Chapter 8
A Survey on Research Initiatives for Healthcare Clouds

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ABSTRACT

Cost reduction for hosted and managed services is one of the key promises of Cloud Computing. Healthcare is one such example of managed services that can greatly benefit by a Cloud offering. However, there are many research challenges that need to be addressed before one can deliver a mature service. This chapter provides a summary of research activities in a variety of healthcare-related Cloud initiatives. The authors highlight the key areas of ongoing research and describe others that require attention. The analysis and observations can be useful to healthcare Cloud professionals and can motivate interested researchers to initiate new efforts for better healthcare services deployed on the Cloud.

1. INTRODUCTION

In recent years, the healthcare (HC) industry has faced significant challenges related to limited budgets, service demands that comply with new regulations and legislation, e.g., HIPAA (HIPAA, 1996), as well as technology-savvy consumers that demand a higher level of interaction, e.g., instant access through mobile phones (Delgado, 2011). Moreover, as HC enterprises expand, their IT infrastructure is becoming more complicated, hence requires more IT staff for maintenance (Zhang & Liu, 2010).

To address these challenges some forward-thinking health organizations are transitioning towards Cloud offerings. Cloud reduces the complexity of maintaining a dedicated infrastructure, reduces the capital expense of introducing new services, and allows experienced entities to handle their applications. At the same time, Cloud offerings allow HC organizations to have high business agility. The HC organizations are able to identify

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relevant products and services in a dynamic environment. They can quickly provision applications, bring new products and services to market, and improve the customer and patient experience.

However, there are several challenges when trying to migrate an IT infrastructure to a Cloud service. This chapter tries to summarize the research activities that address some of these challenges around the HC Cloud. First, we provide a brief background on the concepts of Cloud computing and then describe in details the research trends in HC Cloud offerings. The rest of the chapter is organized as follows. Section 1 presents a background on Cloud computing and its key features. We also introduce representative examples to show how Cloud computing has been used in the HC domain and discuss potential applications. In Section 2, we talk about the research efforts in identifying the vulnerabilities and mitigation techniques in security and privacy aspects of HC applications in the Cloud. This is because a variety of privacy and security acts (e.g. HIPAA, ARRA (ARRA, 2009) etc.) dictate the compliance requirements for HC services. Therefore, it is important to understand the research challenges in the security procedures, encryption of data, and periodic usage logging in the Cloud. Section 3 describes the importance of analyzing the medical data in the Cloud. Since HC records are typical examples of Big Data, we talk about the benefits of using Cloud computing in performing data analytics. In Section 4, we analyze how Cloud can drastically reduce the cost of HC services. Since HC data is typically accessed/utilized by disparate players (HC providers, physicians, patients, insurance agencies, government agencies), HC applications are typically composed of services from more than one provider, each utilized by more than one consumer. Section 5 presents a survey of the research efforts in service composition of HC applications deployed in the Cloud. Performance aspects of the HC Cloud services are described in Section 6. In Section 7, we highlight some of the aspects of the HC services that have not been well addressed in the current literature. These include the availability, resiliency and Service Level Agreements (SLAs) of HC services.

2. BACKGROUND AND CLASSIFICATION OF HEALTHCARE CLOUD SERVICES

Many health organizations have transformed their IT services into Cloud offerings, primarily because of:

- Cost reduction,
- Management simplification, and
- Improved service delivery.

A variety of Cloud services are available to health and life science organizations that include online health and wellness tools, data and image storage and sharing, HC portals etc. Cost reduction is achieved by eliminating large capital expenditures for computing infrastructure as well as human expenses to operate it. The ability to grow and shrink IT capacity with respect to demand is another feature that avoids over provisioning of resources and hence reduces cost. For a HC service provider, understanding the characteristics of Clouds is important to ensure the platform meets all in-house IT requirements.

Cloud computing is a model of Internet based computing. It delivers access to the applications, platforms, and hardware over the Internet (Armbrust et al., 2010). More specifically, the National Institute of Standards and Technology (NIST) defines (Mell & Grance, 2011) "Cloud computing as a model for enabling 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