Review Article

Integration of Healthcare Services of Specialized Healthcare & Medical Education Department, Government of Punjab in Cloud-based System

Qaisar Abbas[1], Muhammad Imran[2] and Muhammad Sajid[3*]

[1]Department of Comuter Science, Islamia University Bahawalpur, Bahawalpur, Pakistan
[2]Department of Computer Science, Institute of Southern Punjab, Multan, 60000, Pakistan
[3]Department of Computer Science, Ghazi University, DG Khan, Pakistan
[*]Corresponding Author: Muhammad Sajid, Email: sajid_army1@yahoo.com

_____

Abstract: To know about the emergent technology in the world is cloud computing, which may utilize in the health sector to improve the mechanism for the delivery of healthcare services of Specialized Healthcare & Medical Education Department, Govt. of the Punjab, Lahore, human resources management system, budget and expenditure, pharmaceutical services, waste management, and patient treatment plan, in a cloud-based integrated system with the motive to change the storage mode of data from manually into digitally computing mod with accessing it efficiently through the cloud. Today, the major issue is to integrate the real-time patient data into cloud-based system information through the architectural design of data canal and formal models/methods. Data privacy & data integrity are the major concerns from the security point of view. Data may protect from loss and theft to mitigate the number of attacks whichever hits from the end-user/client, network, and cloud service providers.

Keywords: Cloud Computing, SHC&ME Department Healthcare Services, Data Canal, Security attacks.

_____

1. Introduction

The adoption of cloud computing especially in healthcare services of SHC&ME Department, Govt. of Punjab is due to minimize the usage of paperwork (as manually work which is being used to store the data of patients and administration activities), to secure the data from becoming the part of garbage or other, access the data in minimum time, easily sharing it with others for mutual collaboration in an emergency, reduce the data redundancy and kept the patient privacy as ethical issues.

However, in the integration of cloud computing, the risk probability is increased due to the lack of security issues as unauthorized users attacked the network through different ways as from Cloud Service Provider, Cloud Network, and from the end-users to steal the confidential information about the organization or person. Their attacks may in form of access control, data integrity, breaches the privacy, data confidentiality, and data availability. Cloud computing can be used with the strong recommendation of security challenges to reduce the accessing time of information, share the information easily, and control the information from anywhere in the world.

1.1 Background

Health is the fundamental element to determine the human capital as it improves the efficiency and productivity of the labor force which played an important role to improves the economic growth and human welfare progressive activities. The government gives subsidies in the healthcare facilities for the public interest, skillful and productive human capital in the country. The public sectors also pay its

participation in the whole or some part for the provision of the best healthcare facilities towards the mass. This kind of healthcare service varies from country to country in the world but the basic question will remain as the same relate to the health expenditures whether these expenditures are effective or productive in the mechanism of delivering the healthcare services in the country or not. It depends upon the volume of mass strength and distribution of the expenditures among them.

The basic purpose for the delivering of better healthcare services in the country is to reduce the Burdon of Diseases (BOD) which attracts the policymakers to concentrate on the provision of better healthcare services in the country.

However, different types of vertical and horizontal programs regarding the delivery of better healthcare services have been initiated in the country through the funded of Federally Government of Pakistan such as the Lady Health Worker Program, Malaria Control Program, Tuberculosis and HIV/AIDS Control Program, National Maternal and Child Health Program, the Expanded Program on Immunization, Cancer Treatment Program, Food, and Nutrition Program and the Prime Minister's Program for Preventive and Control of Hepatitis A, B & C.

Health issues still did not overcome despite the numerous policies for the improvement of healthcare services in the country. Infectious diseases are still a challenge for the policymakers of healthcare services. However, the statistics reveal that more than 51 percent of the burden of death (BOD) is due to these infectious diseases in the country while non-communicable diseases (NCD) are the cause of 10 percent of BOD due to sedentary lifestyles, unhealthy dietary habits, environmental pollution, and smoking, etc. According to the report of the Social Policy Development Centre (SPDC) out of every 1,000 children, 123 die before reaching the age of five years which identifies surviving suffers from malnutrition and infectious diseases on large scale. Human condition reports state that malnutrition is a big challenging issue in Pakistan as under the age of 5 years 40 percent of children become its victim and 50 percent of deaths are the result of malnutrition.

Therefore, the record of such causalities (from the numerous communicable and non-communicable diseases) did not store nor bother to study it for its cultivation from the region over a decade. None of any political government of the country emphasized the better treatment or provision of healthcare services insufficient way. It was due to the lack of resources for managing the budgetary resources of the country as Pakistan always seek or sought donors in the field of health.

Demographics of Pakistan 2017 & Health in Pakistan has been published that death rate in the country is 7.5/1000 population (2018) is the result of contagious diseases such as heat stroke, cholera, plague, cancer, diabetes, pneumonia, jaundice, measles. Some of them are curable somehow but the major becomes the cause of deaths. In Pakistan, primary diseases such as sudden injuries, tumors, cardiovascular and respiratory problems, tuberculosis, typhoid and hepatitis, asthma, malaria, and sunstroke are the major cause of death rate more than 51%.

1.2 Literature Review

A process of Integration of Healthcare services in a Cloud-based system is initiated in the field of medicine to provide quick information relevant to the patient with a unique architectural design using some calculated methodologies with a data canal in the cloud which carries out the data resources in its real-time evaluation. This system is not only to provide the information inefficiently way but also to store the data in the cloud where doctors and patients can easily access the detailed reports after issuance of some reference number or authentication access. The major task proposed to perform is the shifting of real-time data which is always kept in manual form into the computer and stored in the cloud. Patients, doctors, and healthcare services are the major emerging participants which always deal with the medications as an out-door or in-door in the hospital whenever they would enable to understand the disease for treatment. The shifting of manual record into computer need a significant network of interconnecting devices with the remarkable framework and processing efficiency of big data.

Although, patients all over the country are not categorized equally according to their financial assets. Only a few of them are strongest financially and afford all the charges for treatment but most of them belong to a middle and poor family and live behind the line of poverty in the country whose cannot afford the high expenses for their cure. The rate of expansion of diseases is larger in tribal and ruler areas of this country where the average ratio of an infected person in primary diseases is greater than 35-40% and fatal

diseases are between 11-15% according to their regional population. Unfortunately, there is no mechanism for their cure nor to maintain the record of the patient properly through which data can be analyzed for better improvement in the future.

At some regional/ provincial levels, patients' records will be stored in paper format. Although, it's a good practice with time it is time taking procedure in the modern world because storing data in manual format is burnt up after a decade of periods or less than it, and also very difficult to access it ineffective way in any emergency.

Therefore, it is a need of the modern world and revolution of the medical field with the invention of medications on daily basis, to store the patient's record and doctor's advice for the quick service to save the lives of infected people with the cure of disease at its initial level. Turning up the data from paper format to computing format make it easier for the life of a medical person to take a quick decision after finding the symptoms of diseases or to seek the previous history of the patient.

However, the reports of different international & national forums like World Health Organization (WHO), United Nations Children's Fund (UNICEF), Asian Development Bank (ADB), Centre for Poverty Reduction and Income Distribution (CRPRID), Poverty Reduction Strategy Papers (PRSP), Ministry of Health (Islamabad) and Mahbub ul Haq Human Development Centre, are emphasized the systematic approach towards the healthcare services to deliver the better healthcare facilities to every person without any cost and region as it seems systematic in the world.

As geographically, Pakistan is situated in the mid of epidemiological changes of the world where more than 40 percent burden of disease (BOD) is accumulated by infectious diseases such as diarrheal, acute respiratory infections, malaria, tuberculosis, hepatitis A, B&C, immunizable childhood diseases, chickenpox, Hemophilus influenza, measles, meningitis, mumps, pneumonia, polio, rubella, tetanus, whooping cough, influenza virus. While 12 percent out the total are the reproductive health problems due to nutritional deficiency of iron in anemia, Vitamin-A, iodine and 6 percent (out of the total) of total BOD are non-infectious diseases. In old ages, eye problems, paralysis, and bone diseases are also common diseases in the country. In addition to this drug addiction problem is rapidly increasing in youth as reported more than 5 million out of 50% are heroin adductors.

1.3 Aim of the Research

The work aims to identify the problems of the health sector related to the management, delivering of health facilities towards the public on a small budget, storage of data in a manual form as well as in cloud computing, sharing and access the data all over the province, patient's treatment plan, understanding of cloud computing with its infrastructure, data privacy and breakage of information and security attacks in the cloud.

1.4 Basic Questions
- **Question No. 1:** What is the basic structure of the Health Department in Punjab, Pakistan?
- **Question No. 2:** How to improve the delivery mechanism of healthcare facilities in Punjab, Pakistan through the implementation of Cloud Computing in all over the government hospitals of Punjab.
- **Question No. 3:** How to tackle the security challenges in cloud computing to protect confidential data from its loss and theft?

1.5 Restriction of the work

The work is limited to the problems of the health sector, basic introduction about the cloud computing and its infrastructure rather discusses a specific design of the service model of cloud computing, to propose an architectural design for the integration of healthcare services in cloud computing and its security breakage of data privacy and integrity.

2. Health Strategies in Pakistan

This section of research focuses on the health care plans in Pakistan. It is one of the top priority portions of human life, so it needs special attention and budget for the proper implementation of this main task of government.

2.1 Health is a Fundamental Right

According to the Universal Declaration of Human Rights, 1984, Article 25, states:
"Everyone has the right of standard living adequate for the health and is well being of himself and his family". World Health Organization declares it as:
"The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being".

However, more than 120 of the world's nations have admitted that an effective health system is an integral part of the society like a fair justice system and privilege of the democratic political system. Thus, the Constitution of Pakistan,1973 is declared that health and education are the fundamental rights of the public. Also, the 18th amendment is a milestone in the history of Pakistan wherein it was developed the legislation and executive authorities along with departments from the Federal Government to the Provincial Government. In the process of devolution, the health department was also shifted from the federal government to the provincial government along with all financial resources.

2.2 Health Expenditures in Pakistan

Pakistan has not had enough resources to capitalize the health facilities towards the whole country and that's why it seeks donors from the rest of the world for funding especially in the health sector around USD 60 million annually in the last few decades.   At this level, Pakistan lags other low-income countries where donor assistance averages 14% of health spending and it is 22% in the case of Bangladesh. The adverse impact of these low contributions on the health system is compounded by the miserly allocations to health by the federal and provincial governments: The yawning gap states to spend almost US$ 6 on every citizen of the country while WHO suggests that governments of developing countries make ensure to spent US$35-50 in the health sector to improve the essential health services in the country and to develop the relations between the private sectors to attract them for the partnership in the field of health from 2 to 3 times with the mutual collaboration of donors. The donor nations and organizations are increasingly focused on "aid effectiveness" for transparency, financial probity, and accountability utilization of aid in real-time.

2.3 Health Department, Government of Punjab

The 18th constitutional amendment in the Constitution of Pakistan defines the independent objectives, significant and analysis of that reforms which made in 2011 on the prospects for the role of discrimination between the federation and provinces for steering the health sector. The objectives of institutional appraisal were set up on a provincial level in the field of health with the establishment of the health department, the Government of Punjab. The milestones of that department were also be ordered with highlights the problematic area. With the 18th amendment, the Punjab Government framed the strategy of the health sector (2012–2017) which was implemented in different phased approaches. All the districts of the province were developed with three years of progressing plans. The integrated plans of Maternal, Newborn and Child Health (MNCH) and Nutrition and Family Planning (NFP) were implemented in all the regional areas of the Province. However, a regulatory body "Punjab Health Care Commission" was also established for functioning & regulatory of the health sector through rules/ policies. Development Organizations were principally committed to supporting the health sector's strategies till 2017. Fair investments in improving governance, service delivery structure, human resources, health information, and medical products seemed after the 18th amendment scenario. Finally, it is a time for the health sector of the province to serve the vulnerable for the people of Punjab and to save their lives from health shocks.

2.4 Bifurcation of Health Department

Health Department, Government of Punjab is divided into two categories on the demand of workload and to provide the better healthcare services towards the people of Punjab.   One is the Primary and Secondary Healthcare Department and the other is Tertiary Healthcare Department/ Specialized Healthcare & Medical Education Department. These two bifurcate departments are fully responsible to provide healthcare services in the province. All the Medical Institutes/ Colleges/ Universities and other Teaching Hospitals are lies under the jurisdiction of the SHC&ME Department while the Non-Teaching Hospitals,

District Head Quarters Hospitals (DHQH)/ Tehsil Head Quarters Hospitals (THQH), Rural Health Centers (RHC), and Basic Health Units (BHU) are dealt by the Primary & Secondary Healthcare Department.

2.4.1 Specialized Healthcare & Medical Education Department

Specialized Healthcare & Medical Education Department is a regulatory body that took the responsibility for the provision of healthcare services towards the people of Punjab as it is a department trusted by the people of Punjab to make ensure the provision of health facilities for the entire population. It delivers the services of Tertiary Health Care level which are regulated throughout Punjab with well-designed infrastructure. These Tertiary Health Care services are divided into:

Table 1: Detail of Health Care services

Sr. No.	Attached Departments	Total No.
1	Medical Universities and Colleges	20
2	Teaching Hospitals	45
3	Nursing Schools/ Colleges	56

This Department is a fully online managing government department with the establishment of Information & Communication Cell (ICT) since 2012 which is continually looking towards modernization for the better improvement of healthcare services for the public interest on a large scale in the province. It has achieved its goals for years as: -

2.4.1.1 Performance Management System

Performance Management System was launched in 2012 by Information & Communication Cell and upgraded from time to time to achieve its milestones as which were set up during the time from its implementation.

2.4.1.2 Internal Automation

A complete internal automation system has been set up within the SHC&ME Department. Installation of Local Area Network (LAN) as well as Wireless Network Communication within the department is also established in the department.   IT equipment like Servers, Desktop Computers, Laptops, Universal Power Supply (UPS), Scanners & Printers were provided from the Performance Management System to all sections/offices with full internet services for efficient working in administrative matters. Generation of SMS Alert System with masking "SH & ME Department". Installation of Security and Performance Monitoring Cameras within the department.

2.4.1.3 Biometric Attendance System

The biometric attendance system is launched for the monitoring of arrival & exit times of the employees of the SHC&ME Department and their attendance time is monitored on daily basis. The same was also started in its attached departments/ hospitals.

3. Cloud Computing

Cloud computing is an emergent technology that deals with the process and data storage with an application. The National Institute of Standards and Technology (NIST) defines cloud computing 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".

3.1 Cloud Computing Technologies

It is supported with two technologies, virtualization and grid computing where virtualization refer to a method or act of generating something virtually rather than physical or actual form and developing the interaction between different system. However, grid computing refers to a network or collection of multiple computers dispersed geographically with substantial computing power.

3.2 Big Data on Healthcare Services
Different techniques have been successfully implemented in healthcare services to provide the best and most efficient information. Like that, a data search engine for social networks helped to understand the reaction of the people to the epidemic disease. This is a real-time analysis rather than an analysis of the CDC (Centers for Disease Control) and WHO (World Health Organization). The nursing care plan recommendation system provides the clinical decision with support for nursing education and clinical quality control management. A medical recommendation system is proposed to provide a secure rating between patient and physician about health conditions based on their satisfaction.

3.3 Categories of cloud computing
Cloud computing is categorized into different types based on their deployment such as:-
- Private Cloud
- Public Cloud
- Hybrid Cloud
- Community Cloud

3.3.1 Private Cloud
It is the most protective way for the utilization of cloud computing. Its organizational structure can operate and manage within the limitations due to architecture or from third-party vendors which are mostly known as a cloud providers.

3.3.2 Public Cloud
According to the private cloud, the public cloud may manage by one or more organizations or cloud providers. However, this type of cloud is an open type of cloud computing that consists of cloud infrastructure.

3.3.3 Hybrid Cloud
A hybrid cloud is a cloud that consists of two clouds such as public cloud and private cloud, private cloud, and community cloud. Each cloud is remained distinct in hybrid but shared the homogeneous technology with others which permits the accessibility of data and application.

3.3.4 Community Cloud
The structure of community cloud computing is accessible to different groups with care to a definite community especially concerns to the task, safety requirements, plan, and obedience attention. It is accomplished by a third party and is existed on the ground or off ground.
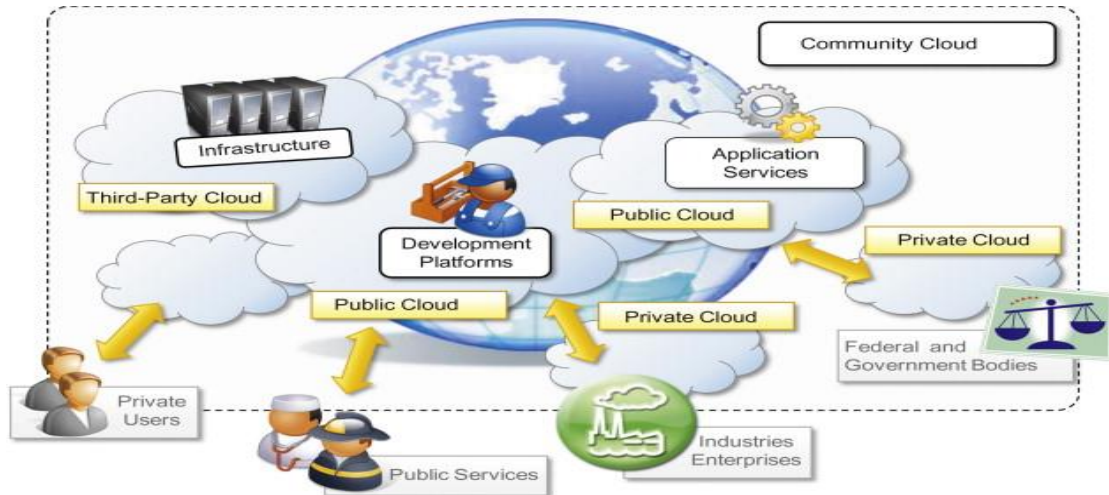
Figure 1: Community Network

3.4 Different Models of Cloud Computing
The following models of cloud computing are:
- Software as a Service (SaaS)
- Platform as a Service (PaaS)
- Infrastructure as a Service (IaaS)

3.4.1 Software as a Service (SaaS)
In this type of model, the software is used as a service in cloud computing. It is also known as cloud application services. It utilized the internet to deliver applications that are managed by a third party like a cloud service provider. It does not require any downloading and installation on the user end because it directly runs on the web browser.

3.4.1.1 Characteristics
The following characteristic of SaaS are:
- It is managed from the central location
- It is hosted on a remote server
- It is accessible through the internet
- Users are not responsible for updates (hardware & software)

3.4.1.2 Examples
- Google Workspace (formerly GSuite)
- Dropbox
- Salesforce
- Cisco WebEx
- SAP Concur
- GoToMeetin

3.4.2 Platform as a Service (PaaS)
In this type of cloud model, the platform is used as a service that allows to access the cloud components for certain software which is used for applications. The developers customized the application on the access of the framework.

3.4.2.1 Characteristics
The following characteristics of PaaS are"-
- The sources can easily spread by making the virtualization

- It provides different services in development like testing & deployment of applications.
- Integrations of database and web services

3.4.2.2 Examples
    It has the following kinds of apps:
- AWS Elastic Beanstalk
- Windows Azure
- Heroku
- Force.com
- Google App Engine
- OpenShift

3.4.3 Infrastructure as a Service (IaaS)
    In this model, the structure of the cloud is scalable and highly resource able and is a fully self-service to access and monitor the systems, storage, and networking with other services. The businessman purchases it on his demand.

3.4.3.1 Characteristics
    The following characteristics of IaaS are:
- Resources are available as a service
- Its Cost varies based on consumption
- Its services are highly scalable
- Organizations retain complete control of the infrastructure
- Dynamic and flexible

3.4.3.2 Examples
    It has the following services:
- DigitalOcean
- Linode
- Rackspace
- Amazon Web Services (AWS)
- Cisco Metacloud
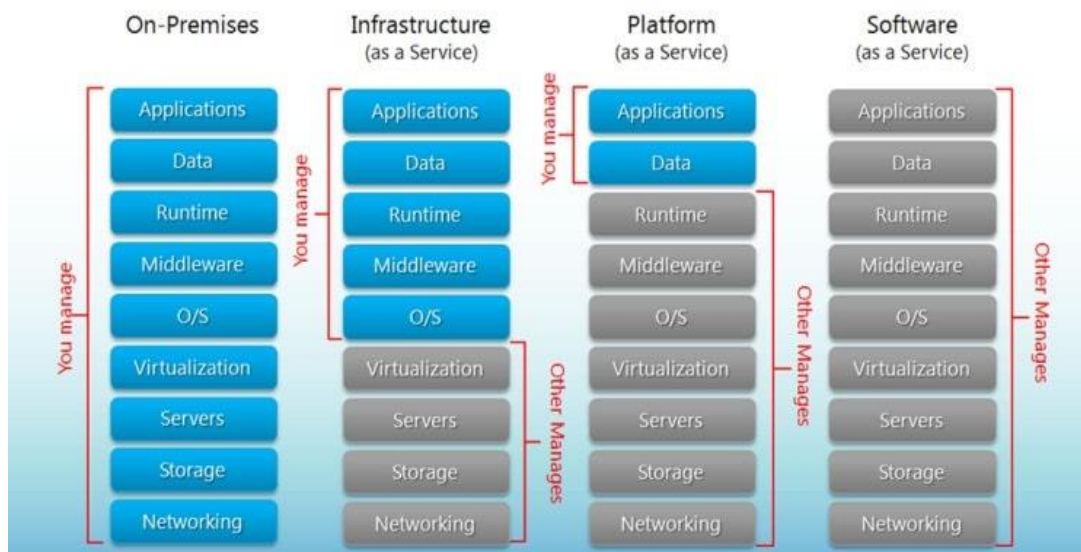- Microsoft Azure
- Google Compute Engine (GCE)

Figure .1: The architecture of IaaS, PaaS & SaaS

3.5 What is Data Canal

Data canal is a scoring methodology that is used for the storage of a large amount of raw data in its original format from where data is extracted for manipulation. Similarly, a data warehouse is another term that is used for the storage of the data in specific or standard format in individual files and folders. Both terms carry out the same concept but differ in their architectural design. Data is kept in an original scenario with unique ids and a tag system in the data canal. The small relevant data from big data which is kept in the data canal can be accessed and analyzed through specific business quires. The relevant comparison between data canal and data warehouse is described under the given table:

Table 2: Data Canal Vs Data Warehouse

Data Canal	Vs	Data Warehouse
Raw data in its semi-ordered format	Data	Well-ordered and managed
It is like the road plan with low cost,	Volume	It is like the inscribe scheme and highly expensive
Modification in its configuration on a need basis, high responsive	Responsive	less responsive with fixed configuration
The growing mechanism for the data mining team.	Users	Business professional

3.6 Advantage of cloud adoption

The advantages in adoption of cloud computing are:
• Maximum the availability of cloud services and low-cost adversity
• To reduce the total cost of maintenance of software and hardware
• Information may store virtually
• Cloud computing can easily manage and update
• Data mobility in cloud computing

3.7 Challenges of cloud adoption

It has the following challenges:
• Security concerned
• Control on data is in another hand or third party like a cloud provider
• Computing performance of cloud
• Cost management in cloud computing

3.8 Cloud-based System

On obtaining the visibility of the information which providing different technologies, especially in the integration of healthcare services in the cloud, it will be necessary to put the raw data including data of hospitals/ private clinical centers of the province into a cloud in an effective way which creates the big picture for the patient. No doubt, different integration approaches have been successfully proposed to discuss the information. Therefore, this research is also being proposed an architectural approach for the integration of healthcare services through using the existed service-oriented architecture (SOA) which will easily provide integrated information about healthcare services in Pakistan.

Following are the features that found out in different research problems which lead to propose an architectural design in cloud-based system information regarding the healthcare service of SHC&ME Department, Govt. of Punjab, such as:
• The concept to integrate the healthcare services in the cloud through service-oriented architecture was not separately categorized with the cloud because SOA is inherited in the cloud.
• There is no suitable design to control and flow the data in the cloud through the proper channel.
• Models which relate to integrating the information are not only especially used for healthcare services but also be sued for business professionals where it will be needed.

3.9 Problem Statement

According to the background and motivational perspectives, this research leads to building and architectural design which enable to provide the complete information regarding the healthcare services which are still line up in that context instead only to provide of single information.

"To build an architectural design for the integration of healthcare services in cloud through data canal, that exist in the cloud, for distinguish information as a service".

This proposed research work for the integration of healthcare services in the cloud-based system will provide the following information using data canal, are:

3.9.1 HRS

It has the followings:
- SHC&ME Department, Govt. of Punjab.
- Medical Colleges/ Universities
- Attached Department of SHC&ME
- Hospitals

3.9.2 Budget & Expenditure

It has the followings budget and expenditure areas:
- Development Budget (relate to project development)
- Current Budget (relate to salaries)

3.9.3 Employee Record

The following type of employees' records can be found:
- Employees of administrative departments like SHC&ME
- Employees of attached departments
- Employees of Hospitals & Medical Colleges/ Universities

3.9.4 Services provided by Hospitals of SHC&ME Department
Below services are provided by the department:
- Pharmaceutical services
- Waste Management
- Patient Turn over Record
- Doctors-patient mapping services
- Prediction of diseases on the behalf of finding symptoms
- Disease alert services
- Tracking the previous history of the patient
- First aid services
- Expiries/ causalities

3.10. Research approach

The proposed architectural design for the integration of healthcare services in a cloud-based system is so simple and will provide the complete big picture of healthcare services after the processing of required queries at a different level.
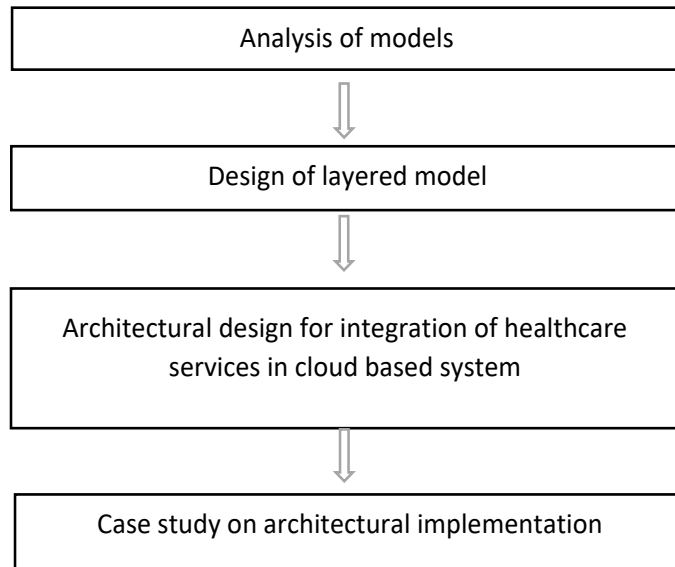
```
┌─────────────────────────────────────────┐
│            Analysis of models            │
└─────────────────────────────────────────┘
                    ⬇
┌─────────────────────────────────────────┐
│          Design of layered model         │
└─────────────────────────────────────────┘
                    ⬇
┌─────────────────────────────────────────┐
│  Architectural design for integration    │
│  of healthcare services in cloud based   │
│                system                    │
└─────────────────────────────────────────┘
                    ⬇
┌─────────────────────────────────────────┐
│  Case study on architectural implementation │
└─────────────────────────────────────────┘
```

Figure 3: Research Approach

3.11 Integrated Information as a Service on Architecture

In a cloud-based system, cloud services changed the adopted techniques of IT Organizations by removing the fixed combination between the business application and its data from other applications for the implementation of the current application.

3.11.1 Architectural Model

The proposed model for integration of healthcare services on the cloud-based system is not only to develop for the provision of complete or big-picture of the patient but also to save the complete previous history of the patient, provide the disease alert services, give the prediction of disease on finding the symptoms in the patient and first aid services automatically. The dominant characteristic of a cloud-based system is the computing of real-time data with increasing computing competency. A cloud-based architectural is shown below.
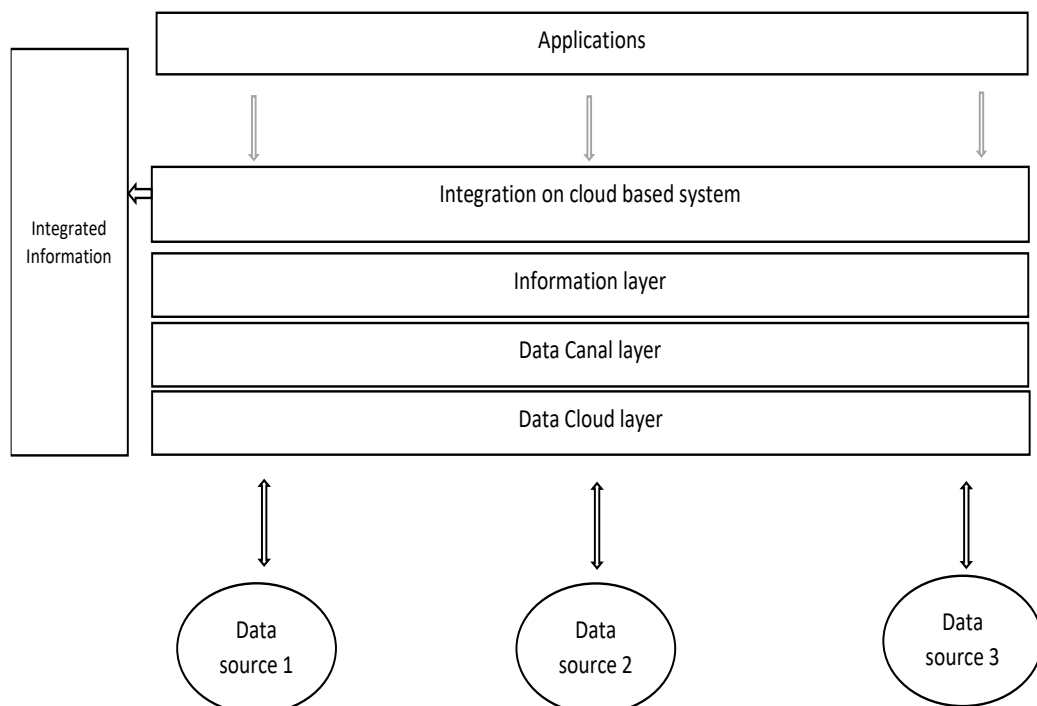

Figure 4:Architecture of cloud-based integrated information

3.12 Detail of cloud components

The component's detail is given in the table as:

Table 3: Cloud Components

Components Name	Detail
Data Source	Hospital and private clinics etc
Data Cloud layer	To manage the various data
Data Canal layer	Carrying the various/ mixture data/ raw data
Cloud-based integration	To integrate the various data which is accessed from other layers
Information layer	Various records of patients.
Application layer	Healthcare services
II-integrated information	Find out the integrated information in geographical location

3.13 Integration of information in cloud-based System

Data is collected from different resources like that administrative department, attached department, colleges/ universities, hospitals, private clinics, labs & pharmacy will be managed in the cloud through data canal which assorted it in different ways.

3.13.1 First

Data canal theoretically attacks the problems which relate to big data because big data is collected from different resources with carrying the different information in huge amounts which varies from project to project base. Therefore, for more connivance, this type of data is the constraint in different geographical shapes like that Relational DataBase Management System.

3.13.2 Second

The integration and information layer collects the requested data and generates the corresponding response against that data with the collaboration of the data canal. This data is converted into information according to the rules & regulations.

3.13.3 Third

The requested information which obtained from the data canal as an information service and processed further in the integration layer.

3.14 Methodology.

Generally, the historical records of the patients are found according to the symptoms of disease which exist in them, their age factor, and also their financial status. Different approaches are being proposed to store the huge record of the patients based on different mathematical techniques or relational diagrams which commonly could be seen in clinical labs in form of EMR (electronic mail record) and patient profiles with a unique tagging system.

In this connection, Petri Net's model is being proposed to integrate the healthcare services in cloud-based systems which are based on the hierarchical models and enable to generate and analyze the activities automatically with the efficient programming language and standard modified language which provides the basis primitives of data.
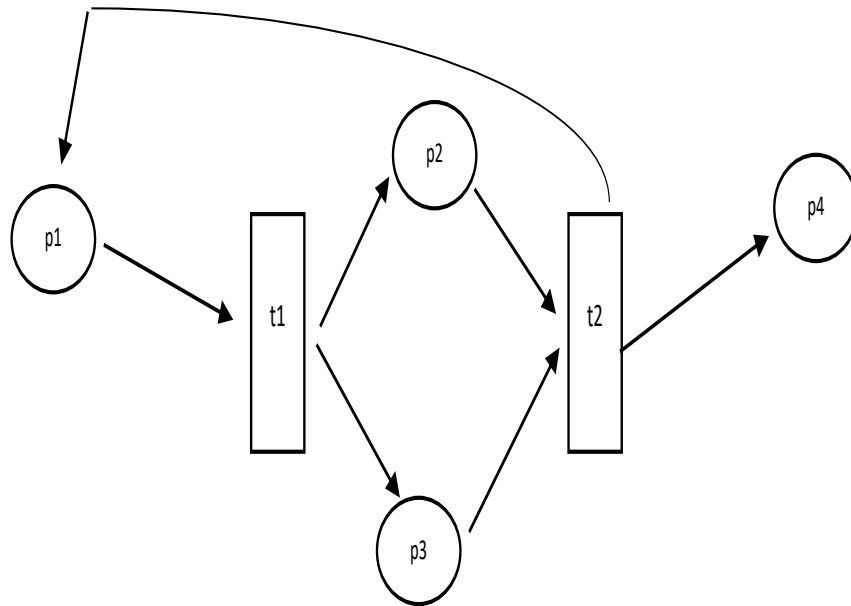
Figure 5: hierarchical relational diagram of patient record

p1 = patient number one
p2 = patient number two
p3 = patient number three
p4 = patient number four
t1 = treatment of patient one on the behalf of finding symptoms
t2 = treatment of patient two on the behalf of finding symptoms
t2 = p1 treatment of patient one is like to the finding symptoms of disease finding inpatient one

As mentioned above the Integration of healthcare services on a cloud-based system has been discussed with complete architectural design and framework as earlier discussed in the literature review in detail. This recommended research work enables to produce the efficient result for significant information regarding the healthcare services i.e doctor-patient mapping service, prediction of disease on the behalf of finding symptoms, disease alert services, tracking the previous history of the patient, and first aid services to store the huge amount of raw data in cloud for efficient access of the record and to provide the plan for a medical person like a doctor to cure the disease in an emergency but have also the great thoughts inherit the characteristics like human resources management, waste management, and pharmaceutical services which attract the interest of researchers to proposed the effective solution for their integration on the cloud-based system in Punjab.

4. Conclusions
Nowadays, cloud computing looks like an emergent technology of the world and becoming dominant in the field of network communication to attract the stakeholders for investment in that area where the network infrastructure and IT personnel are not available or too expensive. Moving of world towards cloud computing with reducing the investment cost and better security challenges. That is why, Specialized Healthcare & Medical Education Department, Govt. of Punjab may look forward towards the cloud computing for better achievement in healthcare facilities, administration and monitoring and controlling to its attached bodies with storage of huge data/ information in a secure platform with reducing the accessible time & ease to share with public & private stakeholders to attract them for mutual partnership in the health sector. It may also make the efficient with IaaS/ PaaS/SaaS cloud models in the delivery mechanism of healthcare services. However, security is a big concern in cloud computing to protect the confidential data/ information from any is-happing as attackers can attack the cloud through different ways but the least

secure area for attack is the end user's in the cloud computing as the end-users are not good familiar to deal such type of attacks from the outside.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Barnett-Page, E., & Thomas, J. (2009). Methods for the synthesis of qualitative research: a critical review. BMC Medical Research Methodology, 9, 59-69.
2. Gough, D., Oliver, S., & Thomas, J. (2012). An Introduction to Systematic Reviews. London, UK: Sage Publications.
3. Hon, W., Millard, C., & Walden, I. (2012). Negotiating cloud contracts: looking at clouds from both sides now. Stanford Technology Law Review, 79-129.
4. Hossain, S., & Luby, D. (2010). Cloud computing in healthcare industry. In Global Science and Technology Forum 2010 proceedings of the Annual International Conference on Cloud Computing & Virtualization (pp. 42-50). Retrieved July 2, 2014, from http://www.globalstf.org/docs/proceedings/ccv/193.pdf
5. Iyer, B., & Henderson, J. C. (2012). Business value from clouds: learning from users. MIS Quarterly Executive, 11(1), 51-60.

6. Khajeh-Hosseini, A., Greenwood, D., Smith, J. W., & Sommerville, I. (2010). The cloud adoption toolkit: addressing the challenges of cloud adoption in enterprise. Software: Practice and Experience, 1-10.
7. King, N. J., & Raja, V. T. (2012). Protecting the privacy and security of sensitive customer data in the cloud. Computer Law & Security Review, 28(3), 308-331. Retrieved July 20, 2014, from http://dx.doi.org/10.1016/j.clsr.2012.03.003
8. Laukkanen, T., Sinkkonen, S., Kivijärvi, M., & Laukkanen, P. (2007). Innovation resistance among mature consumers. Journal of Consumer Marketing, 24(7), 419-427.
9. Mell, P., & Grance, T. (2011). The NIST definition of cloud computing. Retrieved July 27, 2014, from http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf
10. Park, S., & Ryoo, S. (2012). An empirical investigation of end-users' switching toward cloud computing: a two factor theory perspective. Computers in Human Behavior, 29(1), 160-170.
11. Pasquale, F., & Ragone, T. A. (2013). The future of HIPAA in the cloud. Retrieved July 13, 2014, from http://digitalcommons.law.umaryland.edu/fac_pubs/1363/#?
12. Ram, S. S. (1987). A model of innovation resistance. Advances in Consumer Research, 14(1), 208-212.
13. Rogers, E. (1983). Diffusion of Innovations (3rd ed.). New York, NY: Free Press.
14. Rogers, E. M. (1995). Diffusion of innovations (4th ed.). New York, NY: Free Press.
15. Rogers, E. M. (2003). Diffusion of innovations (5th ed.). New York, NY: Free Press. Online Journal of Applied Knowledge Management A Publication of the International Institute for Applied Knowledge Management Volume 4, Issue 1, 2016
16. Accenture.com (2013).Journey to the cloud: Accenture's roadmap and maturity model for healthcare companies.
17. Ahuja, Sanjay, P., Komathukattil, D., (2012), A Survey of the State of Cloud Security, Journal of Network and Communication Technologies (NCT).
18. Bokesebeld, R., (2010), the impact of Cloud Computing on Enterprise Architecture and Project Success. Utrecht, Netherland.: Hogescholl Utrecht.
19. Devadass, L., Sekaran, S. S., & Thinakaran, R. (2017). Cloud computing in healthcare. International Journal of Students' Research in Technology & Management, 5(1), 25-31.

20. English K., (2014), The Cloud Delivers a Better Experience for the Connected Athlete through the Internet of Everything.
21. Gorelik, E., (2013), Cloud Computing Models. Cambridge, Massachusetts, USA.: MIT Hitachi Data Systems (2012), How to improve Healthcare with Cloud Computing Iftikhar, S., Khan, W., Ahmad, F., and Fatima, K. (2011). Semantic
22. Interoperability in E-Health for Improved Healthcare. Technical Report. National University of Computer and Emerging Sciences, Islamabad,Pakistan Jha, A., Doolan D., Grandt, D., Scott, T., Bates, D. (2008), The use of health information technology in seven nations, International Journal of Medical Information Kermanshahche, K., (2012), Shared services and Healthcare Cloud, Intel Corporation.
23. Kvale, S. (1996) Interviews: an introduction to qualitative research interviewing, SAGE, Thousand Oaks, CA.
24. Lupşe, O., & Vida, M. (2012). Cloud Computing and Interoperability in Healthcare Information systems. Timisoara, Romania.: University of Timisoara
25. Marinos, A., & Briscoe, G. (2009), Community Cloud Computing. Surrey, UK.: University of Surrey
26. Mell, P., & Grance T., 2009, The NIST definition of Cloud Computing Preece, J., Rogers, Y. & Sharp, H., (2002). "Interaction Design - Beyond Human- Computer Interaction", John Wiley & Sons.
27. Implementation of Community Cloud Computing Infrastructure in Pakistani Healthcare Organizations
28. Ren, H.,(2012). Transition to Cloud Computing in Healthcare Information Systems: Cambridge, Mass   achusetts,USA.: MIT
29. Ried, S., (2010), Siemens IT Solutions And Services Successfully Positions A Community Cloud,

30. Saleem, R.,(2011),Cloud Computing Effects on Enterprises in terms of cost and security School of Economics and Management. Lund, Sweden.: Lund University Shah, S.,(2012),Importance of cloud computing technology in Pakistan Suo, S.(2013),Cloud Implementation in Organizations: Critical Success Factors, Challenges and Impacts on the IT Function. Arlingtion, Virginia: United States.: UMT.

31. Wang, Q.,(2011),Mobile Cloud Computing, Saskatoon, Canada .:University of Saskatchewan Shi, M. (2012). Incorporating information security in analysis of business strategy: a conceptual framework. Computer & Information Science, 5(5), 1-16.

32. Sommer, T. (2013). Cloud computing in emerging biotech and pharmaceutical companies. Communications of the IIMA, 13(3), 37-53.

33. Subashini, S., & Kavitha, V. (2011). A survey on security issues in service delivery models of cloud computing. Journal of Network and Computer Applications, 34(1), 1-11. Retrieved July 20, 2014, from http://dx.doi.org/10.1016/j.jnca.2010.07.006

34. Sultan, N. (2014). Making use of cloud computing for healthcare provision: opportunities and challenges. International Journal of Information Management, 34(2), 177-184.

35. Surry, D. W., & Farquhar, J. D. (1997). Diffusion theory and instructional technology. Journal of Instructional Science and Technology, 2(1). Retrieved July 29, 2014, from http://www.southalabama.edu/coe/bset/surry/papers/dtit/dtit.htm

36. Tripathi, S., & Jigeesh, N. (2013). A review of factors that affect cloud computing adoption. IUP Journal of Computer Sciences, 7(4), 48-59.

37. Witt, C. (2011). HIPAA versus the cloud. Journal of Health Care Compliance, 13(5), 57-68.

38. Zissis, D., & Lekkas, D. (2012). Addressing cloud computing security issues. Future Generation Computer Systems, 28(3), 583-592. Retrieved July 19, 2014, from http://dx.doi.org/10.1016/j.future.2010.12.006

"Security Guidance For Critical Areas Of Focus In Cloud Computing V3.0", https://cloudsecurityalliance.org/research/security-guidance/