



Checking the potential shift to perceived usefulness—The analysis of users' response to the updated electronic health record core features



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ABSTRACT

Objective: The primary objective of this paper is to identify the main factors which have an impact on the users' attitude towards the functionalities representing the perceived ease of use and to those representing the perceived usefulness. Another objective is to examine whether there occurred a shift towards the perceived usefulness of users' behavior over a period of time. To support these objectives, two different cases are examined – the case in which users are simultaneously offered basic and updated functionalities, and the one in which users are offered a completely new set of features. The results of this study are expected to exert a significant impact on a further development of new software components, as well as the updates of the existing ones.

Material and methods: As the starting point, there were employed the user behavior indicators defined in similar researches and conducted in the countries with a similar cultural background or with a comparatively similar national healthcare system. What ensued was an updated set of functionalities offered within the electronic health record based medical information system. Instead of the survey being posted, the effects of implanted updates were measured through the analysis of the collected data. The data collected in the Niš Primary and Ambulatory Care Center during a four-year period represented the material used in the research. The obtained records indicating the usage of the initial and updated visit registration form, as well as the usage of the new types of visits, were examined in relation to the technology acceptance model and integrated behavior model.

Results: The response to the initial functionalities, perceived as easy to use, was high as expected since they kept the users in their “comfort zone”. As regards the updated features, the ones corresponding to the perceived usefulness, the initial overall acceptance rate was 60%, while the overall increase of their acceptance was around 20%. The overall usage of the newly introduced features was doubled in some cases throughout the four-year period, while some of them were not accepted as expected.

Discussion: Carefully designed additional functionalities, aimed to improve the most common daily activities, have a significant potential to be accepted by the medical professionals. The shift from the perceived ease of use to the perceived usefulness is not uniform, nor is its use in different departments or by the users of the same department. A higher acceptance rate was observed in the departments with more complex administrative procedures, as well as among the users having contacts with more patients and using the system for a longer period.

Conclusion: When accepting new features, medical professionals will initially choose the simpler ones with obvious benefits. If the usage of a feature triggers indirect benefits, the number of examined patients is of a crucial importance for the acceptance of that feature. In the event of the advanced functionality with an extended set of options competing with the simple functionality covering basic requirements, the latter will be used. A feature design, together with a proper training, system stability and ensuring utilization, represent a key point for increasing the positive impact that the information system can have in many application areas, including the healthcare.

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1. Introduction

Registering patients' visits is regarded as the most important set of functionalities within primary care institutions [1]. This standard process is usually supported by the Electronic health record (EHR) based medical information systems (MIS) [2]. The initial idea for the introduction of the EHR based systems has been the improvement in the healthcare process [3]. Additional benefits are evidently a better process control [4] and the overall cost reduction [5]. The basic premise necessary for the attainment of the mentioned benefits is the acceptance of the system by the end users.

A positive user response set of functionalities related to registering patients' visits is crucial for the overall system acceptance. Once the system has been accepted and assumed as rather reliable by the end users [6], the introduction of the updated functionalities can start. Following these guidelines [7], our research group worked on the development of the EHR based system that is currently in active use in 30 different primary and ambulatory care centers in Southern Serbia. It was designed to store a variety of data, starting from demographics and medical history, over prescriptions and laboratory results to imaging services and insurance and billing information [8]. The mentioned EHR system was designed to both satisfy the basic needs for registering medical services and offer some advanced features that should make medical staff's work easier [9]. Basic functionalities were defined to visually resemble and functionally correspond to the previously used paper-based documentation. Within the framework of the technology acceptance model (TAM) [10,11], they can be classified into the perceived ease of use (PEOU) category.

Along with them, a set of advanced features was developed to target the perceived usefulness category (PU). The concept of PU was defined by Davis [10] as "the degree to which a person believes that using a particular system would enhance his or her job performance" while the PEOU is stated as "the degree to which a person believes that using a particular system would be free from effort". From a technical point of view, with the additional features offered, a more effective working environment focused on improving the end user's job performance. When developing the additional and advanced features, we wanted to provoke end users to make a shift from the PEOU to PU.

To check the progress of this process, we offered both sets of functionalities to the users. Our intention was to check whether the software features, developed under the set of the standardized software design guidelines, could be effectively accepted by medical professionals already accustomed to using the paper-based documentation. To track the change in the users' behavior, we performed a longitudinal study and analyzed the data collected throughout the period of four years. The results of the user response analyzed will be applied in the future projects to determine which category of features fits user needs better and in which of the cases.

Examining the existing relevant literature, we identified the most important factors related to the end user behavior and targeted them when developing our software. Since no valid research based on the user behavior was to be found in our closest surrounding, we used the experience of the countries which had similar health systems and/or cultural background to define our EHR system processes. All of these researches obtained their result related to the EHR system acceptance using surveys. Researchers posted questionnaires to groups of medical practitioners, EHR system's end users, and drew conclusions from their answers. To reduce the level of subjectivity, we based our research on the analysis of the system usage through the examination of the collected data. Each collected visit was uniquely signed by the IDs of users, functionality and specific action. In that way, we could compare our results with the ones from the relevant literature and then identify the differences that could be included into the roadmaps for our future projects.

The proposed approach is not limited only to the development of the EHR systems but can be used in the scope of any class of the

information system. The only requirement is to store the data in a way in which the functionality that creates them can be clearly and easily identified.

Today, after more than five years of active use, we are able to analyze a large amount of stored data and identify the overall system acceptance as well as the shifts from the PEOU to PU in the users' behavior. Two different general classes of cases are examined for the purpose of our research – the case in which the basic (correlated to the PEOU) and updated (correlated to the PU) functionalities are offered simultaneously, and the one in which users are offered a functionality that was not present in their previous practice. The results for both classes are presented in the separate section. The findings are elaborated in the discussion section, followed by the conclusion.

2. Background and related work

When starting to work on our project, we were aware that the EHR based systems could not generally bring overall improvements in all areas and in each possible case. As it has been stated in [12], the EHR systems have both positive and negative impacts on the primary care medical practice. Structural and process benefits can be easily identified, but the overall effect on clinical outcomes is less clear. Even when the software is properly and clearly designed and implemented, there are still a lot of potential technical and personal barriers that can jeopardize the project. Besides all potential benefits, the mentioned hurdles must be considered and effective deployment strategies should be defined [13]. This is particularly important at the beginning of the EHR's life when end users should accept it.

A subsequent implementation of additional functionalities is driven by the intention of making users' daily work more efficiently and reducing the number of errors. All good intents supporting the introduction and the updates of the EHR system must be carefully implemented in order for them to bring real improvements. For example, the study [14] shows that, in general, the number of prescription errors has been reduced. But, after the error structure has been examined, many new error types appear. This is a potential drawback when updated functionalities are to be introduced. Besides, they are often in line with the PU paradigm, they should be properly tested and then accepted by prospective users. A certain software feature is more likely to be accepted if it is in accordance with a user's perception of its meaningful use. As it has been stated in [15], the highest level of the positive outcome (73%) is identified in the list of patients associated with specific medical conditions, while the proportion of the overall positive outcome concerning the functionalities with a meaningful use is on the level of 60%.

Examining the structured literature reviews such as [16] and [17], it is proved that most of the studies use the TAM as a basic evaluation framework. As it is stated in [16], it successfully demonstrated its robustness and showed that the acceptance of the medical-care-dedicated software depends significantly more on the user-related variables than on the software type. This leads to the conclusion that the EHR system should be developed as a highly user-centered system. Moreover, the research [17] was of great importance since it represented not only an overview of the factors examined in the computer science (CS) based studies but also of those represented from the healthcare research point of view. It turned out that healthcare studies were focused more on users' attitudes, job relevance, and peer influence than on the PEOU and PU, as is true in CS-based studies. That was the reason why we decided to focus on them in our study. Also, based on the recommendation from [17], we decided not to rely only on TAM, but to include the theory of planned behavior into our analysis [18,19].

A higher EHR system acceptance rate among its users along with a proper utilization is of crucial importance for increasing positive impacts that the EHR can bring to the healthcare. Therefore, the EHR system should not be only easy to use and previous users' habits-related, but it should also provide a higher quality of service [20]. Offering

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