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A Study of Cloud Computing in Healthcare Market

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Abstract

The global cloud healthcare market is expected to grow at a CAGR of 22.0% during 2015 -2021. Healthcare is one of the most dynamic application of cloud computing. Although healthcare organizations are highly concerned about the privacy and security of patient data, the pressure of controlling the increasing healthcare cost has driven the adoption of cost effective solutions such as cloud computing. There has been a surge of interest of the healthcare companies in adoption of cloud computing. Companies are leveraging cloud providers for various benefits such as providing business agility, reducing cost, and so on. The major drivers are shift in focus of healthcare from generalized care to personalized care, limited IT budgets of healthcare organizations, and growing big data in healthcare industry. However, various legal barriers and government regulations are major restraint for the market.

Introduction

Cloud Computing has clinical and non–clinical applications in healthcare. However, clinical applications such as Electronic Medical Records (EMR), Laboratory Information Systems (LIS), Pharmacy Information Systems (PIS), Picture Archiving and Communication Systems (PACS) and Bioinformatics dominates the market contributing to 80% of the total market. The current paper focuses only on Clinical Information System (CIS) applications. Among the various CIS applications EMR dominates the market with 37.06% market share in 2014. The growing adoption of EMR by both public and private organizations is the major driver. However, cloud based bioinformatics is the fastest growing market at a CAGR 27.4% during 2015-2021.

Conceptual framework and review of literature

Cloud computing, as the basis of IoT and smart items, can show immense benefits in a healthcare application (Stantchev et al., 2014). It enables healthcare providers to cure and care more effectively and prevent illnesses from reaching a critical state by introducing new ways to manage and monitor patients (Verzijl and Dervojeda, 2015). The World Health Organization (WHO) found that a majority of patients do not adhere to their medical prescription, which often results in a failure of their therapy (Sabate, 2003). Consequently, this gives an immediate scenario, a smart item monitoring the pill intake time.

The project ‘Optimaler Einsatz von Smart-Items Technologien in der StationarenPflege’, Germany (OpSIT), builds on existing works and is conducting literature research, workshops and expert interviews with healthcare specialists and IT professionals to model reference processes for practice-oriented cloud applications in the healthcare domain.

IBM research also identified some game-changing business enablers powered by cloud. Organizations are exploiting these business enablers to drive innovation that extends well beyond the IT Department and into the boardroom. Our analysis reveals that some organizations are harnessing cloud services to transform both product and service development and recast customer relationships.

Among the cloud service models Software as a Service based cloud model dominates the market with 64.60% market share in 2014. Extensive use of cloud services for analysis of healthcare data and in non- CIS applications are the major drivers for SaaS based cloud services. However, the future healthcare industry is expected to adopt Platform as a Service model growing at a CAGR 25.7% (2015-2021). Among the deployment models, Private cloud leads with 39.60% market share in 2014. However, hybrid is the future for the healthcare industry growing at a CAGR of 23.7% (2015-2021).

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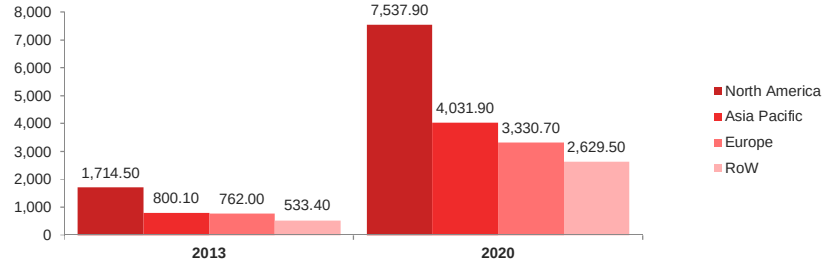
Figure 1 Global Healthcare Cloud Market by Geography in $ Million (2013-2020)

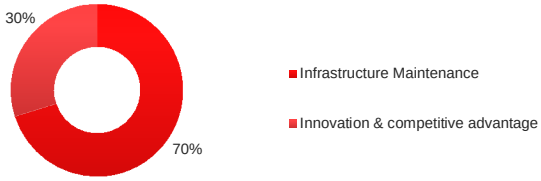


North America dominates the cloud healthcare market with a 44.80 % market share in 2014. Various government initiatives in the region for digitization of healthcare data are the major drivers for the region. However, Asia Pacific is estimated to grow at a highest CAGR of 24.2% during the forecasted period. The APAC market is driven by rapidly increasing patient data due to rising medical tourism in Asian countries such as India and Thailand.

Market Definitions

Cloud Computing in healthcare is a typical pay as a go service model that provides IT as a service to the healthcare organizations. These services consist of core IT services such as infrastructure, software, development and deployment services and so on. The services are provided through private and public model. In public model data is stored and managed at service provider's end where as in private model health organizations can have greater access and control over the data. However, due to highly sensitive patient data, most health organizations are opting for a hybrid solution that enables security of private cloud along with cost effectiveness of public cloud model. The exploding big data in healthcare is a major driver for healthcare cloud. Cloud companies can exploit the opportunities in the healthcare sector. For instance, a recent development is cloud-based medical imaging and information management solutions that enable healthcare professionals to view and interpret images such as X-rays, CT scans, and MRI scans simultaneously. This significantly reduces the long-term technology cost and increases the speed of patient care management.

IT investment pattern of Healthcare Organizations



The high operating cost of the traditional healthcare information system is a huge concern before the healthcare organizations. The cost includes power, cooling, and data centre space, which often exceeds the benefits. The traditional healthcare information system places more focus on the maintenance of infrastructure and existing applications. However, use of a cloud-based platform enables the in-house IT team to focus on innovations while the maximum load of infrastructure is carried by the third party or cloud service provider. Currently, about 25% of the healthcare organizations worldwide have virtualized their IT through cloud. However, healthcare organizations, which have virtualized their IT environments, current paper substantial savings from consolidating servers as a first step in their evolution to a cloud computing model.

Research Objectives:

1. To explore the cloud computing platform and its estimation in healthcare market.
2. To estimate the revenue from various applications of cloud computing

Research Methodology

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The key data points that were used for the estimation of the cloud healthcare treatment market are as follows :

Revenue of key cloud service providers

Revenue from various applications of cloud computing

Revenue from core cloud services (SaaS, IaaS, PaaS)

Data sources

Estimation is based on the data obtained from various reliable healthcare & IT associations such as HIMSS in different countries such as North America, Canada, Japan, China and others. The key estimation is derived from the study of various applications of cloud computing and their percentage contribution in the market share. Intensive primary research was conducted among various healthcare institutes and cloud service providers to validate and obtain data. Various economic indicators and emerging trends were considered to estimate the market size. Some of the factors include expenditure on IT by healthcare industry, investment on healthcare by IT organizations, government incentives and interventions for each region and so on.

The current paper focuses majorly on the clinical applications of the cloud healthcare which contributes 80% of the total healthcare cloud market. The non- clinical applications which include all the management activities are excluded as they are considered under business process as a service, which is not considered while estimating for the total healthcare cloud market. The market is purely derived from the revenue generated from the core cloud services i.e. Infrastructure as a Service (IaaS), Software as a Service (SaaS), and Platform as a Service (PaaS). SaaS is the most used service by the healthcare organizations. The market is further segmented on the basis of clinical applications such as EMR, PIS, LIS, PACS and bioinformatics. The percentage share is considered by the usage of each of these applications in the healthcare organizations.

Revenue by countries is estimated and analyzed through following points:

Investment in Healthcare IT by different governments

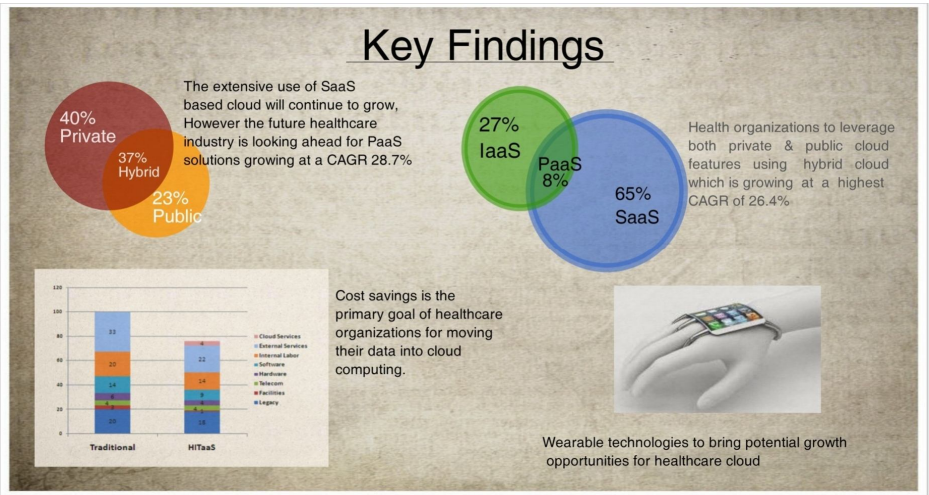
Opportunities of healthcare cloud in each region

Government regulations

Revenue generated by various applications in different geographies

Market forecast was done through proprietary software that analyzes various qualitative and quantitative factors. Growth rate and CAGR were estimated through intensive secondary and primary research. Data triangulation across various data points provides accuracy across analyzed market segments in the current paper findings

Key findings in Healthcare Cloud Market



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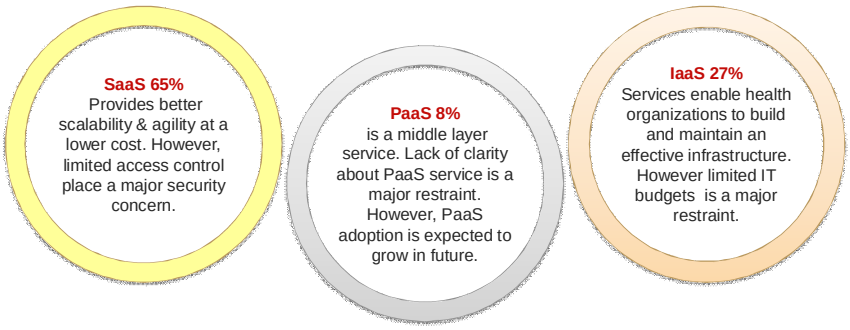
SaaS-Based Cloud Services are Grow

Though healthcare organizations are rapidly adopting the cloud-based services, SaaS-based cloud services are gaining immense popularity. SaaS is forcing the healthcare community to reconsider the value of information and how to pay for it. For example, cloud-based EHRs are enabling providers to mine large caches of data without moving them, and other SaaS capabilities are helping smaller providers implement services such as e-prescribing without making significant capital investments. Currently, almost 80% of the healthcare organizations are using SaaS-based cloud models. SaaS contributes almost 65% of the total cloud healthcare revenue. The market is expected to move upwards during the forecasted period to estimated revenue of $10,868 million by 2020.

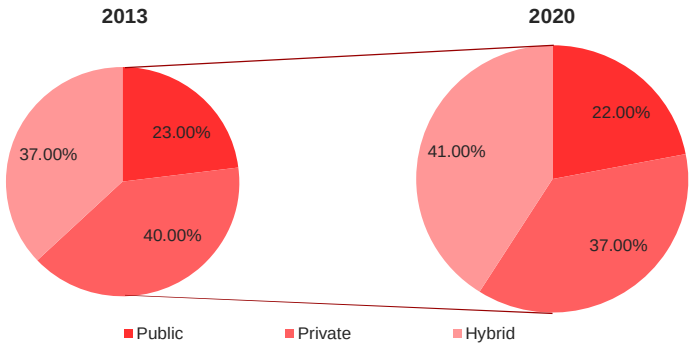
Healthcare cloud service models (%) in 2013



Hybrid Cloud is the Future in Healthcare

Currently, the cloud healthcare market is dominated by private cloud with almost 65% healthcare organizations using hybrid cloud. The hybrid cloud infrastructure allows for the computing capabilities to swiftly expand while maintaining some local data and applications within the traditional IT environment. The hybrid cloud infrastructure approach allows companies to leverage their existing infrastructure and retain control of sensitive data in-house while using the cloud to realize cost savings and scale. Currently, several healthcare companies are managing their data through in-house IT infrastructure; however, the constantly increasing healthcare data may generate a need to shift to a cloud service provider in future. For such organizations, infrastructure as a service deployed in a hybrid cloud is the best choice.

Percentage Penetration of Cloud Healthcare market by deployment model



Growing Wearable devices market drive the adoption of cloud in healthcare

As the world is moving towards gadgets, companies such as Nike, Fitbit, Jawbone, and Apple have recently launched gadgets that can record our heart rate, calories expended. This technology could be a major driver for the transformation of healthcare from general to personal.

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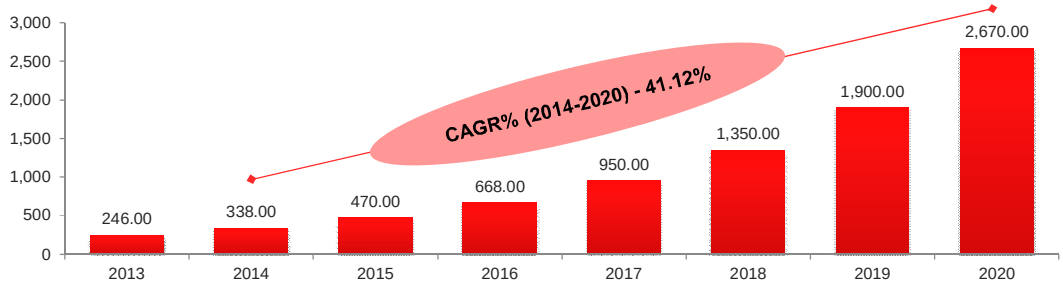
Wearable devices could transform medical care in unimagined ways. From headsets that measure brainwaves to clothes that incorporate sensing devices, these devices are gaining extreme popularity among the users. Moreover, they are driving the adoption of big data and cloud computing services in the healthcare industry. Cloud computing enables these devices to perform faster and better analytics of personal health data.

Global Wearable device market in $ million (2013-2020)



The global wearable fitness sensor device and heart rate meters market is expected to grow up to 2,670 million in 2020 from $246 million in 2013 at a CAGR 41.12% during 2014-2020. Wearable devices market is increasing considerably due the increase in the number of heart patients and affordable prices of the product. According to W.H.O. estimates 17.3 million people died from CVDs and it is responsible for 30% of global deaths. It is estimated that 7.3 million died due to coronary heart diseases and 6.2 million due to stroke in 2013. It is estimated that 80% of CVD deaths take place in low and middle-income countries. It is estimated that the number of deaths will increase to 23.3 million by 2030.

Table 1 : Some Popular Wearable Devices

Device	Company	Function
The Integrated Positioning and Communicating System (IPCS)	9Solutions	A real-time locating solution (RTLS) based on Bluetooth low energy RFID application platform. The system enables real-time tracking of 9Solutions Tags and other Bluetooth devices, such as mobile phones.
AiQ Smart Clothing	AiQ	A range of custom apparel, including a vital sign monitoring system in a t-shirt that measure the user's heart rate, respiration rate, and skin temperature. It can also measure skin moisture and electrophysiological signals such as EKG, electroencephalography (EEG), or electromyography (EMG).
Metria Wearable Sensor	Avery Dennison	It aims at transforming healthcare to prevention. The user attaches the wearable sensor, which uses 'skin-friendly' adhesive; the sensor collects data, such as the number of hours slept and breaths per minute; and the sensor wirelessly transmits a summary of the data to the user's or caregiver's device, such as a Smartphone.
Wearable EEG headset	Imec	The wireless 8-channel EEG system enables ambulatory EEG monitoring. The system measures 8 EEG signals in a referential configuration, with the reference usually placed at the mastoid.
Microsoft Band	Microsoft	The band helps you achieve your wellness goals by tracking your heart rate, steps, calories burnt, and sleep quality. It also helps you be more productive with email previews and calendar alerts - right on your wrist.

Source: Company Websites

Healthcare IT as a Service (HITaaS) will be in more demand

The concept of HITaaS provides an efficient IT environment to the healthcare companies. The IT services such as infrastructure, platform, software, and other services are provided as a package to the healthcare organizations through cloud. Centralized IT means improved care —

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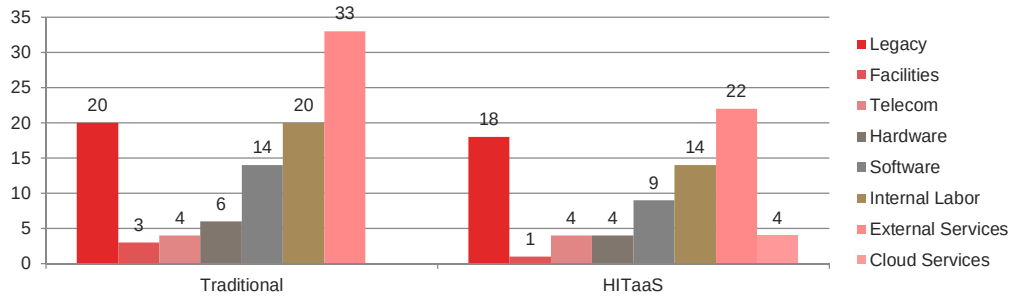
with all patient information available at any time as healthcare IT organizations extend their reach to healthcare providers. This includes ambulatory care settings, physician offices, skilled nursing facilities, home healthcare, and other smaller, healthcare providers.

HITaaS will enhance patient care and delivery and outcomes at a low IT cost. An estimated 24% cost can be saved over the traditional IT from HTIaaS. Moreover, this new service oriented approach moves beyond traditional IT complexity and rigidity by decoupling services from physical hardware assigned to specific applications. The whole IT infrastructure is managed through virtual environment.

Cost Comparison – traditional v/s HITaaS in %



Key Buying Criteria

Although the buying perspective for cloud services varies with the size of healthcare organization, security and privacy of patient data are still key primary concerns. Moreover, it is important to check that the cloud service provider complies with regional and international regulatory standards. Also, cost of the service is one of the major buying criteria due to limited IT budgets with healthcare organizations.

Compliance with government regulations

It is important to ensure that the service provider complies with the regional and international regulatory standards for adoption of healthcare in cloud services. Certain mandatory regulatory compliance includes ISO27001, HITECH Act, HIPPA, and SAS 70 Type II.

Cost contribution to finance

Healthcare organizations have limited IT budgets due to rapidly increasing cost of healthcare service. Moreover, most of the hospitals suffer from poor IT infrastructure and less skilled IT staff. Cloud computing enables them to reduce their capital expenditure by eliminating the cost of IT infrastructure. With cloud, hospitals can save building & maintenance cost of IT infrastructure and also cost of licensing. Thus, cost has become one of the major criteria for most healthcare organizations to choose among cloud services.

Privacy and security concerns

Sensitivity of the data is a major challenge before healthcare organizations in moving their data into cloud. Organizations are likely to select a cloud service provider that complies with the security and privacy of the data. Moreover, as the data is highly confidential, hospitals may select a service in which they can have greater access and control over the data.

Requirement of data storage capacity

Demand for data storage capacity varies with the type of end-users. It is obvious that the storage capacity required for a hospital will be more as compared to patients using personalized healthcare. Cloud service providers provide customized package as per the storage requirement of business enterprise. Hence, storage capacity is also a criterion for deciding the price of the cloud services. The table below illustrates price variation of Amazon's offerings on the basis of different storage capacities:

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Table 2 Amazon cloud price comparison on the basis of storage capacity

Amazon Offering	Cores	RAM (GB)	Temporary SSD Storage	Block Storage (GB)	Amazon Prize in US$/month
M3 Medium Instance	1	3.75	4	250	62.9
M3 Large Instance	2	7.5	10	500	125.8
M3 Extra Large Instance	4	15	10	1000	251.6

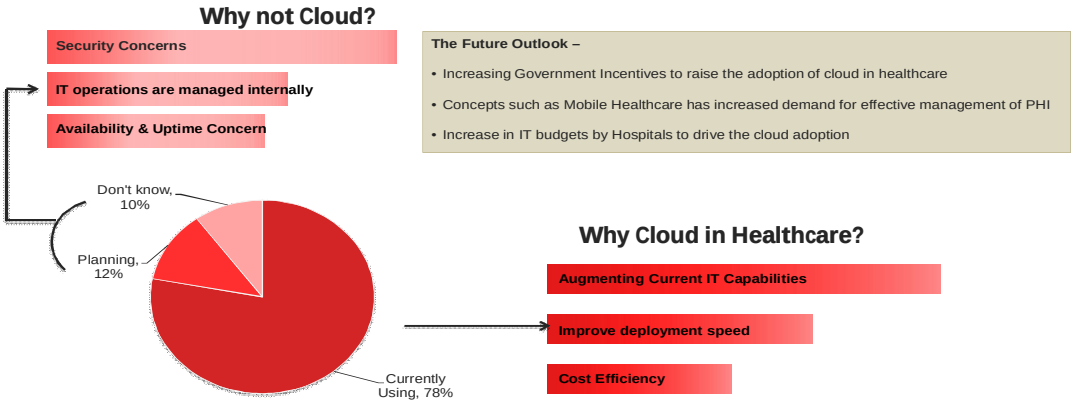
Stability of service provider

A cloud service provider could be a startup or an established firm. Although, initially both startups and established providers can offer cost effective services, reliability lies in winning the customer's trust in terms of stability. If a firm leverages on premise server or storage hardware, it is crucial to ensure that the service provider will continue to provide services for a long time. Cloud services are facing the issue of vendor lock-in and in case a cloud provider exits the market, the customer fears data loss and breach of data security. Vendor lock-in is a situation in which the client is unable to switch to a new cloud service provider, due to proprietary technologies of the existing provider that are incompatible with a new platform. It is necessary to check whether the service provider has any data export functionality and back-up storage facility to recover from data breach. The stability of the service providers can be verified by checking their financial strength, infrastructure availability, customer base, and geographical distribution of data centers.

End-user analysis

According to a survey conducted by HIMMS, 78% of the healthcare organizations are currently using cloud services. However, 12% are planning to move their data into cloud and 10% are yet not sure about adopting cloud services. Currently, most of the hospitals are opting for SaaS models, as they offer the most cost effective cloud solution. However, limited access and control over data is a major concern for SaaS-based cloud services. Currently, 67% of the organizations are opting for private cloud service due to highly sensitive data of healthcare. However, 33% are using public cloud services. The major reason for cloud adoption by healthcare organizations include augmenting current IT capabilities, better and cost-effective services, and high speed transactions in remote departments. However, those still not in cloud are concerned with the security and privacy of their data.

End users in healthcare cloud market



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Conclusion

Cloud computing is being promoted as a potential solution to improve health service delivery, although a number of challenges need to be overcome. However, a key challenge for international governments keen to promote cloud computing in healthcare is to provide an effective legal and regulatory framework, which governs trans-border (patient) data flows .

India is the most important regional economy with a strong interest in Information & Communication Technology (ICT) services development. However, cloud computing readiness in India has been dropping since 2011. Although India occupies a lower rank in the readiness index; cloud providers have witnessed a huge potential in the country in the last few years. Major factors that have hampered cloud adoption in the country are falling currency, policy uncertainties, lack of awareness and support from India's large technology companies.

The Indian healthcare cloud market was expected to reach $373.6 million in 2021 from $70.9 million in 2014 growing at a CAGR 27.6% (2015-2021). SaaS based services show the highest adoption rate by healthcare sector. The growth drivers for SaaS market are e-mail, CRM, and ERP services. India will demonstrate a robust growth in the public cloud. India is also a hub for medical tourism due to availability of lower cost treatment in the region

Developing economy with strong interest in ICT services development Updated copyright laws in line with the development of cloud computing services

Restraints

India has not yet implemented effective privacy laws

India's cybercrime legislation requires updates to conform to international standards

Low level of broadband penetration

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