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Can Cloud Computing Benefit Health Services? – A SWOT Analysis

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Abstract. In this paper, we discuss cloud computing, the current state of cloud computing in healthcare, and the challenges and opportunities of adopting cloud computing in healthcare. A Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis was used to evaluate the feasibility of adopting this computing model in healthcare. The paper concludes that cloud computing could have huge benefits for healthcare but there are a number of issues that will need to be addressed before its widespread use in healthcare.

Keywords. Electronic Health Record, Cloud Computing, Healthcare, SWOT

1. Introduction

Despite the many benefits associated with using the EHR, there are numerous obstacles that restrict its adoption such as the [1]: lack of support for startup expenses or reimbursement for implementation costs; lack of standardized technical platforms to support EHR; lack of uniform standards for documentation of clinical services; concerns about the inability to align workflow with a standardized EHR; concerns that automation of clinical charting requires more time than paper charting; need to overcome security and privacy concerns. According to the Accenture's survey, 58% of survey respondents noted that the expense required to implement EHRs was the area of greatest concern [2].

In 2007, talk of a new on-demand self-service Internet infrastructure (i.e. cloud computing) became more prominent. Many healthcare organizations, managers and experts believe that cloud computing can improve EHR adoption and will change the face of health care information technology [3-8]. The aim of this paper is to discuss the substance of cloud computing, its current applications in healthcare, and the challenges and opportunities of adopting this new approach.

2. What is Cloud Computing?

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service-provider interaction [9]. Examples of similar more limited applications are Google Docs or Gmail. However, cloud computing is different from traditional systems. For example, it provides a wide range

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of computing resources on demand any where and anytime; eliminates an up-front commitment by cloud users; it allows users to pay for use of computing resources on a short-term basis as needed; and has higher utilization by multiplexing of workloads from different organizations [5, 9-12].

From a service point of view, cloud computing includes three models:

- *Software as a Service (SaaS)* - The applications (e.g. EHRs) are hosted by a cloud service provider and made available to customers over a network, typically the Internet (e.g. Google Apps and Salesforce.com).
- *Platform as a Service (PaaS)* - The development tools (e.g. OS systems) are hosted in the cloud and accessed through a browser (e.g. Microsoft Azure). With PaaS, developers can build web applications without installing any tools on their computer, and then deploy those applications without any specialized administrative skills.
- *Infrastructure as a Service (IaaS)* - The cloud user outsources the equipment used to support operations, including storage, hardware, servers and networking components. The cloud service provider owns the equipment and is responsible for housing, running and maintaining it (e.g. Amazon EC2). The client typically pays on a per-use basis.

To deploy cloud computing, the U.S. National Institute of Standards and Technology (NIST) listed four models as follows:

- *Private cloud* - A proprietary network or a data center supplies hosted services to a certain group of people.
- *Public cloud* - A cloud service provider makes resources (applications and storage) available to the general public over the Internet.
- *Community cloud* - The cloud infrastructure is shared by several organizations and supports a specific community that has common concerns (e.g. mission, security requirements, policy, and compliance considerations).
- *Hybrid cloud* - An organization provides and manages some resources within its own data center and has others provided externally such as Microsoft HealthVault.

3. Current State of Cloud Computing in Healthcare

"In the cloud" medical records services, such as Microsoft HealthVault, Google Health, Oracle and Exalogic Elastic Cloud and Amazon's Web Service (AWS) promise an explosion in the storage of personal health information online [13]. Amazon was one of the first companies to launch a cloud product for the general public, and it continues to have one of the most sophisticated and elaborate set of options. Amazon's Web Service (AWS) plays host to a collection of healthcare IT offerings, such as Salt Lake City-based Spearstone's healthcare data storage application, and DiskAgent which uses Amazon Simple Storage Service (Amazon S3) as its scalable storage infrastructure [14]. In addition, MedCommons, a Watertown, Mass.-based health records services provider, utilizes AWS to build its personal health record (PHR) offering, HealthURL [15].

In most healthcare environment physicians don't always have the information they need when they need to quickly make patient-care decisions, and patients often have to carry a paper record of their health history information with them from visit to visit. To address these problems, IBM and ActiveHealth Management worked together to create a cloud computing technology-based Collaborative Care Solution that gives physicians and patients access to the information they need to improve the overall quality of care, without the need to invest in new infrastructure [16]. American Occupational Network

(AON) and HyGen Pharmaceuticals are improving patient care by digitizing health records and streamlining their business operations using cloud-based software from IBM MedTrak Systems, Inc. and The Systems House, Inc. Their technology handles various tasks (e.g. online appointment scheduling) as a cloud service through the internet instead of developing, purchasing and maintaining technology onsite [17]. The U.S. Department of Health & Human Services' (HHS) Office of the National Coordinator for Health IT (ONC) recently selected an Acumen Solutions' cloud computing CRM and project management system to manage the selection and implementation of EHR systems across the country. The software will enable regional extension centers to manage interactions with medical providers related to the selection and implementation of an EHR system [18]. Sharp Community Medical Group in San Diego will be using the Collaborative Care Solution to change the way physicians and nurses access information throughout the hospital group's multiple electronic medical record systems to apply advanced analytics and clinical decision support to help give doctors better insight and work more closely with patient care teams [14]. In Europe, a consortium including IBM, Sirrix AG security technologies, Portuguese energy and solution providers, Energias de Portugal and EFACEC, San Raffaele (Italy) Hospital and several European academics and corporate research organizations announced Trustworthy Clouds (TClouds) - a patient-centric home healthcare service that will remotely monitor, diagnose and assist patients outside of a hospital setting. The complete lifecycle, from prescription to delivery to intake to reimbursement will be stored in the cloud and will be accessible to patients, doctors and pharmacy staff [19].

4. Opportunities and Challenges

The SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis is a well-known strategic planning methodology used by organizations to ensure that there is a clear objective defined for a project or venture, and that all factors related to the effort, both positive and negative, are identified and addressed. In this paper, we use the SWOT analysis to evaluate the feasibility of heath sectors adopting cloud computing to improve healthcare services (Figure 1). In SWOT, strengths and weaknesses are internal factors; opportunities and threats are external factors.

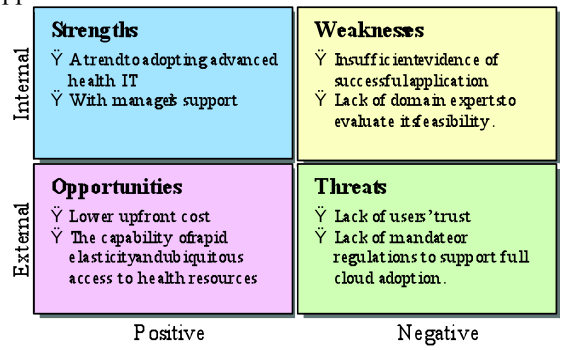

Figure 1. The health cloud computing SWOT analysis

- *Strengths*

Healthcare, as with any other service operation, requires continuous and systematic innovation in order to remain cost effective, efficient and timely, and to provide high quality services. Many healthcare organizations, managers and experts believe that the cloud computing approach can improve health services [4-9]. In addition, recent

research indicates that 75% of Chief Information Officers (CIO) indicated that they will need and use cloud computing in the near future [20].

- *Weaknesses*

Despite many health cloud computing application examples nowadays, however, there is insufficient evidence to indicate that the new approach is suitable for healthcare. Also, the lack of expertise to evaluate the feasibility of the new approach in healthcare sectors is currently another weakness.

- *Opportunities*

One of the greatest advantages of adopting cloud computing in healthcare is that the network, server and security headaches that exist for locally-installed, legacy systems are eliminated. Smaller hospitals and medical practices typically don't have internal IT staff to maintain and service in-house infrastructure for mission-critical applications such as EHRs. Therefore, eliminating the new infrastructure cost and the IT maintenance burdens clearly removes the obstacles to EHR adoption. Also, the cloud computing approach promises to speed deployment while maintaining vital flexibility, i.e. rapid elasticity, and ubiquitous access to health resources.

- *Threats*

Among the possible threats the cloud computing adoption are the healthcare professionals' lack of trust in the new approach and the lack of national or international mandates or regulations to support full adoption. Armbrust et al indicated 10 top obstacles to users' trust in the cloud approach [21]: availability of service, data lock-in, data confidentiality and audibility, data transfer bottlenecks, performance unpredictability, scalable storage, bugs in large-scale distributed systems, scaling quickly, reputation fate sharing, and software licensing. Data jurisdiction, data interoperability and some legal issues are also potential major concerns. For example, the US Health Insurance Portability and Accountability Act (HIPAA) restricts companies from disclosing personal health data to non-affiliated third parties unless specific contractual arrangements have been put in place.

5. Conclusion and Discussion

Cloud computing is a new style of computing that promises to provide a more flexibility, less expense and more security to end-users. It provides potential opportunities for improving EHR adoption and healthcare services. However, there are still many challenges behind the fostering of the new model in healthcare.

In this paper, we use a SWOT analysis to evaluate the feasibility of healthcare cloud computing. We conclude that the pro side includes less up-front capital investment, capability of rapid elasticity and ubiquitous access to health resources. The con side includes the lack of sufficient successful evidence of its application in healthcare, a dearth of domain experts to evaluate the feasibility, less of healthcare professionals' trust, and lack of mandates/regulations to support full adoption.

Perhaps the strongest resistance to the adoption of cloud computing in health IT centers on data security and privacy. However, we believe that compared to locally-housed data, this computing model typically improves security because cloud providers (e.g. Microsoft, Google) are able to devote huge resources to solving security issues that many customers cannot afford, in contrast to the destruction of many medical records and legal documents in the New Orleans Hurricane Katrina disaster.

Regarding data privacy, some organizations such as the Cloud Security Alliance, a non-profit organization have developed a comprehensive guide to deal with privacy issues [22]. Governments can also play a critical role by fostering widespread agreement regulations for both users and providers.

In conclusion, if users, providers and governments act wisely, cloud computing could potentially be very beneficial to healthcare services.

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