Online Storage in Healthcare Organizations

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Abstract

As healthcare technology get improved and medical devices spread in several medical services area, the expected output from these devices became large and therefore the need for additional resources has been mandatory.

When we talk about resources, we mean hardware resources, financial issues, professional physicians, system users, nursing, and other types of resources. The lack of resources (especially in hardware items) may appears clearly in public healthcare sector because of limited government support especially in non-developed countries.

Medical devices in general have a continuous output that give indicators for physicians to treat the patient either they are inpatient or outpatient status or in emergency rooms. The most devices that consume the storage are that one's which produce videos or medical images, therefore the paper focus on medical data in general and specially on radiology and operation theatre devices and how to stop the data explosion that comes from these devices.

The paper will discuss the current methods and techniques that used to store the output of medical devices and introduce new solutions with low cost comparing with the current used methods.

Keywords: Healthcare Information, patient data storage, online storage, interoperability, integration.

I. INTRODUCTION

Nowadays, with smart and super medical devices there are complex health data explosion that includes charts (which need to be stored electronically) and big size of data that needs extra storage capacity and well-trained staff to deal with such kind of data. This data should be available all the time and reachable from anywhere ,even if the user moves from one place to another, using his/her mobile device to access any medical data that he/she have a privileged to use it.

The data is stored in different places of storage: onsite storage, clouds and traditional storages (DVDs, CDs) which users need a permission to access these storages. Any user inside the organization that own this storage can get easily what he is looking for, but what if the patient needs to consult a physician outside the current hospital for additional treatment? It worth to make many researches about this frequently happening case.

Many of the current researches look to make patient data available through encourage different healthcare organizations to interoperable between each other through full integration to make different applications work together. However, even these historical issues solved; the challenge of expandable storage still need to overcome to reduce costs and avoid interrupt or loss of data.

II. MOTIVATION

To make storage available anytime, anywhere; there is a need to search for dynamic solutions and active storage that have accessibility on the internet. Why internet? Because in next few years, most of people will have smart devices that are connected to the internet all the time and therefore most people know how to deal professionally with internet and can manage their needs via their mobiles.

What happened in hospitals to keep the storage available is to increase the size of it when needed and therefore additional cost and resource consuming are needed. However, the question is how much storage could be added, and is it a continuing process? For the first part of the question, it depends on how much the storage expanding could be support. For the second part, it seems it will be a continuous progress to keep patient data available all the time.

To overcome this issue, healthcare industry goes to the Clouds to store healthcare data instead of onsite storage, which also need maintenance and incremental costs. The clouds is suitable for small sites that do not have a lot of data to be stored, but what about big size data (100TB for example), is it profitable regarding costs. Let me explain using an example from real life:

What do you prefer to do: buy a new home and be your own forever, or rent it and maybe pay double of its value and you may cannot own it? It is hard to decide where to go in this case, stay in the traditional method and have your own storage, or rent clouds and pay little prices at the beginning!

So, the suggested solution is to search for a cheap and permanent solution by asking patients to store their data through using available free storage such as email storage, google drive, Dropbox or any other storage that patients can register through it.

It is complex to deal with this idea without any terms and rules that protect patient data from loss. In addition, considering the security and privacy issues that prevent any

unsecure solutions to be applicable. Until these days [11], HIPAA recommendations block any unencrypted server or informal email user to use his\her email's storage for healthcare purposes, so further studies are needed to make emails storage and other online personal storage compatible with HIPAA.

III. CONTRIBUTION

The main goal of this paper is to make data storage in healthcare industry available in cheap price without any conflict with privacy and security issues. We try to offer a solution depends on online storages like e-mail storage, google drive, Dropbox and other types of storage that a user own and have full access on stored data inside it.

This solution depends on that idea to ask the patient to take some responsibility to protect his data with corporate and help from his physician.

IV. BACKGROUND AND LETERATURE REVIEW

A. Background

The increasing of data size due to technology development need to be handled carefully and professionally. Big data and data analysis (especially in medical industry) are hot topics for researchers because the importance of the output of data in researches, and how that output can guide researchers to create and suggest new and innovative ideas which may help in improve the overall of healthcare industry, and to have valuable results in improving and developing human lifestyle.

As mentioned before, the storage issue is a continuous challenge and need to keeping look on it to assure high performance on the offered service and to avoid loss of data either by storage fill out or by change the status of data from online to near line or offline. Therefore, the expanding of data and pay more is necessary.

Radiology images often consuming the storage because of large size due to high resolution and new technologies that are used in its format. DICOM and HL7 format are used to assure devices interoperability between different vendors to make communication easier, and to connect all medical devices that have DICOM output to the same vendor. FHIR is another healthcare protocol that used to integrate two HIS systems together through web services depending on HL7 messages. All of these components and object's format will then be used to help in facilitate the archiving process in healthcare sites.

Many data sources are available to get data from it; Medical devices, body sensors, mobile healthcare applications are some of these sources examples to mention here.

A. Literature Review

The author in [1] explain the benefits of using several kinds of storage like BYOD, mobile storage and PANs. In [2], the authors introduce a storage solution to avoid data deduplication and save costs. Authors discussed the usage of mobile applications to send and retrieve patient data in [3]. In [4], the author discuss the authentication method to give permissions of data sharing among patients themselves and between patients and doctors. The authors show the importance of privacy and security to patient data in [5]. In [6], the author introduce techniques to protect staff data in healthcare industry beside patient's data. In [7], authors to improve their contribution in healthcare sector discussed semantic interoperability and integration.

V. METHODOLOGY

A. Overview

After having a deep look over related works, it is obvious that all of suggested solutions talk about using clouds or by depending on BYOD that may increase the running cost of the storage issues.
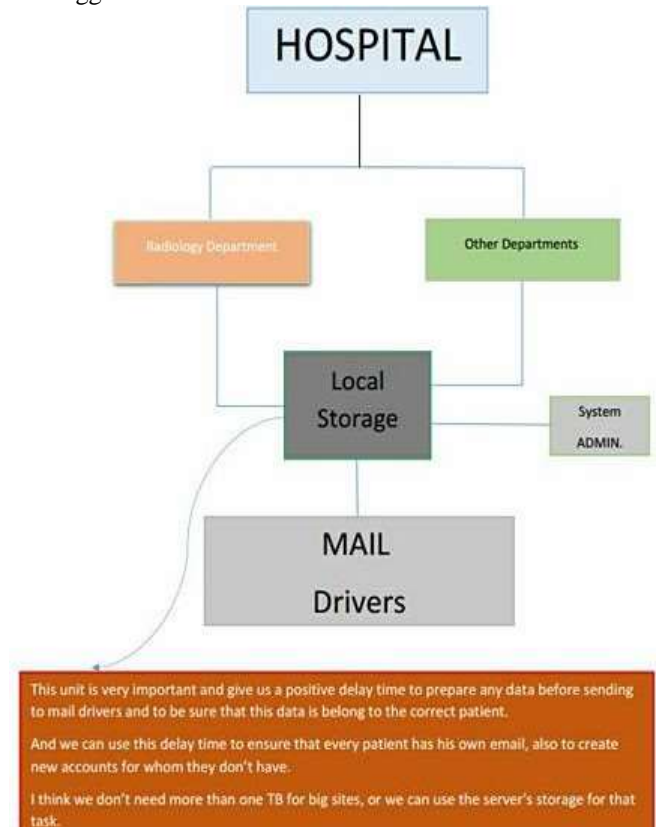
B. Suggested solution

Figure 1 suggested healthcare storage diagram

The above figure shows the suggested solution that depends on online storage like e-mail drivers and other free storage from different social companies.

Any patient decide to visit the hospital for treatment or follow up will visit the registration department for check for availability of the specialist or reserve an appointment. In the suggested solution the patient will be asked to check for his/her e-mail instead or after registration station to start his visit. This fast check could happened by the patient himself

or through well-trained staff to help patients (that do not know how to use their e-mails) to be ready to store the output data from his visit.

The suggested generation of new health e-mails will have an access from any doctor that have a permission from patient through authentication code (like what happened in money transferring over internet). This permission will protect patient data from wrong use by the patient because we can use the same authentication strategy in case of sudden deletion of data. In this case, a message will automatically send to the doctor to alert him if any patient decide to delete any kind of data so he can block this deletion. In other words; a double authentication code will be used to protect data from any unauthorized access, but the doctor, in general, should have more control on this process because he can decide what the best is for the patient.

To avoid duplication of data, specific filters and queries will apply on patient database to prevent it happened. These queries will work better if full integration and interoperability applied overall suggested solution or even in the current ones. This mean that we will not have two different names for the same exam or test and therefore, no need to repeat any exam if there is no need to do that which prevent any extra consuming of the storage.

To avoid the storage of a lot of normal exams or tests, a unique reference for each patient is advisable. This reference copy will have normal X-ray, normal laboratory test, blood pressure, weight and other vital signs that may help the doctor to compare any future results with this reference copy. When we talk about blood pressure for example, we try to justify a fact that not all patients have the same normal blood pressure readings. So, when a patient have different readings comparing with the recommendation one; the doctor shouldn't decide that this patient is sick and ask him to take medicine or make further tests; instead of that, the doctor may compare the current results with the patient reference copy then decide if he have more treatment steps.

After each visit, the system will send the new data to a local storage (which is managed by the system administrator) for check of free errors and check if that data is belongs to the current patient. This positive delay time allow the system administrator to help patients who do not have connect their e-mails yet with the HIS. After check of data, the administrator for final saving will push the data to the e-mails drivers.

C. Algorithm

Step 1: the patient visit the hospital for treatment or check for appointment availability.
Step 2: the registration staff check for the patient if he is ready to use his e-mail for store the results of his visit, otherwise, he send the patient to IT department for assessment.
Step 3: when the patient is ready, he start his treatment by give the doctor and other medical staff a permission to send or retrieve data to or from his e-mail.
Step 4: the data will send automatically to the e-mail storage after check for compatibility from system administrator.

VI. Experimental setup and discussion

When we talk about using of e-mails in healthcare data storage, we aim to make all of patient data available and accessible everywhere the patient decide to go for consulting or visiting new doctor.

All known e-mails engines offer a free big size storage to encourage the user to use it for frequently access the e-mail that therefore increase the rate of the e-mail website and to get more investments and advertisements for more income. Actually, big e-mail providers will get benefits from make their e-mails compatible with HIPAA to get more clicks and visits(the main concept in E-business) to have high ranks comparing with other competitors.

A. Types of storage

Different types of storage used in healthcare industry and in general use for any sector. These types are as follows:
• Onsite or premise storage.
• Clouds.
• Hybrid storage that consists of both previous types.
For the previous types, all of them need to expand their capacity to overcome the increment of the data size and therefore more costs should paid.
For the first type, and due to the continuous development of hard drivers, a need of replacing the storage components appears every couples of years to increase storage capacity or to make these components compatible with the current technology.
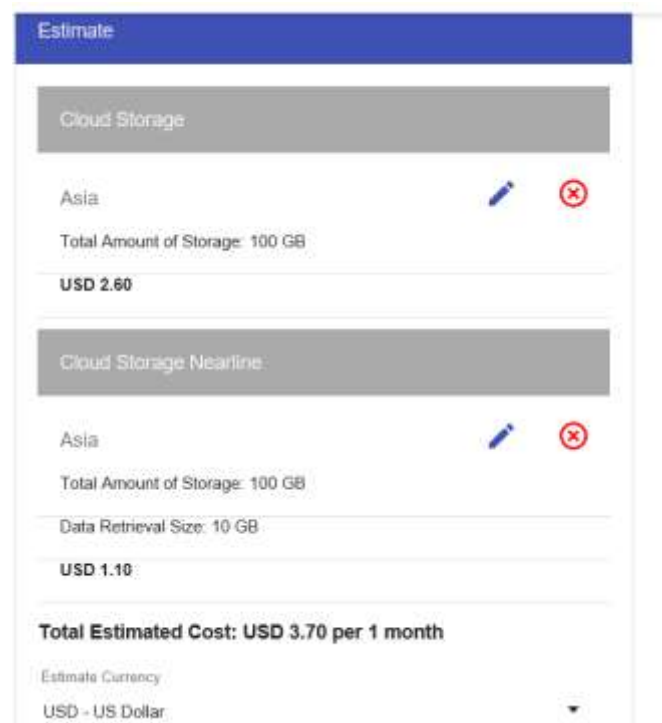In cloud types, let us consider that we deal with google clouds.

Figure 2 *https://cloud.google.com/products/calculator

For the above figure, we found that for 100 GB of storage we will pay 3.7 $ monthly. This amount seems very low in case of low data size, but what if we have 100 TB or more in some big healthcare sites. In this case, we need to

pay (3.7$ * 12 months* ((100 TB/100 GB) =1000)*20 years) which equal approximately 888K $ in 20 years only. The healthcare site or organizer will pay this huge cost as a rent to the cloud over 20 years. While in the first type, they may need less than half of the price and they own the storage forever. This result indicate how the cloud concept may cheat the decision makers in case of wrong analysis of the current situation or bad inspection for growth factor of the patients.

B. Privacy and security

The main issue that prevent using of e-mails storage is the privacy and security that make big trouble issues and encourage the researchers to make more and more studies on how to increase patient data availability without break security or privacy level or at least keep this level close to the recommended one.

We think that a revision on the relation between security and privacy from one side and the patient data from the other side. In another words; if we can reshape the relation between two sides and at the same time keep the security in high level, then we can achieve HIPAA compatibility with online storages.

A great evidence that privacy and security are able to reshape is what happened during pandemic of covid-19 virus. In some countries, especially those countries where people do not accept to reveal their medical history, many cases were confirmed due to their living or working with other people that do not prefer to tell others that they are already infected. Therefore, it is better sometimes to change the mentality and culture concepts regrading medical history and to allow experts to have enough access to patient data in legal circumstances to improve scientific researches and to protect others from patients themselves.

VII. CONCLUSION

As we described before, using of online storage is highly recommended to decrease the costs of the healthcare industry and to make the data available wherever the patient move.

Further studies needed to keep the security and privacy for patient data in high level to avoid any risk or loss of data.

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