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CLOUD BASED DIABETES MANAGEMENT AND RESEARCH - BLUE CIRCLED CLOUD

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ABSTRACT

This paper deals with the concept of Cloud Based, Centralized Diabetes Treatment and Research Strategy and is written in particular ,but not limited to, taking into consideration a nationwide diabetes policy, and can be adopted by any subsidiary, or even can be extended for an intra regional scenario. Diabetes is considered as one of the killing chronic disease of the current era. Right treatment at right time is very crucial for managing diabetes and the diabetologists always require complete patient information and treatment history to offer suitable treatment plan. The current scenario is lacking the centralized diabetes management facilities as different hospitals and clinics have their own Hospital Information Systems(HIS) for the treatment and interaction or sharing of critical patient information among these isolated HISs are limited or even null . If information can be shared in an effective manner, it will definitely enhance the Diabetes Treatment patterns and thus the patient outcome. The advantages of cloud computing power can be used to achieve this common goal. Since diabetes management requires a long term treatment plan and commitment from the patients, analysis of treatment outcome is equally important to treatment. Researchers need adequate data to carry out monitoring on various entities and once we have the proposed concept implemented, they can make use of the system very efficiently to do various advanced studies. Self care management for patients via mobile platforms is also integrated with this concept ,which in turn provides more insight into the disease behavior during the patient's time away from the healthcare provider.

Keywords: Cloud for Diabetes Management,National Diabetes Register,Cloud Computing in Healthcare e-diabetesmanagement,e-healthcare

I.INTRODUCTION

Blue Circle is the universal symbol for diabetes. The purpose of this symbol is to give diabetes a common identity and the International Diabetes Federation (IDF) [1] holds all rights to the blue circle symbol. Diabetes is chosen for this paper, as it is alarming and the rate at which people are heading towards this life style situation is exponentially increasing. Extending the power of Cloud Computing to leverage the treatment for Diabetes and to provide new dimensions in the areas of Diabetes Research motivated the selection of this title and thus the name Blue Circled Cloud (hereafter will be referred as BCC). The expressed concept is not limited to Diabetes; the same can be applied to any similar scenario where a centralized health information management is critical.

The proposed solution will be offered as SaaS, under Line of Business Services (LBS) category. Software as a Service is an application hosted on a remote server and accessed through the Internet. Since the software is hosted and managed remotely, end points, in this scenario healthcare providers, are hassle free from the conventional approaches and SaaS removes the need for them to handle the installation, set-up and daily management and maintenance. SaaS will provide a powerful and secure IT infrastructure and a very few organizations can afford or match the infrastructure and security investments made by SaaS vendors. [2].The two important features of SaaS which are worth to mention in the context of BCC are Easiness of Access and Vendor Responsibility.

Easiness of Access: A major advantage of SaaS model is that, it can easily and quickly be accessed from anywhere with a web browser, thus giving users an improved facility and ease of access. SaaS offers high level of scalability in using the software. By utilizing SaaS, users are free to use as much or as little part of the software as they need, in other words on-demand usage. [2]

Vendor's Responsibility: Managing and maintaining both the software and hardware components of the SaaS application, is the responsibility of the Vendor. Issues such as data redundancy, data backup and recovery and regular software and hardware upgrade are also planned and managed by the vendors. Since SaaS vendors charge a set price per user per month, the end users don't have to pay extra money for modules which they don't even use. It literally removes the maintenance, end user support, and administration costs of the software from the user organization. The implementation and customization costs of SaaS are also lower than the traditional software. All this results in a very low total cost of ownership (TCO)[2].

II.BACKGROUND

The current Diabetes situation is challenging. This is mainly attributable to the increasing prevalence of Obesity [7]. Diabetes is a chronic illness that requires continuing medical care and ongoing patient self management education and support to prevent acute complications and to reduce the risk of long term complications. Diabetes care is complex and requires that many issues, beyond glycemic control, be addressed. The classification of Diabetes includes four clinical classes. Type 1 Diabetes, usually leading to absolute insulin deficiency.Type 2 Diabetes, results from a progressive insulin secretory defect on

the background of insulin resistance. Gestational Diabetes , diagnosed during pregnancy. Other specific types of diabetes, due to other causes like genetic defects, drug or chemical – induced diabetes etc.[4] Persons with Diabetes have bodies that do not produce or respond to insulin, a hormone produced by the beta cells of pancreas that is necessary for the use or storage of body fuels. Diabetes Mellitus contributes to a considerable increase on morbidity and mortality rates, which can be reduced by early diagnosis and treatment. In 2002 diabetes costs in the Unites States were $132 billion. Direct medical expenditures, such as inpatient care, outpatient services and nursing home care , totaled $91.8 billion. Indirect costs , totaling $39.8 billion, were associated with lost productivity, including premature death and disability. Total medical expenditure incurred by people with diabetes totaled $91.8 billion, or an average annual total direct cost of medical care of $13,243 per person compared with $2560 per person without Diabetes (ADA, 2003). Diabetes requires changes for a lifetime. The management of diabetes includes medical nutrition therapy, physical activities, blood glucose monitoring, medications and self management education. An important goal of treatment is to provide the patient with necessary tools to achieve the best possible control of the decease.[4,5]

Cloud computing represents the new revolution in the IT world. This area and its related technology components are worth to be used in Healthcare. Cloud computing offers three kinds of services, Infrastructure-as-a- Service (IaaS), in which providers like, Amazon, provide machine instances to developers. Platform-as-a- Service (PaaS), in which providers like Google App Engine, provides a programming environment that abstracts machine instances and other technical details from developers[2]. And Software-as-a-Service (SaaS), which we are making use for Blue Circled Cloud..

III.OBJECTIVES

The objective of this paper is to present a concept towards Centralized Diabetes Management and Research (CDMR). The following aspects are taken into consideration.

- Find out the possible ways to achieve CDMR by exploring the cloud power
- Usage of BCC to help Diabetic Patients for self care management.
- To enhance the research towards modern diabetes treatment by providing adequate data
- To suggest the healthcare domain to minimize the wastage on IT infrastructure and to focus the resources towards innovations.

IV.THE BLUE CIRCLED CLOUD

A. Selection of Deployment Model

Selection of the cloud deployment model for BCC is flexible. It can be a private, public, or a hybrid cloud. A fully managed, leased ,private cloud could be the optimal deployment model in terms of economic and resource point of view.

B. Architecture

Architecture and setup at Centralized Data Center: A centralized Data Center is the key to BCC, which needs to be highly secure and state of the art, to serve all kinds of users in an optimum manner as per the roles and privileges. Figure 1 depicts the view of BCC as a single component.The key features on which BCC should not make any compromise are:[3].

- High Security(physically and technologically)
- High speed data transmission between entities
- Data consolidation and integrity check
- Authentication and Authorization
- Confidentiality, Integrity and Availability(CIA Triad)
- Access control monitoring and Logging(metering the access- who is accessing what and when)
- Efficient reporting.

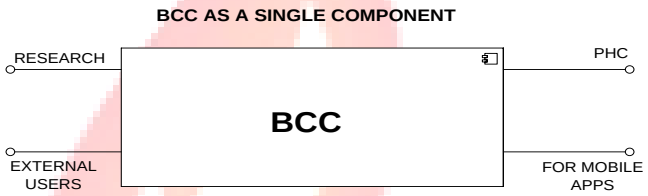

Figure1: BCC as a single Component

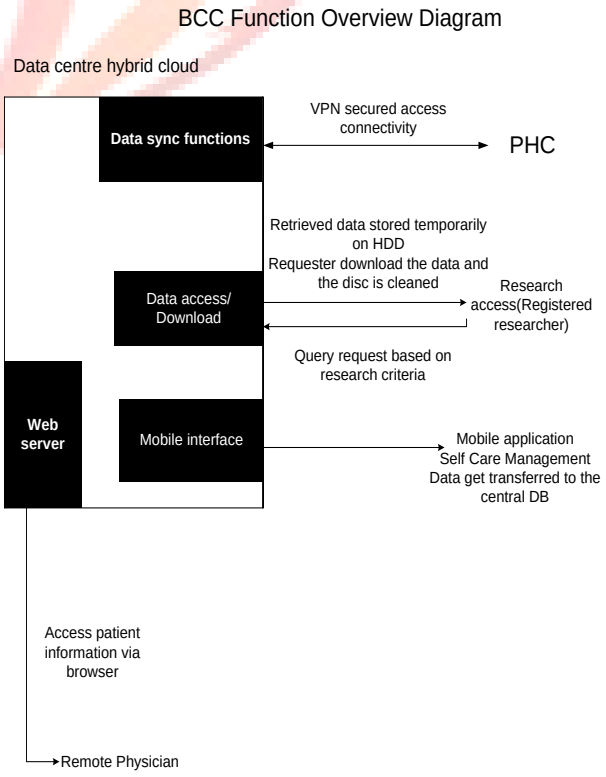

Figure 2 : BCC Block Diagram

V.INTERFACES

BCC is based on four interfaces, each for a specific purpose. Below the detailed description of the interfaces. Figure 2 depicts the interfaces of the proposed architecture.

A. PHC Interface

PHCs interact with BCC via the BCC Provided Front end or through an automated script, which will transfer data from local HIS to BCC.BCC can provide a browser based front end to the clinics, if needed, for data entry. If PHC is having its own HIS application, data transfer should happen between PHC and BCC. BCC will define the data structure and the accepted data template. Local PHC's HIS should have the facility to extract the data in the prescribed format for upload. A mutually agreed and scheduled batch activity will do the function. How often patient data needs to be transferred, what are the parameters to be captured, these are all to be formalized and agreed on a strategic level[8].Every patient in BCC will be identified by a BCCID, and it is independent of the specific hospital ID.Figure 3 depicts visualization of PHC interface.

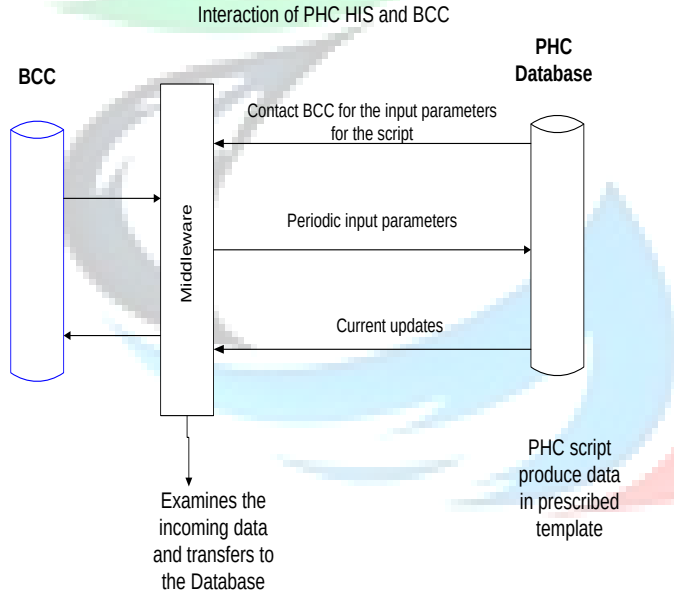

Figure 3: PHC Interface

B. Mobile Interface

Mobile Application needs to be downloaded from the designated mobile providers store and to be configured from the corresponding PHC. BCCID needs to be configured in the application to communicate with the cloud. There are thousands of applications already available for diabetes self care. The one ,we propose is also not much different from the existing ones. The only difference is that, this application will transfer the data(blood values/BP etc) collected by the mobile device ,to the appropriate patient records in BCC. This gives the benefit of having a complete profile of the patient or visibility of the patient condition when he/she is away, during the interval between the consultations. Application will have the facility to download the complete diabetes information of the patient to his smart phone. Access to this area on the smart device also needs to be encrypted and protected. This will act as a mobile diabetic medical record for the patient, to present, in case he is travelling or consulting a different physician. Proposed Mobile Application will be an assistant to the patient for self care management by providing push notifications and reminders.Figure 4 depicts mobile interface view of BCC.

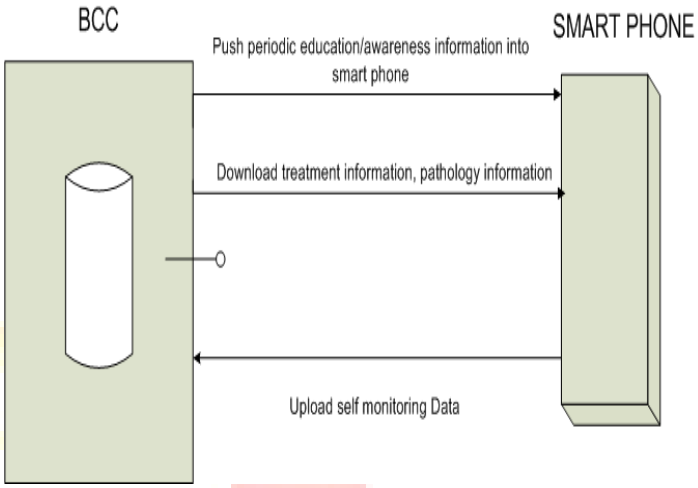

Fig 4 : Mobile Interface

C. Public Physician Interface

A secured layer of access for external physicians, who want to see the patient details. This will be the simplest interface in the whole scenario. The concerned physician will be accessing the BCC as a simple website. He will be able to access the specific patient by his BCCID or through some other identifiers.
Every external physician (who is not a part of this private cloud directly) will need to get the access to the system via a formalized method.

D. Research Interface

Accessible for researchers. Need to sign and agree terms of access. Based on the search criteria, the end user will be granted access to the data in a csv or any other optimized format, which will be stored temporarily on the designated storage area. Researcher need to download the data to his local disc. The data stored on the central machine will be cleared immediately after the download or after a specific time interval.

VI.OUTCOME PUBLISHING

Specified body will publish the treatment outcome, based on various parameters and scenarios using the BCC database. Parameters to be published need to be formalized. These outcome reports could be a guide for patients to choose their treatment partner.

A.CHALLENGES

Legal obligation to be established: To get the concept materialized, PHCs and clinics dealing with diabetic patients should have the obligation towards providing the accurate information. This should be controlled by some governing bodies and should be bound by some sort of laws. Many countries have national diabetes register and the PHC are legally responsible to be a part of this. This kind of legal contracts needs to be established first. Whatever pain we are taking today will be paid off in the near future. If this move can, at least control and offer a systematic treatment towards diabetes, this is one of the best efforts we can offer to the

current and to the next generation through this emerging cloud technology. Some more challenges on the way are:

- Ethical issues regarding the medical records – Cloud will not store any personal information of the patient.
- Security issues involved in accessing and maintaining BCC.
- Integration of heterogeneous applications to the central BCC.
- To create a nationwide awareness.
- Funding
- Compliance to the system.

VII.CONCLUSION

In this paper, authors surveyed the state of the art researches in cloud computing and the possibility to utilize the cloud power in diabetes treatment and research. We then introduced a new concept of Blue Circled Cloud, which is meant for centralized management of Diabetes via cloud. It is web based, flexible and easy to use. We also analysed the technical aspects of the concept. Through this, if the healthcare sector can achieve some improvements in the area of Diabetes treatment and help the diabetic patients to improve their lifestyle , we are satisfied.

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