Developing Framework for Agent-Based Diabetes Disease Management System: User Perspective

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ABSTRACT

Background: One of the characteristics of agents is mobility which makes them very suitable for remote electronic health and telemedicine. The aim of this study is developing a framework for agent based diabetes information management at national level through identifying required agents.

Methods: The main tool is a questioner that is designed in three sections based on studying library resources, performance of major organizations in the field of diabetes in and out of the country and interviews with experts in the medical, health information management and software fields. Questionnaires based on Delphi methods were distributed among 20 experts. In order to design and identify agents required in health information management for the prevention and appropriate and rapid treatment of diabetes, the results were analyzed using SPSS 17 and Results were plotted with FREEPLANE mind map software.

Results: Access to data technology in proposed framework in order of priority is: mobile (mean 1/80), SMS, EMAIL (mean 2/80), internet, web (mean 3/30), phone (mean 3/60), WIFI (mean 4/60).

Conclusions: In delivering health care to diabetic patients, considering social and human aspects is essential. Having a systematic view for implementation of agent systems and paying attention to all aspects such as feedbacks, user acceptance, budget, motivation, hierarchy, useful standards, affordability of individuals, identifying barriers and opportunities and so on, are necessary.

Key words: Diabetes, agent based system, disease management.

1. INTRODUCTION

Diabetes is one of the most common chronic diseases of human societies and is a major problem for public health. In terms of early and late complications of the disease, the patients and the societies impose many problems (1). Diabetes care may account for up to 15% of national health care budgets (2). This hidden disease imposes indirect and inestimable costs to society and causes complications such as ischemic heart disease, hypertension, types of heart failure, retinopathy, neuropathy, nephropathy, cataracts, and more. Direct and indirect costs of diabetes and complications compared to other diseases are very high. Diabetes is an expensive medical problem in Iran so that the aggregate annual direct costs of diabetes were estimated to be $112.424±10.732 million. Diabetes complications contributed to 53% of the aggregate excess direct costs of diabetes (3).

In diabetic patients, if monitoring of health situation is done with high quality in coordination with nutrition program and physician orders, the quality of care will improve dramatically (4). The best way to reduce costs of health sector is to increase the empowerment of people, prevent chronic diseases and manage appropriate health activities through monitoring patients. In fact, fast diagnosis based on regular and accurate monitoring by using information communication technology (ICT) devices, can help prevent death (5). Telemedicine as a main tool for remote health care delivery, home care with fast and timely access to health information (6, 7), reducing medical errors (8), increasing coordination among health care professionals (9), reducing travelling and physical presence of patients in urban health centers in remote areas (10), providing education to patients and providers, (11) and so on, can help significantly reduce health care costs and correct performance management particularly in chronic disease management (12,13).

To enjoy the full benefits of E-health, making use of methods and modern technologies is very important. One of the innovations in the field of information technology in healthcare applications is agent technology. Agent is a software component that uses artificial intelligence techniques to select the best course of action to achieve the user targets. Some of the important abilities of agent technology are: a) They can react timely and flexibly to unexpected and dynamic changes in environment; b) They have an autonomous and independent behavior for tasks that are assigned to them; c) They perform proactive to reach their
goals, 4- They can communicate with users or other agents, and 5- They have the ability to reason, plan and learn. These abilities allow them to have intelligent behavior (14, 15). Also one of the characteristics of agents is mobility that because of this feature they are very suitable for remote electronic health and telemedicine (16). The aim of this study is developing a framework for agent based diabetes information management at national level through identifying required agents.

2. METHODS

In 2012-2013, a research was conducted with the help of endocrinology and metabolism research institute of Tehran University of Medical Sciences and Health Information Management Research Center in this university in order to provide a model for national diabetes information management to support decision-making, create alerts and remote monitoring of patient status and provide appropriate treatment and prevention of diabetes with high speed approach by using mobile health and agent technology.

The main tool is a questioner that is designed in three sections based on studies library resources and performance of major organizations in the field of diabetes in and out of the country and also interviews with experts in the medical, health information management and software fields. The questionnaire in order to determine the validity distributed among experts in the above three areas. The questionnaire included three parts. The first section covers personal identification. In part two, questions are related to the general features of agent-based diabetes management systems and the third section examines the specific features of the systems in hospitals, for medical staff and for patient care. An open question was at the end of the questionnaire in order to find expert opinions about the structure of multi-agent diabetes management.

The questionnaire was distributed in Delphi methods among 20 experts from health information management, software and physicians in diabetic research center. Finally with the help of SPSS 17, results were analyzed in order to identify agents required in health information management for the prevention and treatment of diabetes and rapid analysis. Results were plotted with FREEPLANE mind map software.

3. RESULTS

The first diabetes virtual clinic in Iran at Tehran University of Medical Sciences is a non agent and user center system that by providing useful information to patients and providers helps better self-care and tele care. The most important point in virtual clinic is possibility of tele consultation and people’s access to updates, accurate and necessary information about diabetes from preventive measures to decreasing side effects and better and new treatments. Recently health care systems shift towards high speed access, accurate health information, online health services, high quality health care, and shared information to better decision-making. Dynamic health environment needs high interoperability among professionals with different skills, various specialties and complicated processes. Hence, in 2012-2013, a research was conducted with the help of endocrinology and metabolism research institute of Tehran University of Medical Sciences and Health Information Management Research Center in this university in order to provide a model for diabetes information management using agent technology to support decision-making, create alerts and remote monitoring of patient status and provide appropriate treatment and prevention of diabetes with high speed approach.

According to the findings, important business processes in diabetes management include the following: monitor, diagnosis, consultation, information processing, decision support system, archiving documents and patient records, appropriate interface for communication between patients and health electronic systems, monitoring operations and service delivery and allocating tasks. Using FREE PLANE software, the most important applications in the field of diabetes management are plotted:

Capabilities of diabetes management system, based on agent technology in three sections: medical centers and hospitals, medical staff, and patient care, according to the viewpoints of experts in this research, in order of priority include:

1. In hospitals and health care centers: tele monitoring (mean 1/90), tele education (mean 2/35), transferring information to the doctors as soon as possible (mean 2/75), providing appropriate treatment for patients (mean 3/50), determining the exact location of the patient (mean 4/50)
2. For patients: tele education (mean 2/05), intelligent alarm (mean 2/10), patient monitoring (mean 2/40), self treatment (mean 3/50), determining the exact location of hospitals and health care centers (mean 4/95)
3. For health care personnel: tele education (mean 2/15), intelligent knowledge management (mean 2/45), intelligent alarm (mean 2/65), electronic health record management (mean 2/75).

4. DISCUSSION

In order to accelerate diabetes management systems based on agent, the following items must be considered: cultural readiness, providing the required technical infrastructure, application of appropriate mechanisms for security and privacy, appropriate investment, user involvement, and private sector participation. In addition to these, in agent-based diabetes management system structure, designing and creating a database backup has particular importance and a rich database must also be designed in order to provide support for various training formats and tasks.

5. CONCLUSION

Providing immediate feedback for patients, promoting interaction of the patients with the organization that provides remote health care and reinforcing their motivation for the use of telemedicine systems, patients and clinicians focusing on abnormal data that will prevent future occurrence of danger-

| Type of communication | Access to data technology | Development method | Usage | System |
|-----------------------|---------------------------|--------------------|-------|--------|
| According to studies, to provide better health services communication used be wired or wireless connection tools | 1- mobile (mean 1/80) | 1- Tele monitoring or tele treatment services (55%) | 1- Home care (70%) proposed framework |
| 2- SMS, EMAIL (mean 2/80) | | 2- User center (30%) | 2- Outpatient (55%) |
| 3- internet, web (mean 3/30) | | 3- Merging of telemedicine with knowledge management (30%) | 3- Inpatient (25%) |
| 4- phone (mean 3/60) | | 4- Local, personal health services (15%) | | Table 1. Proposed framework characteristics in order of priority |
| 5- WIFI (mean 4/60) | | | | |
| 6- PDA (mean 4/65) | | | | |
ous situations, can be considered some of the benefits of agent technology in telemedicine services delivery. It should be noted that the use of agent system only with technical view does not lead to the elimination of obstacles.

In delivering health care to diabetic patients, considering social and human aspects is essential. Some users, especially elderly people, don’t trust machines like computers. These issues should be considered before designing and implementing agent-based systems to provide health services for diabetic patients. So, having a systematic view for implementation of agent systems and paying attention to all aspects such as: feedbacks, user acceptance, budget, motivation, hierarchy, useful standards, individual’s affordability, identifying barriers and opportunities are necessary. Also accelerating the application and implementation of multi-agent diabetes management systems needs providing the necessary infrastructure and appropriate readiness.

Furthermore, for the users, especially elderly people to make use of the system, special attention should be paid to the ease of use and user friendliness. Use of reminders for patients about drug use and injection in addition to the built-in alarm system is also very important.

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CONFLICT OF INTEREST: NONE DECLARED.

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