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Information Collaboration Framework for Health Care Management System

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ABSTRACT
This paper presents a healthcare collaborative framework for chronic disease management in Gulf region. Advances in information technology have great impact on the quality of patient care. In Middle East and the growing economy countries the availability of medical experts is also a concern. One of the good solutions is to use clinical information systems (CIS) which improves the quality of patient care. Medical Sensors can be used for monitoring physiological parameters for the patients. Disease management issues and metabolic process of diabetics are analyzed in the paper in detail. Collaboration framework is suggested for health care management system.

General Terms
Computer Science, Computing, Information Systems, Framework

Keywords
Health information systems, Collaborative framework, clinical information systems, chronic disease management

1. INTRODUCTION
Disease management is defined as “a system of coordinated health care interventions and communications for populations with conditions in which patient self-care efforts are significant.”[1] In recent years, a pattern of chronic diseases has started to emerge in the Middle East. These diseases appear in the form of increases in obesity, heart diseases, and diabetes (both types 1 and 2). This increase in chronic illnesses, along with the increasing sedentary lifestyle in the Middle East has imposed a great pressure on healthcare providers, especially when trying to ensure that structured patient follow-up is achieved after each therapeutic change. Moreover, this in turn causes other problems such as overload on the medical providers and a significantly increased financial cost. According to WHO, in 2010 the estimated worldwide cost to treat and prevent diabetes and its associated complications is expected to total at least $376 billion (USD), and within 20 years, expenditures are projected to exceed $490 billion (USD). In the UAE, the Research and Statistics report on diabetes across the UAE suggests that the disease will cost an estimated Dh10 billion by the year 2020 if the condition is not treated more effectively. This is based on the average annual cost of treatment in 2007, which was $993 for each person. This is approximately the same as in Oman, where it was anticipated from the Oman National Health Survey that by 2020 [1], the incidence of type 2 diabeteswould be 11.7% and is expected to have increased notably since then. The cumulative effect on the healthcare system of this and other chronic diseases will make this situation even worse.

In this paper we suggest a smart healthcare monitoring system to offer a cost-effective means to improve the quality of healthcare and follow-up in Oman. Such services will assist the medical sector to offer better healthcare, in the areas of diagnosis, monitoring, control and follow-up of patients’ diseases. The paper will focus on monitoring the chronic disease in general, and diabetes, blood pressure and blood lipids in particular. The research aims to transfer part of the responsibility to patients by building awareness among them.

The research has significant potential economic impact, by reducing the need for frequent direct access to medical providers, the risk of operation in case of chronic disease, and cost of treatment in early detection and prevention for chronic diseases[2]. This offers the potential to save a lot of money for the Omani government.

In this paper we will design a collaborative framework for the health care system and efforts are made to integrate it with HIS-HL-7[2].

2. DIABETES AND HIGH BLOOD PRESSURE
Hyperglycemia drives diabetic complications and the pathos physiologic mechanisms involved in the development of diabetic complications are related, for example, to glucotoxicity, lipotoxicity, and oxidative stress, triggering damage to the vascular endothelium [2].

Diabetes is a life-long disease and the diabetic patient, who is often co-morbid, has a significantly shorter life expectancy compared to the general population. This decrease is dependent on the age at disease onset: e.g., life expectancy in a 40-year-old patient is reduced by approximately 10 years, while a 20-year-old patient has a predicted reduction of approximately 18 years. Micro- and macro vascular complications are the primary cause of premature mortality and severe morbidity in diabetes.

Metabolic control and the risk of diabetic complications each country has guidelines and there are international guidelines are also available. Despite official guidelines for diabetes management, physician expertise, and the adherence of diabetic patients, achieving glycaemic, goals may sometimes require an empiric and time- consuming “trial and error” procedure.

In light of the high frequency of long-term diabetes complications and budget deficits, the establishment of better diabetes control and improved quality of life requires new technologies that are both highly efficient and cost effective.

Information technology has something to offer this time which can help patients as well as doctors. For treating diabetes we can develop tools that provide evidence-based support for improved diabetes control, e.g., by simulating and predicting of individual glucose profiles in response to therapeutic adjustments. Prediction of blood glucose values, insulin dose adjustments, simulation of glucose profiles, and improvement of the therapeutic regimen can be made possible using the decision support system using SOA and service

Cloud. These advisory systems will help the patients and doctors and will reduce the load on the doctor as well as on the hospitals.

In the past, many advisory systems have been proposed as being effective for outpatient diabetes care [7,8]. Achieved functionalities include the waysin which patients learn to interact with their diabetes aredetailed in this research the four themes: understanding typical life style, accommodating atypical activities, disproving& discovering healthy tips and re-evaluating personalexpectations of the sugar and blood pressure and sugar. The proposed diabetesmanagement systemthat includes addresses a patient'sphysiological, social and psychological activities within theprocess of individual disease management. The paper proposes new opportunities for designing interactivesystems to account for individual differences, encouragingpositive patient involvement and sustaining long-term health outcomes for the patients of the chronic diseases.

3. CHRONIC CARE MODEL

All the chronic diseases involve certain components and each of them play critical role in the disease management. Community resources and policies play very important role in diabetic management. Self-management and delivery system also provide support informed and activated patients and at the same time use of decision support systems and information technology tools provides productive interactions for the proactive practice team. [4]

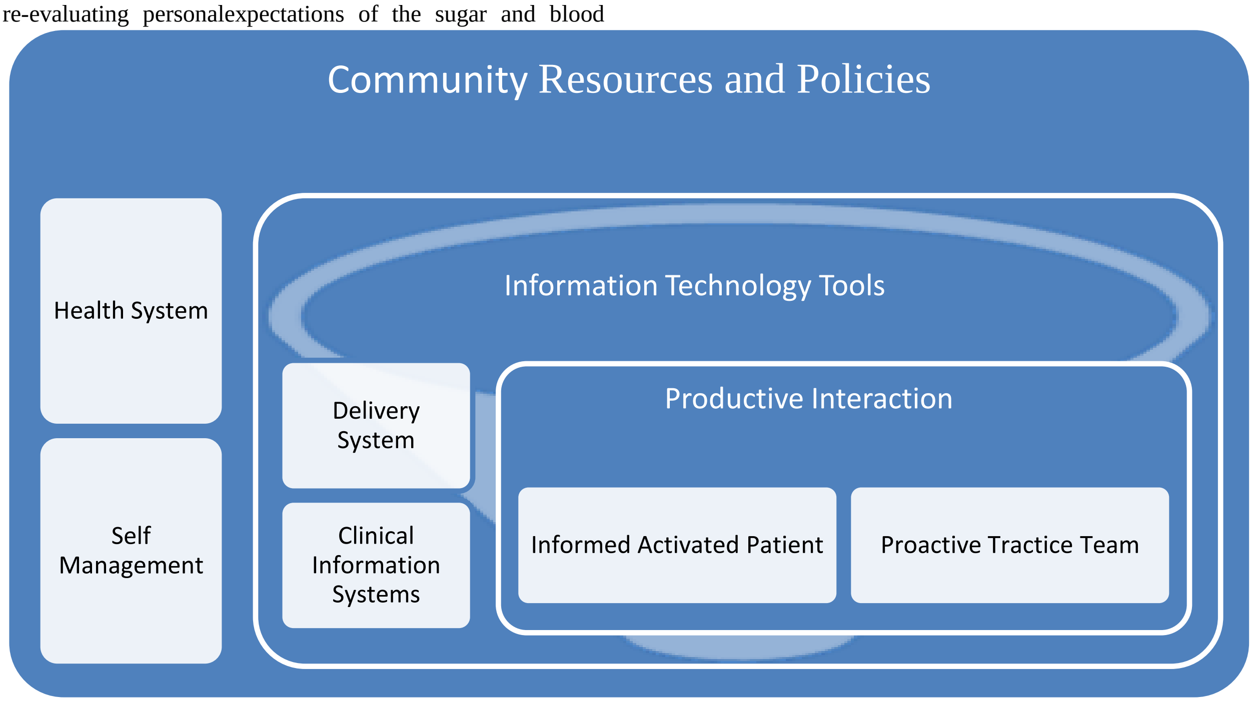

Figure1: Health Information Systems Architecture

4. DECISION SUPPORT SYSTEM

The model-based Karlsburg Diabetes Management System (KADIS) has been tested and deployed as a patient-focused decision-support tool to provide evidence-based advice for physicians in their daily efforts to optimize metabolic control in diabetes care of their patients on an individualized basis using latest information technologies. Cloud computing and Service oriented architectures can be used for building such applications which can support patients and doctors on the services. Automation of Diabetes Management System using HIS –HL-7 health care networks indicates a significant improvement of metabolic control.

This model-based decision-support system provides an excellent tool to effectively guide physicians in personalized decision-making to achieve optimal metabolic control for their patients.

5. COLLABORATIVE FRAMEWORK

In the collaborative framework all the components are participating and uses information infrastructure. Consumers like hospitals, doctors, medical centers, and patients all are the important aspects of the framework with support functions, and services. A knowledge system with management system and security system is to be kept in place for smooth functioning of the framework. The system should be robust and fault tolerant so that it can be more reliable and it should provide better quality of services. In the figure all the components of the framework is shown and all the components are interrelated.

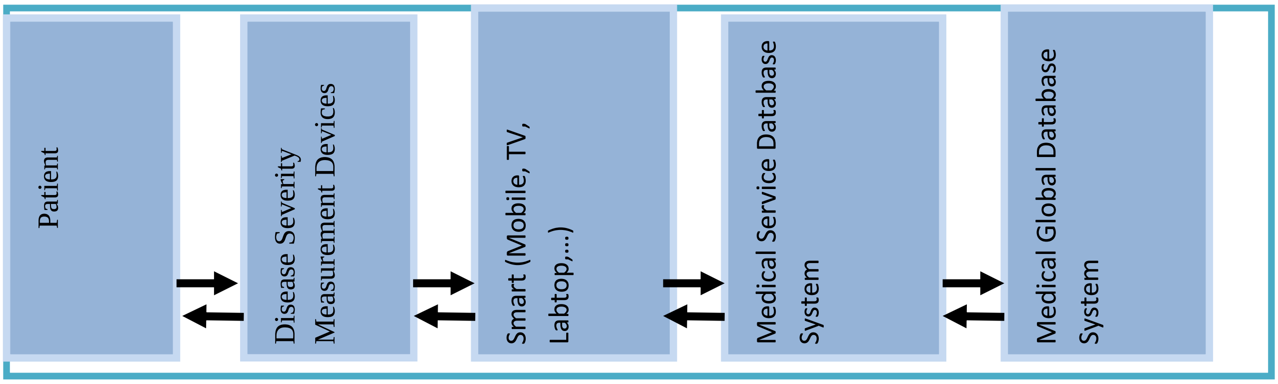

Figure2 : Medical Database

6. CHRONIC DISEASES INFORMATION SYSTEM PROCESS

The patient uses his/her instrument for measure the severity of the illness (diabetic, blood pressure …etc). The "Medical Global Database System" is the integration of medical services databases and it can be used decision support system. It can be used for example to find out the most effect of drug on the one disease[8, 9,10].

- The reading of the instrument is automatically transferred to in patient smart mobile, smart TV, lab tab.
- The reading transferred via the internet the medical service database (e.g. hospital, clinic) where the clinic is uniquely identified.
- The medical service database process the reading , and send the results via the internet to the patient.
- The patient can see the severity of his/her illness in his/her mobile or smart TV. The information should be displayed graphically, sound and textual.
- If the severity is bad the system should send a message to the Dr/Nurse, and they have to call the
- Patient and give him/her advice to what to do e.g. come to the clinic today.
- To help control the patient illness some information has to input by the patient. The medical service should inform the patient when (s)he can sent it in the system(daily, weekly, ..). the information required is thing that affect the severity of the illness such as support, stress, diet (far, sweets)[11].
- The medical service should monitor the number of the times the patient is measuring his/her illness situation. The patient or a member of the patient family should be contacted if it noticed that the patient ignoring take the reading for his/her illness.
- The medical services should store the illness type (e.g. diabetic 1 or 2), type of drugs and doses, and the doctor should inform the patient weather to keep the same doses, reduce of increase doses via the system, and the patient can confirm that he read these instruction, otherwise direct contact she take place.
- If the patient visits another clinic, the patient unique ID should be used to read all the information about this patient.

7. DIABETIC METABOLIC PROCESS

Glucose- and/or insulin-dependent and independent endogenous hepatic glucose balance [5, 6].

• Glucose-dependent insulin secretion of the -cells;

• Circulating blood insulin concentration including exogenous insulin application;

• Resorption profiles of food intake and of orally per glycaemic agents; and

• Glucose and insulin degradation and excretion of the kidneys above defined thresholds.

For translating this physiologically based model into a computer program, the KADIS ® model was transferred to a structured control system, consisting of three interacting[3].

8. MATHEMATICAL MODEL

Model of insulin/glucose metabolism is described in the form of a coupled differential equation system that consists of four differential equations [7,8] metabolic situation for each patient individually based on the Karlsburg model of the physiological glucose/insulin regulatory system is modeled with the following equations [6].

$$dx/dt = u + (CHO(t) - OHA1(t))$$

$$du/dt = -(b1+b2)u - b3\ (y+e+OHA\ 2) + b1(b0 - CHO(t)+OHA\ (t))$$

$$dy/dt = -ky + ID + OHA4(t) + INS(t)$$

$$de/dt = -ke + EXE(t),$$

Whereas ID (ID=a 0 +a 1 (x –x w) +a2 3 dx /dt) represents the pancreatic insulin supply and xW the mean glucose target value which is set to be 5.00mmol/l in the KADIS model.

The parameters a i , b j and k of the model can be identified on an individual basis [4].

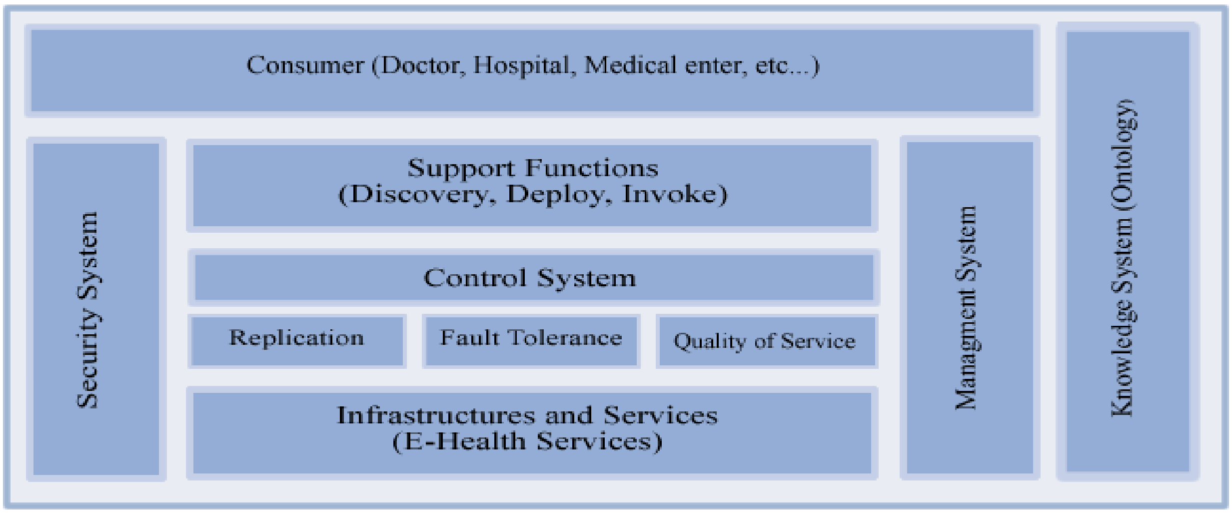

Figure3: Collaborative Framework

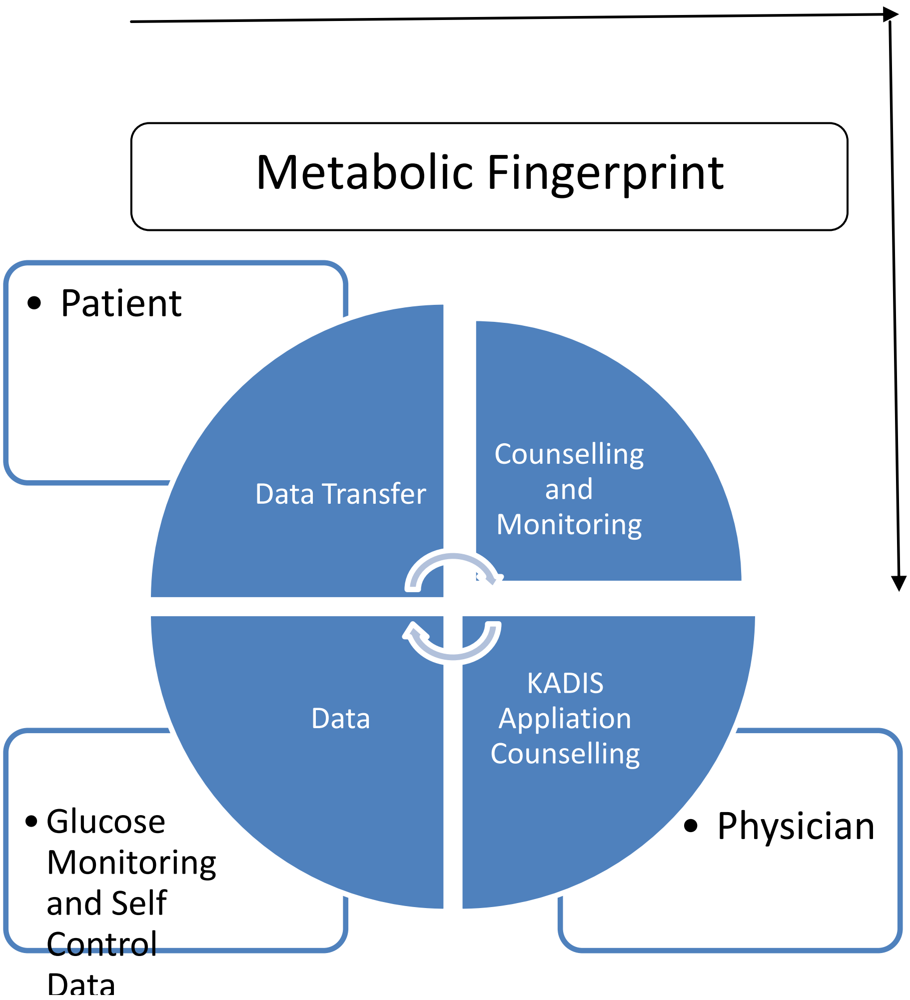

Figure 4: Monitoring System KADIS

Interoperability in semantic web is a core challenge in the current distributed, communicating andco-operating health information systems enabling sharedcare and e-Health. Chronic Care Models (CCM) needs quality improvement continuously and these models can help create system-based changes that improve the likelihood appropriate care is delivered in a proper way [15, 16].
All over the world there need for health care system which is tax free, support insurance and should be market based[18,19].

9. Conclusion

Health Care Management System and Collaboration Framework is the need of time. Through these software systems we can provide expert advices to the patients and can reduce the load on the hospitals. In Middle East and the growing economy countries the availability of medical experts is also a concern. One of the good solutions is to use clinical information systems (CIS) which improves the quality of patient care. Medical Sensors can be used for monitoring physiological parameters for the patients. In the paper we discussed the proposed systems for chronic diseases like diabetics and high blood pressure.

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