Design of a Decision Support System for a Home Telehealth Application

Mas S. Mohktar, GSBME, University of New South Wales, Sydney, NSW, Australia & Department of Biomedical Engineering, Faculty of Engineering, University of Malaya, Kuala Lumpur, Malaysia

Kezhang Lin, GSBME, University of New South Wales, Sydney, NSW, Australia

Stephen J. Redmond, GSBME, University of New South Wales, Sydney, NSW, Australia

Jim Basilakis, School of Computing and Mathematics, University of Western Sydney, Sydney, NSW, Australia

Nigel H. Lovell, GSBME, University of New South Wales, Sydney, NSW, Australia

ABSTRACT

A decision support system (DSS) that has been designed to manage patients using a home telehealth system is presented. The DSS has been developed to assist home telehealth clinical support staff with their workload, and to provide more effective communication between multiple home telehealth users. The three-tier system architecture that consists of a data layer; a business logic layer; and a front-end layer employs business processes and uses a rule engine for its logic and knowledge base. This paper discusses the design considerations involved in the construction of a DSS for the purpose of home telehealth, and illustrates how it may be developed using entirely open source software.

Keywords: Business Processes, Decision Support System (DSS), Home Telehealth, Open Source Software, Rule Engine

INTRODUCTION

The purpose of telehealth is to remotely provide healthcare services to patients. It enhances the power of multidisciplinary teams using communication technology to allow healthcare to be delivered to a patient at distant locations. The usage of telehealth technologies has offered inclusive access to healthcare services and has reduced the cost of their delivery (Darkins & Cary, 2000).

Home telehealth systems have been beneficial to elderly patients who are in need of healthcare at home. These electronic monitoring...
systems enable patients to monitor their own physiological signs unsupervised at home. Using a telecommunication technology, home telehealth personnel (often skilled nurses) can monitor the patient’s information and provide necessary clinical consultation, remotely (Finkelstein et al., 2006).

Elderly people favour living independently and prefer to stay in their own homes (Mynatt & Rogers, 2001). Therefore, it is important to provide a service that can maintain functional independence in elderly patients, especially those with chronic disease such as chronic obstructive pulmonary disease (COPD) (Hanania et al., 2010).

Most of the studies on home telehealth reveal benefits of using telehealth in terms of patient outcomes. However, the acceptance of home telehealth among ambulatory care staff is a challenging issue (Koff & Westfall, 2008). The reason being that there is a much wider variation of data (in terms of signal quality for example) captured by the home monitoring device (Dankins & Cary, 2000) and this quantity and mixture of data cannot be efficiently processed without computerised or semi-computerised support (Clifford, Long, Moody & Szolovits, 2009). Consequently, the home telehealth nurse workload increases owing to the need to analyse and synthesise the remotely acquired data. Therefore, to assist the ambulatory care team in the task of organising visits and monitoring and assessing the patient’s telehealth measurement data, a customised decision support system (DSS) is proposed.

A DSS, typically used by health practitioners, is a computer-based system that supports clinical decision-making. The benefits of using DSSs as an addendum to home telehealth services is to assist with workload management by completing vast numbers of automated tasks in a short time frame and improving the storage and the management of information. Data acquired from home telehealth systems are typically digitised and stored on a centralised database (DB). These data are easily made available to the healthcare professionals via an internet service. The remotely acquired data are usually stored until the primary care physicians (PCPs) or nurses are prepared to perform a data evaluation. An effective DSS would provide notifications to these clinical support staff to alert them of patients who require urgent review or intervention (Lovell et al., 2010). Thus, enabling PCPs and/or nurses to prioritise their patient workload based on monitoring results highlighted for abnormal deviations for each particular patient, rather than having to routinely monitor every patient. Moreover, the ability to remotely access the data also enables the discussion about health concerns and health conditions between the patient and disparately located clinical experts. This capability also allows a single nurse carer to proactively monitor more than one patient (Mekhjian, Turner, Gailiu, & McCain, 1999).

The barriers that have hindered the implementation of DSSs are that most systems are tightly integrated with a specific DB as well as being costly to license. Bilykh (2006) developed a standalone open-source DSS to make decision-support available for any electronic medical record (EMR). However, the design was meant for hospital-based EMRs only and not suitable for home telehealth systems (Bilykh et al., 2006).

This paper presents a DSS design that has been developed using open source software and a business process management (BPM) concept. The DSS structure consists of three important components; a data layer that connects the DSS with the home telehealth remote DB; a business logic layer that organises the management activities embedded with a rule engine that holds the knowledge base; and a front-end layer that provides the user interface. At present, the system is intended to be used by COPD patients with objectives to assist in staff workload and effective communication.

**DESIGN MOTIVATION**

COPD is a complex and a poorly understood disease caused mainly by smoking (Fishman, 2005). The World Health Organization (WHO)
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