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Role of Cloud Computing for Improvement in Healthcare Services

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Abstract: ***Cloud helps in offering on-demand latest technology that helps in deploying, accessing and using network-accessed information along with various applications and resources. Nowadays electronic health records are maintained by many hospitals that want to undergo a change in their legacy system. This type of transformation has helped physicians, nurses and also administrative staff access the desired record whenever needed. They believe that this may change the complete face of health information technology. However, lack of security and privacy are two important concerns that may provide hazards when choosing cloud solutions for various health-related factors. This problem can be avoided to some extent by evaluating cloud technology in an effective manner before its complete adoption. This paper uses four major aspects i.e., technology, security, legal and management for finding different types of challenges of this computing model. When any health services want to migrate from traditional to cloud-based health services then they can do different types of strategic planning for determining strategy, allocated resources and direction for maintaining a cloud environment in their organization.***

Keywords Electronic health record (1), Cloud computing (2), Health care (1), quality improvement (3)

I. INTRODUCTION

According to many researchers, cloud computing is not new technology we may call it a model that delivers computing resources anywhere and anytime [3]. Some common examples of non-healthcare applications are Microsoft Hotmail and computing, usage in the health care sector, advantage and disadvantages and what type of strategic planning should be done by an organization for moving from the traditional approach to cloud approach. Google Docs and some examples of healthcare applications are Microsoft HealthVault and PHI. Though they provide some advantages such as elimination of an upfront commitment by users on-demand availability of huge computing resources and pay-as-you-go. Cloud computing applications industry, business, transportation, education and national security are reported in various journals [4-7] In order to provide high-quality services continuous and systematic innovation is required by health care or with any other service operation.

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There are many advantages of cloud computing in improving health care services that may also change the face of information technology (IT) [8-13]. For example, it is believed by Schweitzer [10], Haughton [11], and Kabachinski [12] that electronic health record (EHR) startup expenses can be reduced by cloud computing, and thus adoption can be encouraged. Research done by Rosenthal et al shows that the biomedical informatics community, especially consortiums that share data and applications, can take advantage of the new computing paradigm [13]. As indicated in the paper by Anderson et al, problems related to data handling, complexity and unavailability of computation resources are some major issues in the biomedical field. However different types of informatics innovations show that cloud computing can overcome these difficulties with ease. [14-21].

Though healthcare sector can be benefitted a lot from cloud computing services, in spite of that certain legal, technical and managerial issues needs to be taken care of. The main objective of this paper is to define the concept of cloud approach.

II. CLOUD COMPUTING

A. New Economic Computing Model

Definition, properties and characteristics of cloud computing is a developing attribute. More than 20 definition was studied by Vaquero et al [22] and he tried to give exact definition that contains the important characteristics of cloud computing. Following are some important points related to the definition of cloud computing [23].

Clouds can be defined as a huge resource of virtualized resources that can be accessed. Re- configuration of these resources can be done in dynamic manner so that resource can be utilized in optimum manner. This is based on pay as you go model where services can be provided to customer by the help of strong level service agreements [24].

There are three models based from service point of view that include: software, platform and infrastructure.

(1) Software as a service (SaaS): IN these various types of application services are provided by cloud service provider through the internet.
(2) Platform as a Service(PaaS): In this development platform are provided by cloud provider that can be accessed with the help of any browser. There is no need of installing any tools in ones machine. Various types of web application can be developed by developer that can be further deployed with the help of administrative skills [25].

(3) Infrastructure as a service (IaaS): In this various supporting software such as storage, hardware, servers and networking components are provided to user. In this Cloud provider is the main owner of all the equipment along with their maintenance also.

In order to deploy above mentioned model of cloud computing, the US National Institute of Standards and Technology (NIST) listed four different methodology [1]

(1) Public cloud: In this cloud service provider (CSP) such as Amazon elastic compute cloud (EC2) provides the required resource to general public on pay as you go basis. Virtual computer are rented to customers where they can run their own application [26].

(2) Private cloud : Cloud service is provided to single organization. For example Microsoft Azure help customers in building private cloud infrastructure with the help of windows server.

(3) Community cloud : In this many organization share the same cloud infrastructure, for example policy, security requirement, goals and objectives etc. Google GovtCloud is the best example.

(4) Hybrid cloud : It is the combination of public, private or community cloud. Some resources are managed by organization themselves. For example IBM is merged with Juniper network in order to provide hybrid cloud infrastructure that enhances private cloud service to remote server within secure public cloud [27]. Fig 1.

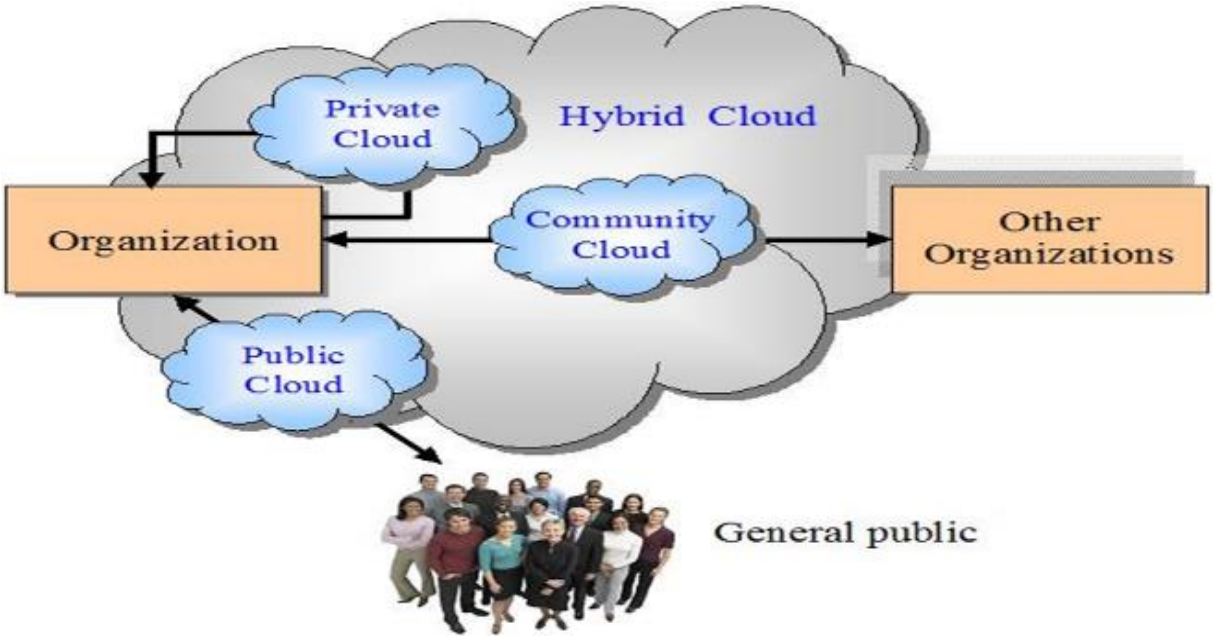

Fig 1: Cloud Deployment Model (Courtesy: Google)

B. Status and Adoption Of Cloud Computing

In an attempt to improve health care services many research are done that illustrate the potential benefit of improving the health care services [28-35]. Among them, it was proposed by Rolim et al for collecting all vital information of patient automatically based on cloud platformcloud with the help of sensor connected to inherited medical devices. After this data is further delivered to cloud medical center for further storage, processing and distribution. Most important advantage is removing manual collection work and reduce the possibility of typing errors that further makes the deployment process easy [36]. Protocol related to cloud computing management system was described by Nkosi and Mekuria that helps in providing security and multimedia sensor signal processing to mobile devices as a service. Mobile health services are now delivered using security algorithm and heavier multimedia [37]. This will help in efficient utilization of mobile devices which will further helps in efficient delivery of health facility to rural community [38]. cloud initiative in persistent manner was reported by Rao et al called Dhatri, which that helps in giving knowledge of the power of cloud computing and wireless technologies in order to help physicians to read health information of patient that can be accessed from anywhere and at any time [39]. Koufi et al described a cloud-based prototype emergency medical system for the Greek National Health Service combining the emergency system with personal health record systems to provide physicians with easy and immediate access to patient [40]. Application of cloud computing in bioinformatics research are published in numerous articles and resources [15-21] [41]. For example, fundamental of colorectal cancer imaging analysis and research for clinical use was proposed by Avila-Garcia et al [18]. Amazon's EC2 service with 100 nodes to assemble a full human genome with 140 million individual reads requiring alignment using a sequence search and alignment by hashing (SSAHA) algorithm were used by Bateman and Wood [19]. Kudtarkar et al also used Amazon's EC2 [21]. The impact of G-quadruplexes on Affymetrix arrays was evaluated by Memom et al using this service [42]. Generic testing model was developed by The Laboratory for Personalized Medicine of the Center for Biomedical Informatics at Harvard Medical School that helps in managing huge amount of data in limited time [43].

Many world class software companies have spent huge amount in cloud services so that they can offer something with better application to medical services for example huge investment in cloud is also done by many companies so that they can extend offerings in medical fields in many a [44].

C. Challenges and Computing Opportunities In Health Cloud Computing

More than 70% of chief information officer said that cloud computing is very useful in near future according to current research [47]. According to Mark Beccue total number of people going to mobile cloud applications will rise drastically by 2022 [45]. Many manager and expert in health sector organization also trust that cloud computing approach may change health care sector drastically [46].

It is important that before adopting cloud computing it should be evaluated rigorously [49]. Systematic study and impact of cloud computing on health care IT in terms of its opportunities and challenges

Rigorous evaluation of cloud computing should be performed before adopting in mass scale. Systematic study on impact of cloud computing on health care are done by some research paper [48]. These research paper also explain about various opportunities and challenge

Aspect	Opportunities	Challenges
Management	Infrastructure cost is less	Lack of trust by health care professionals
	On-demand availability of computing resources.	Organizational inertia
	Pay as you go	Loss of governance
		Uncertain provider's compliance
Technology	Reducing the maintenance burden of IT.	Resource exhaustion issues
	Flexibility and scalability of infrastructure	Unpredictable performance
	Green computing advantage	Data lock-in
		Data transfer bottlenecks
Security	Data protection resource availability.	Separation failure
	Advanced data security by enhancing replication of data	Public management interface issues
	Dynamically scaled defensive resources strengthen resilience	Poor encryption key management
		Privilege abuse
Legal	Providing customer data and privacy commitments by the provider.	Data jurisdiction issues
	Enabling construction of the trusted platform	Privacy issues
	Fostering of regulations by the government for data and privacy protection	

III. MANAGEMENT-RELATED ASPECT

A. Opportunity

An important advantage of cloud computing is low cost and accessibility. For example, Amazon takes the only US $0.1 per hour for 1.0 GHzX86 instructions set architecture "slices" of EC2 [51]. Hence in this way, any company's rigorous IT solution can be cost-effective through cloud computing without purchasing hardware or software or without maintaining [20] IT staff that are needed for in-house infrastructure maintenance [40]. In this way, any company can focus on the critical task without giving extra cost in terms of training and staffing IT staff [51]. Cloud computing also helps in maintaining speed while maintaining important features (such as rapid elasticity, access to health resources in a unique manner etc. as the a result as the demand increases or decreases, health care service providers do not have to adjust their infrastructure in order to accept the changes.

B. Challenges

The most important challenge includes lack of data security trust, users' privacy, Governance loss and uncertainty in provider compliance. In a cloud environment, the most important factor is trust [52]. when any type of sensitive or mission-critical applications are shifted to the cloud then sometimes cloud provider may not provide guarantee of security effectiveness and privacy control [53]. In some cases, even a strong service level agreement may not offer a commitment to allow the client to audit its data.

IV. TECHNOLOGY ASPECT

A. Opportunity

Mostly there is a lack of IT staff who are responsible for maintaining in house infrastructure in smaller hospital and medical practices [10]. Also there may be a lack of mission critical application such as EHRs. In this way EHR adoption can be made feasible by curtailing the new infrastructure cost and burden for It maintenance [55]. Cloud computing can increase flexibility, scalability and infrastructure cost effectiveness from an IT management point of view [56].

B. Challenges

Some major issues cresting problem in cloud computing are resource exhaustion, unpredictability of performance, data deadlock, problem in data transmission and various errors in large scale distributed cloud systems. Two key features of cloud computing are less cost and on demand availability of resources.

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Now a days since the market is becoming overflooded with cloud provider who sometime overcommit computational resources such as CPU, storage space, application etc. for attracting clients. However, the market is becoming over crowded with large providers. Hence instead of providing quality services, quantity services will be provided. For example limiting access to resources, supplying outdated hardware or software, implementing outdated CPU technology and so on. Cloud provide may not give auditing permission to customer and sometime are unable to provide virtual architecture. This result in unpredictable performance in the service [57]. Hence customer expectation may not match with provider delivery and hence end user may get deprived of high-quality service.

V. SECURITY ASPECT

A. Opportunity

Maybe the strongest resistance to the relinquishment of pall computing in health IT centers relates to data security [58]. Nonetheless, compared with locally housed data, this model isn't inescapably less secure. In some cases, it generally improves security because pall providers (eg, Microsoft, Google, Amazon) are ready to devote huge coffers to working security issues that a lot of guests can not go, in discrepancy to the destruction of the numerous medical records and legal documents within the Japan9.0 magnitude earthquake or the New Orleans Hurricane Katrina disaster.

All kinds of security measures, similar as in tackle, software, mortal coffers, and operation costs, are cheaper when enforced on a large scale. Utmost pall providers replicate druggies'data in multiple locales. This increases data redundancy and independence from system failure and provides A position of disaster recovery. In addition, a pall provider always has the power to stoutly reallocate security coffers for filtering, business shaping, or encryption so as to extend support for protective measures (eg, against distributed denial-of- service attacks). The capability to stoutly gauge protective coffers on demand has egregious advantages for adaptability [54].

B. Challenges

There are numerous data security pitfalls in the use of IT, similar as hacker attacks, network breaks, natural disasters, separation failure, public operation interface, poor encryption crucial operation, and honor abuse. Specific pitfalls to pall computing are separation failure, public operation interface, poor encryption crucial operation, and honor abuse.

Cloud computation is generally accessible to numerous different customers. However, it could beget veritably serious security pitfalls, If the provider fails to separate the coffers. For illustration, a client requests to cancel data stored in the virtual structure; as with utmost operating systems, this may not affect in true erasing of the data incontinently. The data are still stored on the fragment but are just not available [54]. In the multiple vacancy's terrain, tackle coffers are reused by other guests. In this case, a third party could have access to another client's "deleted" data. This presents an advanced threat to the pall guests than with devoted tackle.

VI. LEGAL ASPECTS

A. Opportunity

Data and sequestration protection are essential to erecting the client trust demanded for cloud computing to reach its full potential. However, druggies would be better suitable to assess the affiliated pitfalls they face, If the providers borrow better and clearer programs and practices. Fortunately, numerous main providers have commitments to develop stylish programs and practices to cover guests' data and sequestration [59-61]. Besides providers commitments to this protection, some associations, similar as the Cloud Security Alliance, have developed a comprehensive companion to deal with security and sequestration issues [62]. The Trusted Computing Group a not-for- profit association, suggests a set of tackle and software technologies to enable the construction of trusted platforms. Governments also play a critical part by fostering wide agreement regulations for both druggies and providers [63-66]

B. Challenges

The use of cloud computation presents numerous legal issues similar as contract law, intellectual property rights, data governance, and sequestration [67-71]. Among them, data governance and sequestration issues are major enterprises.

In the cloud, physical warehouses could be extensively distributed across multiple authorities, each of which may have different laws regarding data security, sequestration, operation, and intellectual property. For illustration, the US Health Insurance Portability and Responsibility Act (HIPAA) [63] restricts companies from telling particular health data to nonaffiliated third parties, and the Uniting and Strengthening America by Furnishing Appropriate Tools Needed to Block and Obstruct Terrorism (Loyalist) Act [72] gives the US government the right to demand data if it declares conditions as being an exigency or necessary to motherland security [73]. Also, the Canadian Personal Information Protection and Electronic Documents Act (PIPEDA) [64] limits the powers of associations to collect, use, or expose particular information in the course of marketable conditioning. Still, a provider may, without notice to a stoner, move the stoner's information from governance to governance. Data in the pall may have further than one legal position at the same time, with differing legal consequences

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PROPOSED MODEL

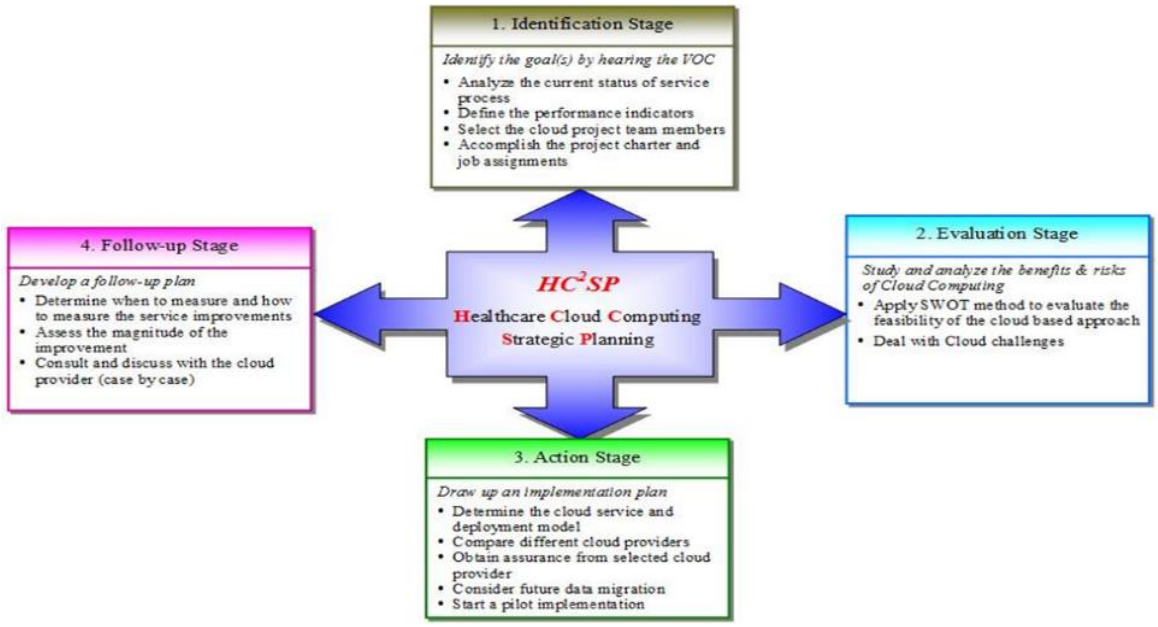

Figure 2. Health care cloud computing strategic planning (HC²SP) model (SWOT = strengths, weaknesses, opportunities, and threats; VOC = voice of customer)

Stage 1: Identification

In this HC2SP model, the first stage is to dissect the current status of the health association's
service process and identify the abecedarian ideal of service enhancement by hearing the voice of the client or the cases [74]. The root causes analysis system can be applied to dissect the problems of the
current service process. A typical scale of causes would be expressed as follows [80]

Problem# 1 The process of patient admission to, or discharge from, hospital is too long. Why? There's too important indistinguishable charting. Why? The paper-grounded charting system is hamstrung. Why? There's lack of automated information systems similar as EHR/ EMR. Why? It involves a lot of over-frontal IT investments and conservation.

The objective identification and its compass must be clarified so as to serve the end druggies (cases) more efficiently and effectively. In addition, the strategic planning platoon has to define health care service quality pointers and explain their purpose as well as the use of each index. This stage of the model provides the strategic planning platoon with a well- defined compass for the service problem being faced.

Stage 2: Evaluation

Next stage of the model is to estimate the openings and challenges of adopting cloud computing. ENISA [54], the Cloud Security Alliance [62], and NIST [53] have developed comprehensive attendants to estimate the benefits and pitfalls of adopting cloud computing. An authorized customer can also apply a strengths, weakness and threats (SWOT) analysis to estimate the feasibility of the cloud-oriented approach.

Likewise, the customer needs to assess styles to handle the linked issues. Numerous references are available for this purpose [51,53,62,71,82,83]. For example, Armbrust et al [51] report 10 major obstacles for cloud computation. Each hindrance is paired with openings (results), ranging from straightforward product development to major exploration systems. Buyya and Ranjan [82] bandy several cloud computational operational issues, similar as data transfer backups, participated logging, and confederation of distributed clusters. They also give farther references to handle the bandied issues. In addition, Kuo et al [83] propose an XML- grounded middleman to conquer data cinch-in problems.

Furthermore, the user needs to assess methods to handle the identified issues. Many references are available for this purpose [51,53,62,71,82,83]. For example, Armbrust et al [50] report 10 major obstacles for cloud computing. Each obstacle is paired with opportunities (solutions), ranging from straightforward product development to major research projects. Buyya and Ranjan [81] discuss several cloud-federated management issues, such as data transfer bottlenecks, shared logging, and federation of distributed clusters. They also provide further references to handle the discussed issues. In addition, Kuo et al [83] propose an XML-based mediator to conquer data lock-in problems.

Stage 3: Action

Once the new computing model is evaluated, adopting new services or not will be decided by the organization. Implementation plan should be drawn, if the final answer is yes. 5 step plan is proposed in this paper as follows:

Step 1: Determine The Cloud Deployment Model

As mentioned above, there are three service model of cloud computing (SaaS, PaaS and IaaS) and there are three deployment models (private, public and hybrid). They have their own advantage and disadvantage [55]. Hence different factors should be considered while adopting service or deployment models.

Step 2: Compare Different Cloud Providers

Choosing a proper cloud provider is the most important part of the implementation plan. Different providers may offer different service models, pricing schemes, audit procedures, and privacy and security policies. The organization has to compare different offerings. Also, it needs to evaluate the provider's reputation and performance before it signs a contract.

Step 3: Assurance Given By Preferred Cloud Provider

Before providing service to any organization, cloud provider should give assurance to any company regarding security, legal aspect and confidentiality. Pay as you use, fast elasticity, data availability, support in troubleshooting and transparency in operation are some major factors covered. This helps in achieving three major network security goals such as data confidentiality, data integrity and data availability [54]. One most important point in this is geographic access to data should be limited according to contract mentioned in service level agreements.

Step 4: Future Data Migration Consideration

In this step when provider stops the google health services then organization takes their data back from cloud to in house [2]. There may be decrease in service quality, or some dispute in SLA. Important part of the plan of this step may be data availability [84-87].

Step 5: Start A Pilot Implementation

If some company is not used to any cloud environment, then pilot implementation is the beast possible way [75-79].

Stage 4: Follow-Up

This is the last stage of cloud computing implementation. In this stage required improvement of services can be measured. After fixing the target, improvement limit can be measured by performance related indicators [80]. If it doesn't match the required criteria then health sector needs to study impact of aim achievement. In this organization may also consult with cloud provider if any problem is from their side. Chances are there that organization may decide once again to shift from cloud to in-house IT environment.

VII. DISCUSSION AND CONCLUSION

Cloud computing helps in providing more relaxation, that may be less expensive and, in this way, providing IT services to end users may be more efficient. Thus, potential opportunity of research in health care services increases. However adopting new health care model may be very challenging. Securing the data and legal related issues are the powerful hindrance to adopt cloud computing in IT field of health care center. However some cloud service provider such as Microsoft, Google, Amazon try to provide best practices and policies for securing and safeguarding customer data [59-61]. Some different and trusted computing group such as cloud security alliance have designed detailed technologies related to hardware and software to boost reliable cloud application.

Proper planning such as finance, manpower, tradition and culture of an organization should be taken into consideration by any organization when they wants to move their service into cloud. This paper provides required planning for potential user and organization those who wants to shift to cloud. New model introduced in this paper includes 4 stages such as identification, evaluation action and lats but not the least to follow up.

REFERENCES

1. Mell P, Grance T. The NIST definition of cloud computing. Commun ACM 2010;53(6):50.
2. Brown A, Weihl B. Official Google Blog. 2011 Jun 24. An Update on Google Health and Google PowerMeter URL: http://googleblog.blogspot.com/2011/06/update-on-google-health-and-google.html [accessed 2011-08-05] [WebCite Cache]
3. Armbrust M, Fox A, Griffith R, Joseph AD, Katz R, Konwinski A, et al. A view of cloud computing. Commun ACM 2010;53(4):50-58. [CrossRef]
4. Technology firms and health care: heads in the cloud: digitising America's health records could be a huge business. Will it? The Economist (US) 2011;399(8727):63.
5. Li ZJ, Chen C, Wang K. Cloud computing for agent-based urban transportation systems. IEEE Intell Syst 2011;26(1):73-79.
6. Behrend TS, Wiebe EN, London JE, Johnson EC. Cloud computing adoption and usage in community colleges. Behav Inf Technol 2011;30(2):231-240. [CrossRef]
7. DarkGovernment. 2009 Jul 23. NSA Embraces Cloud Computing URL: http://www.darkgovernment.com/news/nsa-embraces-cloud-computing [accessed 2011-07-11] [WebCite Cache]
8. Chatman C. How cloud computing is changing the face of health care information technology. J Health Care Compliance 2010 Jun;12(3):37-70.
9. Dudley JT, Pouliot Y, Chen R, Morgan AA, Butte AJ. Translational bioinformatics in the cloud: an affordable alternative. Genome Med 2010;2(8):51 [FREE Full text] [CrossRef] [Medline]Schweitzer EJ. Reconciliation of the cloud computing model with US federal electronic health record regulations. J Am Med Inform Assoc 2011 Jul 4. [CrossRef] [Medline]
10. Haughton J. Year of the underdog: Cloud-based EHRs. Health Manag Technol 2011;32(1):9.
11. Kabachinski J. What's the forecast for cloud computing in healthcare? Biomed Instrum Technol 2011;45(2):146-150. [CrossRef] [Medline]
12. Rosenthal A, Mork P, Li MH, Stanford J, Koester D, Reynolds P. Cloud computing: a new business paradigm for biomedical information sharing. J Biomed Inform 2010 Apr;43(2):342-353. [CrossRef] [Medline]
13. Anderson NR, Lee ES, Brockenbrough JS, Minie ME, Fuller S, Brinkley J, et al. Issues in biomedical research data management and analysis: needs and barriers. J Am Med Inform Assoc 2007;14(4):478-488 [FREE Full text] [CrossRef] [Medline]
14. Dudley JT, Butte AJ. In silico research in the era of cloud computing. Nat Biotechnol 2010 Nov;28(11):1181-1185. [CrossRef] [Medline]
15. Wall DP, Kudtarkar P, Fusaro VA, Pivovarov R, Patil P, Tonellato PJ. Cloud computing for comparative genomics. BMC Bioinformatics 2010;11:259 [FREE Full text] [CrossRef] [Medline]
16. Schatz MC, Langmead B, Salzberg SL. Cloud computing and the DNA data race. Nat Biotechnol 2010 Jul;28(7):691-693. [CrossRef] [Medline]
17. Avila-Garcia MS, Trefethen AE, Brady M, Gleeson F, Goodman D. Lowering the barriers to cancer imaging. In: eScience 2008: IEEE 4th International Conference on eScience. New York, NY: IEEE; 2008 Presented at: The 4th IEEE International Conference on eScience; December 8-12, 2008; Indiana, USA. [CrossRef]
18. Bateman A, Wood M. Cloud computing. Bioinformatics 2009 Jun 15;25(12):1475 [FREE Full text] [CrossRef] [Medline]
19. Kudtarkar P, Deluca TF, Fusaro VA, Tonellato PJ, Wall DP. Cost-effective cloud computing: a case study using the comparative genomics tool, roundup. Evol Bioinform Online 2010;6:197-203 [FREE Full text] [CrossRef] [Medline]
20. Memon FN, Owen AM, Sanchez-Graillet O, Upton GJ, Harrison AP. Identifying the impact of G-quadruplexes on Affymetrix 3' arrays using cloud computing. J Integr Bioinform 2010;7(2):111. [CrossRef] [Medline]
21. Vaquero LM, Rodero-Merino L, Caceres J, Lindner M. A break in the clouds: towards a cloud definition. ACM SIGCOMM Comput Commun Rev 2008 Jan;39(1):50-55. [CrossRef]

22. Iyer B, Henderson JC. Preparing for the future: understanding the seven capabilities of cloud computing. MIS Q Exec 2010;9(2):117-131.
23. Vouk MA. Cloud computing: issues, research and implementations. J Comput Inf Technol 2008;16(4):235-246. [CrossRef]
24. Han Y. On the clouds: a new way of computing. Inf Technol Libr 2010 June; 87-92 2010 Jun 1;29(2).
25. Cervone HF. An overview of virtual and cloud computing. OCLC Syst Serv 2010;26(3):162-165. [CrossRef]
26. IBM and Juniper Networks Solutions Brief. IBM Global Services. 2009. IBM and Juniper Networks: Delivering Solutions That Transform Your Networking Infrastructure URL: ftp://public.dhe.ibm.com/common/ssi/ecm/en/jns03002usen/JNS03002USEN.PDF [accessed 2011-07-25] [WebCite Cache]
27. Sittig DF, Singh H. Eight rights of safe electronic health record use. JAMA 2009 Sep 9;302(10):1111-1113. [CrossRef] [Medline]
28. Wang X, Tan Y. Application of cloud computing in the health information system. In: Proceedings of the 2010 International Conference on Computer Application and System Modeling (ICCASM). New York, NY: IEEE; 2010 Presented at: International Conference on Computer Application and System Modeling; October 22-24, 2010; Taiyuan, China. [CrossRef]
29. He C, Jin X, Zhao Z, Xiang T. A cloud computing solution for hospital information system. In: Proceedings of the 2010 IEEE International Conference on Intelligent Computing and Intelligent Systems (ICIS). New York, NY: IEEE; 2010 Presented at: IEEE International Conference on Intelligent Computing and Intelligent Systems (ICIS 2010); October 29-31, 2010; Xiamen, China. [CrossRef]
30. Botts N, Thoms B, Noamani A, Horan TA. Cloud computing architectures for the underserved: public health cyberinfrastructures through a network of healthATMs. In: Proceedings of the 2010 43rd Hawaii International Conference on System Sciences (HICSS). New York, NY: IEEE; 2010 Presented at: The 43rd Hawaii International Conference on System Sciences; January 5-8 , 2010; Hawaii, USA. [CrossRef]
31. Yang CT, Chen LT, Chou WL, Wang KC. Implementation of a medical image file accessing system on cloud computing. In: Proceedings of the 2010 IEEE 13th International Conference on Computational Science and Engineering (CSE). New York, NY: IEEE; 2010 Presented at: The 13th IEEE International Conference on Computational Science and Engineering; December 11-13, 2010; Hong Kong, China. [CrossRef]
32. Hoang DB, Chen L. Mobile cloud for assistive healthcare (MoCAsH). In: Proceedings of the. Asia-Pacific: :; 2010 Presented at: the IEEE Asia-Pacific Services Computing Conference; December 6-10 , 2010; Hangzhou, China. [CrossRef]
33. Guo L, Chen F, Chen L, Tang X. The building of cloud computing environment for e-health. In: Proceedings of the 2010 International Conference on E-Health Networking, Digital Ecosystems and Technologies (EDT). New York, NY: IEEE; 2010 Presented at: The IEEE International Conference on E-Health Networking; July 1-3, 2010; Lyon, France. [CrossRef]
34. Alagoz F, Valdez AC, Wilkowska W, Ziefle M, Dorner S, Holzinger A. From cloud computing to mobile Internet, from user focus to culture and hedonism: the crucible of mobile health care and wellness applications. In: Proceedings of the 2010 5th International Conference on Pervasive Computing and Applications (ICPCA). New York, NY: IEEE; 2010 Presented at: The 5th International Conference on pervasive Computing and Applications (ICPCA); December 1-3, 2010; Maribor, Slovenia. [CrossRef]
35. Rolim CO, Koch FL, Westphall CB, Werner J, Fracalossi A, Salvador GS. A cloud computing solution for patient's data collection in health care institutions. 2010 Feb 10 Presented at: In: Proceedings of the 2nd International Conference on eHealth, Telemedicine, and Social Medicine; February 10-16, 2010; New York, NY: IEEE. [CrossRef]
36. Nkosi MT, Mekuria F. Cloud computing for enhanced mobile health applications. In: Proceedings of the 2010 IEEE 2nd International Conference on Cloud Computing Technology and Science (CloudCom). New York, NY: IEEE; 2010 Presented at: The 2nd IEEE International Conference on Cloud Computing Technology and Science; Nov 30- Dec 3, 2010; Indianapolis, USA. [CrossRef]
37. Rao GSVRK, Sundararaman K, Parthasarathi J. Dhatri: a pervasive cloud initiative for primary healthcare services. In: Proceedings of the 2010 14th International Conference on Intelligence in Next Generation Networks (ICIN). New York, NY: IEEE; 2010 Presented at: The 14th IEEE International Conference on Intelligence in Next Generation Networks (ICIN); October 11-14, 2010; Berlin, Germany. [CrossRef]
38. Koufi V, Malamateniou F, Vassilacopoulos G. Ubiquitous access to cloud emergency medical services. In: Proceedings of the 2010 10th IEEE International Conference on Information Technology and Applications in Biomedicine (ITAB). New York, NY: IEEE; 2010 Presented at: The 10th IEEE International Conference on Information Technology and Applications in Biomedicine (ITAB); November 3-5, 2010; Corfu, Greece. [CrossRef]
39. Arrais JP, Oliveira JL. On the exploitation of cloud computing in bioinformatics. In: Proceedings of the 2010 10th IEEE International Conference on Information Technology and Applications in Biomedicine (ITAB). New York, NY: IEEE; 2010 Presented at: The IEEE 10th International Conference on Information Technology and Applications in Biomedicine (ITAB); November 3-5, 2010; Corfu, Greece. [CrossRef]
40. Amazon Web Services. 2011. AWS Case Study: Harvard Medical School URL: http://aws.amazon.com/solutions/case-studies/harvard/ [accessed 2011-07-20] [WebCite Cache]
41. Business Wire. The Free Library. 2008. DiskAgent Launches New Remote Backup and Loss Protection Software as a Service Offering URL: http://www.thefreelibrary.com/DiskAgent(TM)+Launches+New+Remote+Backup+and+Loss+Protection+Software...-a0182194404 [accessed 2011-07-25] [WebCite Cache]
42. Strukhoff R, O'Gara M, Moon N, Romanski P, White E. SYS-CON Media, Inc. 2009 Mar 20. Cloud Expo: Healthcare Clients Adopt Electronic Health Records with Cloud-Based Services URL: http://cloudcomputing.sys-con.com/node/886530 [accessed 2011-07-18] [WebCite Cache]
43. Editorial Staff. HealthImaging.com. 2010 Feb 16. Acumen Nabs ONC Cloud Computing Contract URL: http://www.healthimaging.com/index.php?option=com_articles&view=article&id=20648:acumen-nabs-onc-cloud-computing-contract&division=hiit [accessed 2011-07-19] [WebCite Cache]
44. Korea IT Times. IT Times. 2010 Jul 20. Telstra Plans Launch of E-Health Cloud Services, Tip of the Iceberg for Opportunity URL: http://www.koreaittimes.com/story/9826/telstra-plans-launch-e-health-cloud-services-tip-iceberg-opportunity [accessed 2011-08-05] [WebCite Cache]
45. IBM Press Room. IBM. 2010 Nov 22. European Union Consortium Launches Advanced Cloud Computing Project With Hospital and Smart Power Grid Provider URL: http://www-03.ibm.com/press/us/en/pressrelease/33067.wss [accessed 2011-08-05] [WebCite Cache]
46. Danek J. Public Works Government Services Canada. 2009 Oct 6. Cloud Computing and the Canadian Environment URL: http://www.scribd.com/doc/20818613/Cloud-Computing-and-the-Canadian-Environment [accessed 2011-08-05] [WebCite Cache]
47. Avery P. IT Business Edge. 2009 Aug 26. Research Indicates Increase in Cloud Computing URL: http://www.itbusinessedge.com/cm/community/kn/blog/research-indicates-increase-in-cloud-computing/?cs=35256 [accessed 2011-08-05] [WebCite Cache]
48. Cherry S. Forecast for cloud computing: up, up, and away. IEEE Spectrum 2009 Oct;46(10):68.
49. Bannerman PL. Cloud Computing Adoption Risks: State of Play. In: Proceedings of the 17th Asia Pacific Software Engineering Conference Cloud Workshop. New York, NY: IEEE; 2010:10-16.
50. Armbrust M, Fox A, Griffith R, Joseph AD, Katz RH, Konwinski A, et al. EECS Department, UC Berkeley. 2009. Above the Clouds: A Berkeley View of Cloud Computing. Technical Report URL: http://www.eecs.berkeley.edu/Pubs/TechRpts/2009/EECS-2009-28.pdf [accessed 2011-09-08] [WebCite Cache]
51. Everett C. Cloud computing: a question of trust. Comput Fraud Secur 2009 Jun 10(6):5-7. [CrossRef]
52. Jansen W, Grance T. National Institute of Standards and Technology, US Department of Commerce. 2011 Jan. Guidelines on Security and Privacy in Public Cloud Computing URL: http://csrc.nist.gov/publications/drafts/800-144/Draft-SP-800-144_cloud-computing.pdf [accessed 2011-09-08] [WebCite Cache]
53. European Network and Information Security Agency. ENISA. 2009. Cloud Computing: Benefits, Risks and Recommendations for Information Security URL: http://www.enisa.europa.eu/act/rm/files/deliverables/cloud-computing-risk-assessment [accessed 2011-09-08] [WebCite Cache]
54. Zhang R, Liu L. Security models and requirements for healthcare application clouds. In: Proceedings of the 2010 IEEE 3rd International Conference on Cloud Computing (CLOUD). New York, NY: IEEE; 2010 Presented at: The 3rd IEEE International Conference on Cloud; July 5-10, 2010; Miami, FL, USA. [CrossRef]

55. Baliga J, Ayre RWA, Hinton K, Tucker RS. Green cloud computing: balancing energy in processing, storage, and transport. Proc IEEE 2011;99(1):149-167. [CrossRef]
56. Durkee D. Why cloud computing will never be free. Commun ACM 2010;53(5):70-69. [CrossRef]
57. European Network and Information Security Agency. ENISA. 2009 Nov. An SME Perspective on Cloud Computing: Survey URL: http://www.enisa.europa.eu/act/rm/files/deliverables/cloud-computing-sme-survey/ [accessed 2011-07-23] [WebCite Cache]
58. Microscoft Corp. 2010 Nov. Privacy in the Cloud: A Microsoft Perspective URL: http://www.microsoft.com/privacy/cloudcomputing.aspx [accessed 2011-09-07] [WebCite Cache]
59. Google Privacy Center. Google. 2010 Oct 3. Privacy Policy URL: http://www.google.com/google-d-s/intl/en/privacy.html [accessed 2011-08-06] [WebCite Cache]
60. Amazon Web Services. 2008 Oct 01. AWS Privacy Notice URL: http://aws.amazon.com/privacy/ [accessed 2011-08-05] [WebCite Cache]
61. Cloud Security Alliance. 2009 Dec. Security Guidance for Critical Areas of Focus in Cloud Computing V2.1 URL: http://www.cloudsecurityalliance.org/csaguide.pdf [accessed 2011-07-25] [WebCite Cache]
62. US Department of Health & Human Services. 1996. The Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy and Security Rules URL: http://www.hhs.gov/ocr/privacy/ [accessed 2011-07-26] [WebCite Cache]
63. Minister of Justice, Canada. 2011 Jan 1. Personal Information Protection and Electronic Documents Act (PIPEDA) URL: http://laws.justice.gc.ca/PDF/Readability/P-8.6.pdf [accessed 2011-08-05] [WebCite Cache]
64. European Commission. EuroPriSe: The European Privacy Seal for IT Products and IT-Based Services URL: https://www.european-privacy-seal.eu/ [accessed 2011-08-06] [WebCite Cache]
65. United Nations. United Nations Commission on International Trade Law. 2010. UNCITRAL Legislative Guide on Secured Transactions URL: http://www.uncitral.org/pdf/english/texts/security-lg/e/09-82670_Ebook-Guide_09-04-10English.pdf [accessed 2011-08-05] [WebCite Cache]
66. Pearson S. Taking account of privacy when designing cloud computing services. In: Proceedings of the ICSE Workshop on Software Engineering Challenges of Cloud Computing (CLOUD'09). New York, NY: IEEE; 2009 Presented at: the IEEE First international workshop on software engineering challenges for Cloud Computing (ICSE); May 16-24, 2009; Vancouver, BC, Canada. [CrossRef]
67. Svantesson D, Clarke R. Privacy and consumer risks in cloud computing. Comput Law Secur Rev 2010;26(4):391-397. [CrossRef]
68. Mather T, Kumaraswamy S, Latif S. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice). Sebastopol, CA: O'Reilly Media, Inc.; 2009.
69. Kuner C. Data protection law and international jurisdiction on the Internet (part 1). Int J Law Inf Technol 2010;18(2):176-201. [CrossRef]
70. Ward BT, Sipior JC. The Internet jurisdiction risk of cloud computing. Inf Syst Manag 2010;27(4):334-339. [CrossRef]
71. Financial Crimes Enforcement Network, US Department of Treasury. FinCEN. Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism (USA PATRIOT) Act of 2001. no date URL: http://www.fincen.gov/statutes_regs/patriot/index.html [accessed 2011-07-13] [WebCite Cache]
72. Cavoukian A. Information and Privacy Commissioner, Ontario, Canada. 2009 Nov. A Discussion Paper on Privacy Externalities, Security Breach Notification and the Role of Independent Oversight URL: http://www.ipc.on.ca/images/Resources/privacy_externalities.pdf [accessed 2011-07-13] [WebCite Cache]
73. Javelin Strategy & Research. 2011. Data Breach Notifications: Victims Face Four Times Higher Risk of Fraud URL: https://www.javelinstrategy.com/brochure-158 [accessed 2011-07-23] [WebCite Cache]
74. Marks EA, Lozano B. Executive's Guide to Cloud Computing. Hoboken, NJ: Wiley; 2010.
75. White Paper. Project Management Institute (PMI). 2011. Cloud Computing: The New Strategic Weapon URL: http://www.pmi.org/~/media/PDF/Home/CloudComputing_FINAL.ashx [accessed 2011-07-23] [WebCite Cache]
76. Stanoevska-Slabeva K, Wozniak T, Hoyer V. Practical guidelines for evolving IT infrastructure towards grids and clouds. In: Stanoevska-Slabeva K, Wozniak T, Ristol S, editors. Stanoevska- Slabeva K, Wozniak T, Ristol S. editors. Grid and Cloud Computing: A Business Perspective on Technology and Applications. Berlin: Springer; 2010:225-243.
77. US Department of Health & Human Services, Office of the National Coordinator for Health Information Technology. The ONC-Coordinated Federal Health IT Strategic Plan: 2008-2012. Washington, DC: ONC-HIT; 2008.
78. Kuo AM, Borycki E, Kushniruk A, Lee TS. A healthcare Lean Six Sigma System for postanesthesia care unit workflow improvement. Qual Manag Health Care 2011;20(1):4-14. [CrossRef] [Medline]
79. Lee TS, Kuo MH. Toyota A3 report: a tool for process improvement in healthcare. Stud Health Technol Inform 2009;143:235-240. [Medline]
80. Marston S, Li Z, Bandyopadhyay S, Zhang J, Ghalsasi A. Cloud computing: the business perspective. Decis Support Syst 2011;51(1):176-189. [CrossRef]
81. Buyya R, Ranjan R. Special section: Federated resource management in grid and cloud computing systems. Future Generation Comput Syst 2010;26(8):1189-1191. [CrossRef]
82. Kuo MH, Kushniruk AW, Borycki EM. Design and implementation of a health data interoperability mediator. Stud Health Technol Inform 2010;155:101-107. [Medline]
83. Gagliardi F, Muscella S. Cloud computing: data confidentiality and interoperability challenges. In: Antonopoulos N, Gillam L, editors. Antonopoulos N, Gillam L. editors. Cloud Computing: Principles, Systems and Applications (Computer Communications and Networks). London: Springer; 2010:257-270.
84. Knowledge@Wharton. Wharton Business School, University of Pennsylvania. 2009 Apr 1. No Man Is an Island: The Promise of Cloud Computing URL: http://knowledge.wharton.upenn.edu/article.cfm?articleid=2190 [accessed 2011-07-15] [WebCite Cache]
85. Creeger M. CTO roundtable: cloud computing. Commun ACM 2009;52(8):50-56. [CrossRef]
86. Fox A. Computer science. Cloud computing: what's in it for me as a scientist? Science 2011 Jan 28;331(6016):406-407. [CrossRef] [Medline]
87. Gartner Newsroom. Gartner, Inc. 2011 Jan 21. Gartner Executive Programs Worldwide Survey of More Than 2,000 CIOs Identifies Cloud Computing as Top Technology Priority for Abbreviations.

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