Cyberinfrastructure for CHOIS - a Global Health initiative for obesity surveillance and control

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***Abstract*— CHOIS, the Childhood Obesity Informatics System, supported by high-performance grid computing has been developed following Open Grid Services Architecture, an accepted standard for accessing Grid Computing and other services under Open Grid Collaborating Environments (OGCE). For this work in progress[1], we are developing various web based tools for data input & data visualization, data integration, SMS alert system, Content Management system (CMS) and a Decision Support System (DSS), to name a few. A mobile application has also been developed for interacting with its remote database using a smart phone at the point-of-care. This system is now available for use by the Illinois Department of Human Services (IDHS) School Health Program for obesity surveillance among the school-going children.**

***Index Terms*— Obesity, Body Mass Index, Portal technology, OGCE, BMI, wellness program, grid technology, mobile technology**

I. INTRODUCTION

OBESITY is defined as the excessive accumulation of fat in certain parts of body to the extent that it may exert an adverse affect on health, leading to reduced life expectancy [1]. Currently, one-third of children and two-thirds of adults in US are at-risk or obese [2]. This disorder is often associated with an increased risk for developing a variety of serious health related conditions including social and emotional problems [3]. It has now become so common that in 1997 the WHO formally recognized obesity as a global epidemic [4]. It has been estimated that nearly one-fifth of the healthcare budget in US alone may have to be used for obesity control [5]. This has become a major concern in US. This led the present administration under President Obama to establish a task force on childhood obesity (White house, February 09, 2010). Development of effective surveillance, prevention, treatment and management strategies to address the health, social and emotional problems associated with overweight, particularly among school-aged children is very critical. The American Academy of Pediatrics recommends that BMI should be measured on all children as part of normal health supervision. BMI, which is easy to measure and correlates with body fat, assesses the weight status of an individual to identify those at risk Many states including the State of Illinois have established mandatory BMI surveillance and screening programs for all students attending the public school system for prevention and possibly intervention. It has also been realized by the present administration that the application of information technology in healthcare can improve the services if not reduce the costs. In collaboration with others both nationally and internationally, NUCRI[2] is involved in developing software tools and relevant educational content materials for the community health and *CHOIS* is the result of such collaboration.

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II. DESIGN AND METHODS

The CHOIS system has been developed using Open Source Portal Technology with three-tiered Open Grid Services Architecture (OGSA; Figure 1), an accepted standard for accessing Grid and other services [6] under Open Grid Collaborating Environments for scientific use, developed within the Global Grid Forum. OGSA, based on several Web service technologies is a distributed interaction and computing architecture based around services, assuring interoperability on heterogeneous systems so that different types of resources can communicate and share information [6]. Figure 1 provides a simplified concept of the architecture that we are adopting for CHOIS to provide various services. OGCE Software system[3] has a bundled set of JSR 168/286 compatible portlets and services for building Grid Portals and related tools for Web access to Grid and Cloud computing resources. A number of Science Gateways supported by TeraGrid have been built following this approach (see, teragrid.org). This author (AKD) is a Campus Champion [7] for Teragrid usage, and therefore, followed the same approach for building CHOIS that would provide the users a vast amount of resources including the bioinformatics and visualization tools for research. In 2008 alone, SBHCs in Illinois enrolled approximately 80,000 students and collected demographics (age, sex, race, and ethnicity), height and weight, diagnosis codes, procedure codes, insurance status, and documentation of assessed risk behaviors of individuals for providing medical, dental and mental healthcare. Various web based forms have been created for CHOIS to collect such data and more on an individual's health conditions and store in a

[2] More information at http://nucri.nu.edu

[3] www.collab-ogce.org/ogce

MySQL database. *Drupal*- based CMS has been integrated for providing information on obesity and related disease conditions. We are also developing a variety of web based tools including SMS-based alert system, a data integration tool and a DSS, to name a few. The DSS is to guide an individual for proper diet and physical activity. Modern technologies including XML based web services have been used for developing CHOIS and its mobile version, mCHOIS, for using the application through Android-based smart phones. At present CHOIS has 110 fields for data input including genomic data that can be uploaded through a web Application Programming Interface. It is anticipated that this system will eventually need space for storing terabyte or more amount of data ranging from text, graphics, audio, and video. This portal is supported by a datagrid network and archival system that was established earlier by NUCRI [8] to

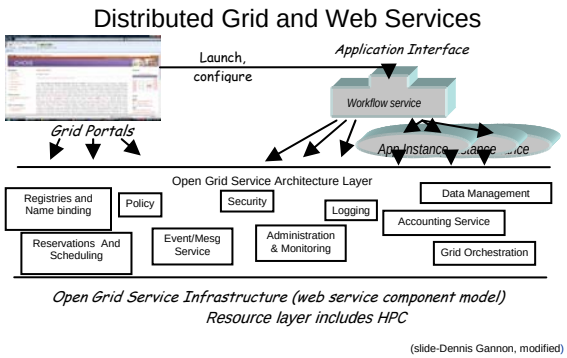

Figure 1. Distributed grid and various web services. This three-tiered architecture is accepted standard for a portal accessing Grid and other services through a unified interface. It also supports aggregation of services at the backend.

store massive amount of health related data for further analysis. Remote management of such data grid infrastructure using ezSRB was developed [9] for managing data through Storage Resource Broker (SRB). Effort is underway to modify this web service for managing data through iROD, the modified version of SRB.

An ideal EHR should be able to integrate a variety of data types and data formats, common in medical field, ranging from text (e.g., demographic data), graphics (e.g., X-Ray) to video (e.g., Colonoscopy), for generating reports and visualization through an web interface. Moreover, information exchange and dissemination should be possible between various EHRs. There are almost 30 large vendors for EHR operating in US to serve this trillion dollar healthcare industry [10]. However, to this author's (AKD) knowledge, none of the EHRs meet all the criteria that the customers are now demanding. For example, the Illinois Department of Human Services (IDHS) provides healthcare services to students through 39 School Based Health Centers (SBHCs). At present, the SBHCs and its partnering organizations are using EHRs from multiple vendors. Incidentally, the information from one EHR can not be exchanged to another EHR, causing multiple entries of the same data to various EHRs for various purposes, such as, clinical management, reporting to the IDHS, insurance claims, etc. Lack of information exchange between these EHRs is severely limiting the usefulness of any of these EHRs. Moreover, in health informatics, data standardization for information exchange is still a challenge. Although the HL7 standard has been agreed upon by the industry, it's implementation is still lagging behind because of any standard guidelines. The data interchange in the CHOIS is based on national standards following the standardized nomenclatures [11] for building a semantic interoperability platform that serves to exchange information among all the electronic health record systems. Several communication standards were reviewed and HL7v3 has been selected to exchange health records in our solution. We will develop a HL7 broker as a gateway between CHOIS and the HL7 message-based infrastructure.

In conclusion, this HIPAA compliant secure EHR system now enables school-nurse and healthcare service providers to collect data on children and report statistical and surveillance information on BMI to identify those at risk and obese. Its mobile version, mCHOIS, will greatly facilitate collecting data at the point-of-care.

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