Chapter 68
The Cloud Gets Personal:
Perspectives on Cloud Computing for Personalized Medicine

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ABSTRACT

Cloud computing, at its most fundamental level, is a technology that allows computing to occur as an on-demand utility. Personalized medicine is revolutionizing the field of medicine, and aims to provide individualized treatment for patients, based on their genetic material and medical history, through comparisons to genetic material from thousands of other patients. Better patient outcomes are expected in a personalized medicine domain as compared to more generic generalized options. In this paper the authors explore the use of cloud computing in the area of personalized medicine examining unique benefits and opportunities. They also recognize and discuss the presence of some inherent risks. Using the cloud for personalized medicine can expedite collaborations and data collection across different clinicians, researchers and other stakeholders involved in the fight against diseases. This paper examines key elements associated with using cloud computing in the specialized area of personalized medicine.

1. INTRODUCTION

The top three causes of death in the United States are heart disease, cancer, and chronic lower respiratory diseases (CDC, 2013). Each year thousands of people suffer through and die from chronic diseases. Information and communications technologies (ICTs) have long been a stalwart in the healthcare industry for diagnosing, treating and preventing chronic diseases. Wearable devices, sensors, mobile technologies, electronic health records (EHRs) are a few of the technologies impacting healthcare today (Jayanthi, 2014). In this paper, we demonstrate the use of cloud computing for personalized medicine as another tool in the arsenal of technologies to fight disease and improve human health.

Two main research questions are examined in this paper: 1. what are the risks associated with the use of cloud computing in the area of personalized medicine; and 2. how does/can cloud computing impact the field of personalized medicine? Personalized medicine first requires a genetic profile of the patient. This profile provides very specific information about the patient and also the disease(s) that they are diagnosed with. This profile is then analyzed, and compared to thousands of profiles of other patients to find an optimal tailored solution for the current patient.

One recent study by Horowitz (2014) identified the value of cloud computing in the area of personalized drug treatments for patients. More specifically this study collected genetic data and examined the treatment of elderly patients that take a large combination of prescription drugs. The program in the study - PACE (Program of All-inclusive Care for the Elderly) is a Medicare and Medicaid program that partnered with two firms: Coriell Life Sciences and CareKinesis; used cloud computing along with personalized medicine to better serve elderly patients taking as many as 16 different prescription drugs per day (Horowitz, 2014). Anticipated outcomes of this program include better understanding of drug side-effects and faster responses to patients that may develop complications associated with drug cocktails.

The use of cloud computing for personalized medicine requires effective management of sensitive and vast datasets. Vast datasets are characteristic of the big data landscape that exists today. As data sets continue to grow, it is increasingly challenging to maintain privacy for genomic data that is shared across computer networks (Chow-White, MacAulay, Charters, & Chow, 2015). In addition to managing the challenges associated with large data sets other issues exist such as: managing the versatility across different environments; scaling to accommodate large data centers; automating to create self-managed environments; and integration of non-cloud products into the cloud architecture (Martin-Flatin, 2014). Personalized medicine involves collaboration across different entities, so overcoming some of the managerial challenges is paramount for continued growth and success.

Personalized treatments for patient conditions are already established in the personalized device industry. Currently, personalized medical devices using both iOS and Android technologies comprise a financially lucrative industry of approximately $27 billion (Bendor-Samuel, 2014). Examples of personalized medical devices include the "Tinnitus Masker" a product that is designed for an individual's auditory needs; and the "Zenith Fenestrated AAA Endovascular Graft" a product that is customized to fit the patient's aortic anatomy (U.S. Food and Drug Administration FDA, 2013). Undoubtedly there is a strong financial incentive for some related businesses to pursue personalized medicine. Hopefully, these financial business gains will also translate to improving the quality of patient lives and reducing premature mortality.

To develop the presented research questions, this paper proceeds in the following sections. First we present an overview of cloud computing. Then an overview of personalized medicine is presented followed by a discussion on the overlap of personalized medicine and cloud computing. The theoretical model is presented showing the key factors involved in examining their intersection. Lastly, discussion, implications and conclusions are presented.

2. CLOUD COMPUTING OVERVIEW

Cloud technology has become an important change agent in the field of information technology. Cloud computing has revolutionized the way that many businesses operate today, by freeing up internal resources, and shifting some technology related tasks and data management to external cloud computing

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