Chapter 92
Review of Business Intelligence and Intelligent Systems in Healthcare Domain

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ABSTRACT

Business intelligence and corresponding intelligent components and tools have been one of those instruments that receive significant attention from health community. In order to raise more awareness on the potentials of business intelligence and intelligent systems, this paper aims to provide an overview of business intelligence in healthcare context by specifically focusing on the applications of intelligent systems. This study reviewed the current applications into three main categories and presented some important findings of that research in a systematic manner. The literature is wide with respect to the applications of business intelligence covering the issues from health management and policy related topics to more operational and tactical ones such as disease treatment, diagnostics, and hospital management. The discussions made in this article can also facilitate the researchers in that area to generate a research agenda for future work in applied health science, particularly within the context of health management and policy and health analytics.

1. INTRODUCTION

Healthcare information systems generate massive amounts of healthcare and medical data pertaining to several health processes including inpatient/out-patient registration, patient care, billing, payroll, budget, medical treatment and etc. (Cios & Moore, 2002; Wasan, Bhatnagar & Kaur, 2006). Although healthcare environment can be considered to be "information rich and wealthy", yet, making the most of health and medical data in obtaining strategic knowledge has not been fully accomplished (Abidi, 2001; Bose, 2003; Srinivas, Rani & Govrdhan, 2010). A healthcare organization can gain competitive advantage via

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turning the health/medical data into knowledge using data-oriented decision support systems and tools, aka business intelligence (BI) or analytics.

BI is an umbrella term and can be defined as a set of technologies that enable companies to acquire the competency of making accurate, timely and effective decisions at all levels of organizations (Turban, Sharda, Delen & King, 2011). These technologies consist of solutions for gathering, consolidating, analyzing and providing access to data and they are used to discover various patterns, generalizations, regularities or anomalies and rules hidden inside the data. BI refers to applying various analytics techniques to organizational data which may be generated through the internal business processes (e.g., clinical or medical processes or health-related administrative business (core or support) processes) or could be acquired from external and open data sources (Vercellis, 2009). The main components of business intelligence can be categorized under four elements (Turban et al., 2011), namely Data Warehouse (data mart in small scale) and associated technologies such as ETL (Extraction-Transformation-Load), business analytics (simple ad-hoc reporting, online analytical processing, data mining, web/text mining), performance and strategy (business performance management components such as dashboards and scorecards), and user interface (other visualization tools).

BI have been implemented in variety of industries where the majority of these applications exists in services industries including transportation, banking, retail, pharmaceuticals, and health care (Chee et al., 2009). One of the main reasons that those applications appear in service-oriented organizations is that the volume and diversity of data in those industries can be considered rather big and complex, hence, so as to process and analyze them. Although health and medical data possesses similar characteristics, the characteristics and roles of different processes (medical, administrative, and support services) in healthcare industry vary compared to other service industries (Mettler & Vimarlund, 2009). Therefore, the considerations regarding data collection, processing and analyses might be different as part of healthcare processes. In fact, the necessity of taking the patients at the center of attention may pose different challenges when modeling the data throughout business intelligence activities.

Although BI is useful for managing the massive amount of data generated by healthcare information systems, the unstructured characteristics of these data have forced decision makers to use more sophisticated approaches within the context of business intelligence applications. In fact, intelligent systems or the techniques within the area of artificial intelligence are considered to be a family of BI methods and tools that have been of use in modelling data for variety of application areas. Intelligent techniques such as; expert systems, fuzzy logic, neural networks, genetic algorithms, agent-based systems provide some advantages for processing and extraction of knowledge from structured and as well as unstructured data sets. Therefore these intelligent techniques have used for analyzing and interpreting the medical and healthcare data in healthcare decision support systems, especially in diagnostics.

Taking into account the massive data sources unique to the healthcare and the potential knowledge that can be derived for various health organizations, it would be of significant importance for researchers working solely in the area of healthcare management to comprehend the potential research that can be conducted together with the research circles working in the area of data analytics and knowledge discovery where the focal practice is making the most of that rich data environment. This study, in fact, aims at increasing the awareness of healthcare research community on potential applications of wealthy health and medical data when appropriately processed and mined using business intelligence technologies, alongside with intelligent techniques, to extract strategic healthcare knowledge. The study tries to accomplish that by providing an overview of the current applications of business intelligence and intelligent technologies in healthcare context.