A novel concept for integrating and delivering health information using a comprehensive digital dashboard: An analysis of healthcare professionals' intention to adopt a new system and the trend of its real usage

Keehyuck Lee (M.B.A., M.D.) [a,b,d,1], Se Young Jung (M.D.) [b,d,1],
Hee Hwang (M.D., Ph.D.) [a,d,e,*], Sooyoung Yoo (Ph.D.) [a,d], Hyun Young Baek [a,d],
Rong-Min Baek (M.D., Ph.D.) [c,d], Seok Kim (M.P.H.) [a,d]

[a] Center for Medical Informatics, Seoul National University Bundang Hospital, Seongnam, South Korea
[b] Department of Family Medicine, Seoul National University Bundang Hospital, Seongnam, South Korea
[c] Department of Plastic Surgery, Seoul National University Bundang Hospital, Seongnam, South Korea
[d] Department of Orthopedics, Seoul National University Bundang Hospital, Seongnam, South Korea
[e] Department of Pediatrics, Seoul National University Bundang Hospital, Seongnam, South Korea

ARTICLE INFO

ABSTRACT

Objective: To introduce a new concept of medical dashboard system called BESTBoard. Such a system was implemented in all wards in a tertiary academic hospital to explore the development process, core designs, functions, usability and feasibility.

Methods: The task-force team made user interface designs for 6 months based on a need analysis. Hardware configuration and software development was carried out for 3 months. We conducted a survey of 383 physicians and nurses to determine the usability and feasibility of the system.

Results: In March 2012, the system was installed in all wards, including the intensive care units, emergency rooms, operation rooms, and even delivery rooms. Healthcare professionals had access to all information of EHRs optimized for a large 55-inch touchscreen. The satisfaction rate of BESTBoard users was high, with a mean of 3.3 points. Voluntary users tended to consider BESTBoard as a good system that is useful for team round visits, interdisciplinary team approach, and collecting the status of the hospital rooms. Elderly users didn't tend to think of BESTBoard as a useful tool for interdisciplinary team approach and collecting the status of the hospital rooms. Greater expectations regarding work performance affected the users' attitudes positively. A positive attitude toward using the system resulted in consistent real usage and health care professionals' satisfaction with the new dashboard system.

Conclusions: A new concept of hospital dashboard system proved to be feasible and useful in delivering health information to healthcare professionals. A positive attitude and an expectation regarding work performance were important factors for intention to use the system. This finding can serve for developing new systems to present health information effectively. Further studies will be needed to evaluate the extent to which BESTBoard can have a positive impact on clinical care outcomes and work performance.

© 2016 Published by Elsevier Ireland Ltd.

1. Introduction

With the greater integration of electronic health records (EHR) systems, healthcare professionals are now able to retrieve almost all health information through a computer. However, the availability of an enormous amount of data can cause information overload and scattering, which can cause physicians to waste time collecting basic health information and miss crucial information that could lead to medical errors [1]. It is crucial for EHR systems to reprocess and provide all necessary health information to healthcare professionals in a comprehensive and organized manner that is conducive to quick and accurate decision making [1,2]. To address this problem, various EHR solutions have been introduced, including clinical decision-making support systems, critical value reporting systems, mobile electronic medical records, and digital dashboard systems [3–10]. The digital dashboard system is a typical example of a concise and context-specific display system that can help users promptly capture relevant information from a complex system [1,2]. Displaying information on a large screen can enhance communication and information sharing. Although digital dashboards have been proven efficient for providing information in some hospital departments, they have not been used for general purposes – such as chart review, team rounds and interdisciplinary team approaches – in all hospital units because of their limited functionality [4,6,7]. Although healthcare professionals have been able to capture core health information using previous medical dashboard systems, they must log in to conventional EHR systems to gain access to more specific information after they use the dashboards. This process can be an annoying and time-consuming and can interfere with medical decisions based on information from the EHR systems.

As the first hospital outside the USA to receive Healthcare Information and Management Systems Society (HIMSS) stage 7 status and as a tertiary academic hospital, Seoul National University Bundang Hospital (SNUBH) has implemented a new digital dashboard system that provides EHR information effectively and intuitively for all hospital units, including the general wards, intensive care units (ICUs), emergency rooms (ERs), operating rooms (ORs), and delivery rooms. This system is known as the Bundang Excellent & Smart Touch Board (BESTBoard). Through the system, medical personnel can retrieve all types of health information from the EHR and use it for general practices in all hospital units.

In this study, we describe the development process, core designs, and functions of the BESTBoard and explore its usability and feasibility by analyzing the factors that can influence healthcare professionals' intention to adopt the new system and the trend of its real usage.

2. Methods

2.1. Development process

To develop BESTBoard, a task-force team (TFT) of 10 attending physicians; 7 nurses in charge of wards (medical and surgical), ICUs, and ER; and 5 engineers was formed. In June 2011, the TFT began conducting an analysis of the digital dashboard, and for six months, they created user interface designs based on this analysis. Hardware configuration and software development took 3 months.

The BESTBoard client consists of a BESTBoard client program and an updater based on .Net Framework 4.0 of Windows 7 64 Bit. The BESTBoard server consists of the Healthcare Software Framework (HSF) Windows Communication Foundation (WCF) Business Server for .Net Framework 4.0 and the HSF Logging Service based on a Windows 2008 server, .Net Framework 4.0, Internet Information Services (IIS) 7.0, and File Transfer Protocol (FTP) 7.0. The server provides services to the BESTBoard client through the WCF and HSF WCF Business Server for .Net Framework 4.0 (Fig. 1).

The BESTBoard client installed in each unit communicates with the BESTBoard server using the WCF service. The BESTBoard server can access the EHR database through the application server using the WCF service.

2.2. Conducting a survey to analyze the usability of BESTBoard

We conducted a survey between October 12, 2012, and October 26, 2012, to analyze the usability and feasibility of BESTBoard. The survey was conducted among all doctors and nurses of SNUBH by using an intranet online survey system and 383 physicians and nurses responded to the survey. The survey results were collected and recorded directly into Excel files. The survey items were based on the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) [11].

The TAM is used to test end-users' intentions to use new technology and has been adopted as the gold standard in industries other than healthcare [12]. It was introduced by Davis in 1989 and is widely used to analyze whether end-users will actively accept a new technology. However, this model has insufficient variables to reflect various types of acceptability scenarios for new technologies. Venkatech introduced the UTAUT, which is based on an integrated perspective theory. The UTAUT is known to have up to 30% more explanatory power than the TAM, which has an average explanatory power of 45% for end-users' behavioral intention to use [13]. Consequently, the UTAUT has been widely used to identify end-users' willingness to utilize healthcare IT [14–18]. In this study, we modified these two tools and used them to determine how end-users accept the new dashboard system (Fig. 2).

This study's structural equation model (SEM) was derived from the TAM and UTAUT models. The TAM consists of two variables that influence behavioral intentions to use, while the UTAUT includes two additional behavioral variables: Social Influence (SI) and Facilitating Conditions (FC). The four variables of the UTAUT moderate the entire process leading to actual use. Theoretically, FC influences Actual Usage (AU). However, similar to previous studies, we hypothesized that FC influences Attitude (ATT) rather than AU because of the difficulty of investigating actual uses.

Below are the hypotheses we used to apply the modified UTAUT to our survey results:

Hypothesis 1. Performance Expectancy (PE) for the BESTBOARD will positively influence ATT.

Hypothesis 2. Effort Expectancy (EE) for the BESTBOARD will positively influence ATT.

Hypothesis 3. Social Influence (SI) for the BESTBOARD will positively influence ATT.

Hypothesis 4. FC for the BESTBOARD will positively influence ATT.

Hypothesis 5. ATT toward the BESTBOARD will positively influence Intention to Use (ITU).

The survey consisted of 8 main components: Performance expectancy, effort expectancy, attitude, social influence, facilitating conditions, intention to use, satisfaction, and expectation of work effectiveness based on each work dimension.

Each question could receive a maximum of 5 points, and we assumed that scores higher than 3 points indicated a positive response.

Additionally, we performed univariate analyses to explore which variables could influence survey outcomes. When we analyzed the associated between survey scores and age, position, familiarity with IT and voluntary use, we used 3 scoring categories rather than 5. We performed multivariable regression analyses to