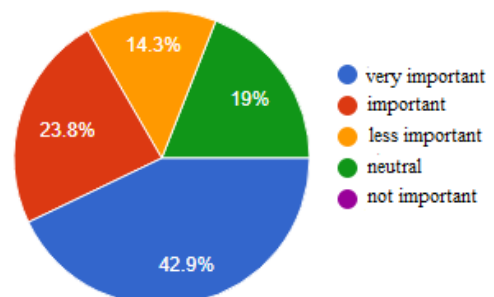11 - 43% of them see that Cloud computing minimizes software license costs

Figure 11: Cloud minimizing software cost

12 -38% of them see that Cloud computing minimizes the cost for maintenance and updating the devices.
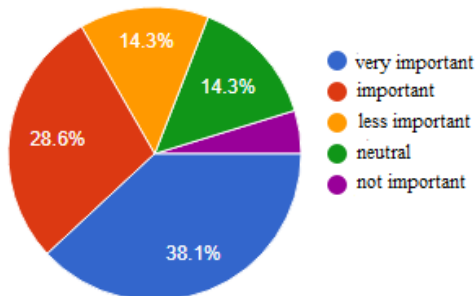

Figure 12: Cloud minimizing maintenance cost

6. Conclusion

In this paper, we investigated benefits and challenges of applying cloud computing in healthcare service providing institutions in Palestine. Cloud computing is an emerging trend that provides a robust infrastructure that enables delivering low-cost services over the internet. The results revealed that there is a clear gap between the IT service models provided by Palestinian healthcare service provider, and the potential models based on latest IT trends, mainly; cloud computing. Staff working in healthcare service providing organizations need more training on IT based health management systems. Majority Staff working in healthcare providing organizations support the application of cloud-based systems as a driver to enhance accessibility, availability, shareability, maintainability and development costs of Health management systems. There was a clear shortage on the people working on system development and new service integration.

The work presented in this paper can be further extended to tackle the potential importance of migrating current systems into the cloud. In addition to the training needs for IT professional working healthcare service providing organizations to develop cloud based software services.

Acknowledgement

References

[1]   Olubanke B., "Consumers and Their Demand for Healthcare,"Journal of Health & Medical Economics, vol. 3 no. 1:6m pp. 1-3, 2017.

[2]   Vaibhav K. N., Shubham B., "Impact of Cloud Computing on Healthcare," IRJET, vol. 03, no. 5, 2016.

[3]   Chowdhury C., "A Survey of Cloud Based Healthcare System," An ISO 3297: 2007 Certified Organization, vol. 2, no. 8, 2014.

[4]   Aziz H.A. and Guled A., "Cloud Computing and Healthcare Services," Journal of Biosensors & Bioelectronics, vol. 7, no. 3, pp. 1-4, 2016.

[5]   Mell P. and Grance T.,"The NIST Definition of Cloud Computing," Communications of the ACM, vol. 53, no. 6, pp. 50, 2010.

[6]   Wang L., Alexander C., "Medical Applications and Healthcare Based on Cloud Computing," International Journal of Cloud Computing and Services Science (IJ-CLOSER) vol.2, no.4, pp. 217-225, 2014.

[7]   Stallion A. ,"Cloud Computing: will 2018 the year of rapid growth," March 2018.

[8]   IBM, Cloud Computing guide available from: URL: https://www.ibm.com/cloud/learn/cloud-computing, as accessed in 18/06/2019.

[9]   Chandrasekaran K., "Essentials of Cloud Computing," CRC Press, Tayler and Francis Group, A Chapman and Hall Book, pp: 11, 2015.

[10]   Alzoubaidi A.,"Cloud Computing National e-health services: Data Center Solution Architecture," IJCSNS International Journal of Computer Science and Network Security, vol. 16, no. 9, 2016.

[11]   AbuKhousa E., Mohamed N. and Al-Jaroodi J., "e-Health Cloud: Opportunities and Challenges," Future Internet, vol. 4, pp. 621-645, 2012.

[12]   Marinescu D.C., "Cloud Computing: Theory and Practice," Morgan Kaufmann, Waltham, MA, 2013.

[13]   Doheir M., Hussin B., Basari A. and Elzamly A., "Identifying Critical Cloud Computing Technology Issues for Improving Healthcare Management," Journal of Advanced Research in Dynamical & Control Systems, vol. 10 no. 7, pp. 732-743, 2018.

[14]   Palestine Doctors Association. 2016. [online] available at: hhps://www.jma.ps/. Accessed: 30/7/2019.