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# A Categorization of Cloud- Based Services and their Security analysis in the Healthcare Sector

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**Abstract**
In today's world, the security measures of all web transactions not only in health sector but in all sectors should always be taken care of and constantly updated due to the fact that new electronic threats appear every day. Only under this condition, cloud services have positive impact to health, saving more lives than in t0.he past instantly. The contribution of cloud-based services in the healthcare environment is a vital issue. So we provide and present its benefits and tools in hospitals, clinics as well as diagnostic centers. Earlier existing applications and services are separated in categories, which basically concern data storage, computing power, network, PaaS, SaaS, data analytics, business intelligence and project management. Then, some security and risk assessment issues in cloud-based services are analyzed thoroughly together with some case studies. Keywords—Hospitals, diagnostic centers, cloud-based services, information systems, security, risk assessment

## Introduction

Nowadays, cloud computing has interfered in all sectors of human life. Marketing, education as well as healthcare are three of them which have been web digitalized. As far as the healthcare is concerned, considering how many diagnostic tests and therapies, like myopia laser and axis tomography, were not feasible until the 90s decade, is enough in order the importance of cloud services to be conceptualized. This happens because such clinical operations require storage of many patients' data (e.g. records from medical ultrasounds) and simultaneously an easy, fast access to them. This can be achieved only through secured cloud systems. Imagine for a moment how many terabytes in external or portable disk drives would be necessary for every hospital and every doctor if the interactive cloud storage systems did not exist. This means that their contribution to the healthcare sector should be thoroughly and methodically studied as far as the benefits, the offered tools and the threats/risks are concerned. More specifically, these three mentioned factors must be categorized in a manner that will help all employees, as well as scientists in the Information Technology (IT) sector of Healthcare. For this reason, a prototype classified analysis of the advantages and tools (section II) of cloud in health is the start point to begin our research. After a useful categorization of the already existing cloud-based applications and services in healthcare sector (section III), there is a focus on the security issues (section IV), as well as on a risk analysis for healthcare cloud-based IT environments (section VI). Between chapters IV and VI, some case studies (section V) are noted which prove that the secured cloud computing has really boosted the effectiveness of healthcare sector.

## Related Work

## 1. Material and Methods:

### 1.1 Methods:

This paper focus on Hospitals, Diagnostic centres etc.. To protect patients data we use cloud services.

**a) Storage Applications**

They allow hospitals, clinics, and diagnostic centers to store their data in local or cloud databases. The latter presents the data online to patients, doctors, patients' relatives and insurers as "pools" or/and "buckets". Pools provide immediate, around-the-clock access to various file archives with less Full Time Equivalent (FTE) required support.

**b) Computing Power Applications**

The computing power services give information about the Central Process Unit (CPU), the Random Access Memory (RAM) and the Input / Output Units. Their pricing differs from provider to provider

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but generally, depends on the cost of computing resources. This means that all health sectors need to make efforts for achieving big capacity, high speed and low maintenance costs at the same time.

**c) Network Applications**

The most important network services are provided by public cloud providers and concern Domain Name Servers as well as network load balancing. Network load balancing offers a common access point to many providers which are executed behind. A network balancer is a device that distributes the network traffic to providers, using a reverse proxy for the management of incoming requests between end users and one or more network servers. Determining the clients' IP addresses, a reverse proxy distributes the load requests across multiple servers. Its key function is the TCP multiplexing. In this way, the servers cut down their response time as well as their used resources when their capacity is increased. Some of the network applications, which balance the network load and can be used in clinics/hospitals, are: the AWS Elastic Load Balancer, the Microsoft Azure Load Balancer, the Google GPC Load Balancer, and the Amazon Route 53.

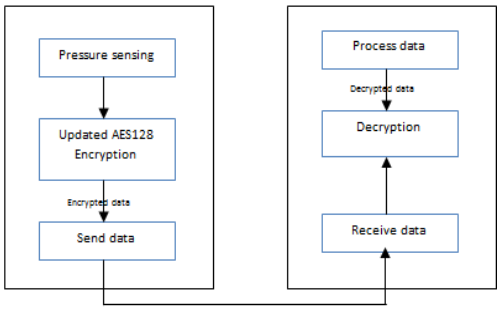
**d) PaaS Applications**

A PaaS platform includes preinstalled software stack. It is considered as a removal layer above the levels of hardware, operating system, and virtualization. It offers great value to hospitals, clinics and diagnostic centres as it simplifies the infrastructure complexity and maintenance. Its necessity can be better understood if the two operating systems are compare like e.g. Windows 1.0 vs Windows 10. Of course, the latter can be utilized far more easily, effectively as well as faster even by an almost digital illiterate person. So, it is realized that especially, doctors of previous generations are not able to examine or cure patients without a good platform incorporated in the cloud health system. Some applications that have been used for this purpose are: the Digital MRI analysis, the X-rays dashboard built on Microsoft Azure, the Digital Pathology System for archiving pathological slides.

## 2. Algorithm

### 2.1 AES Algorithm

**AES** is an encryption standard adopted by the US government. The standard comprises symmetric block cipher AES from a larger collection originally published as Rijndael. Rijndael supports a range of block and key sizes; whereas the AES adopts a 128-bit block size and a key size of 128, 192 or 256 bits which has 10/12/14 rounds. In the AES-128 shown as Figure 1, a state is a 4 × 4 array of bytes, and the AES operates on states. The AES includes 10 rounds, where each round includes 4 stages except the last round. The 128-bit (16 byte) block is depicted as a square matrix of 4 × 4 bytes. The block is copied into the state array. This state array is modified at each stage of encryption or decryption and copied into the output array at the end. In each round of encryption and decryption, four operations are performed. They are: substitute bytes, shift rows, mixcolumns, and add round key.




### A. Measurements

- Precision: is defined as the number of true positives divided by the number of true positives plus the number of false positives as indecated in (2).
- **Fscore:** is a measure of how accurate a model is by using precision and recall following the formula in (3):

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F1_Score = 2 * ((Precision * Recall) / (Precision +Recall))
(3)

**B. Cross validation**

In cross validation, the original training data set is divided into four groups, 4-fold cross validation fortesting and training. After applying validation techniques on the models, the prediction accuracy is found as indicated in Table IV and V.

## 4. Result:

It is obvious that a lot of steps will be made in the future as new secure mobile apps and tools offer more and more abilities. For instance, there are: watches for measuring diabetes mellitus and cholesterol, time automated insulin belts, oxygen finger counters, portable oxygen masks as well as heartbeat counters etc. It is expected that, in one day, all these kits communicate with the respective Android and IOS apps which in turn will store the collected data in a cloud database.
we are implementing an eyecatching categorization
of cloud benefits and threats in the healthcare
sector providing many important tools

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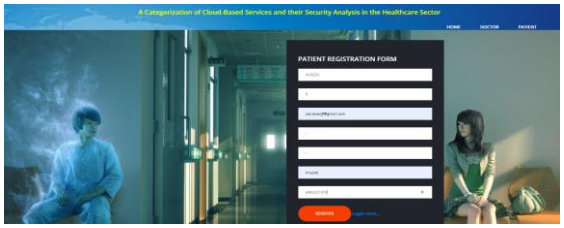


**REPORTS:**


## 5. Conclusion:

In this paper,we are implementing an eyecatching categorization of cloud benefits and threats in the healthcare sector providing many important tools and applications. In this way, the information exchange and management are boosted because less time is consumed. This fact is a necessary precondition for the implementation of the future trends which are next described.
In future we can implement to add security authentication schemes for data sharing (patient) to the other doctors and also implement to data auditing schemes

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