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Understanding the Perceived Usefulness and the Ease of Use of a Hospital Information System: the case of a French University Hospital

R. OLOGEANU-TADDEI\textsuperscript{a}, D. MORQUIN\textsuperscript{ab} and R. BOURRET\textsuperscript{c}

\textsuperscript{a} Montpellier Research in Management, University of Montpellier, France
\textsuperscript{b} Infectious and Tropical Diseases Department, Gui de Chauliac, University Hospital of Montpellier, France
\textsuperscript{c} Innovation and Research Division, University Hospital of Montpellier, France

Abstract. The goal of this study was to examine the perceived usefulness and the perceived ease of use of a Hospital Information System (HIS) for the care staff. We administrated a questionnaire composed of open-end and closed questions. As results, the perceived usefulness and ease of use are correlated with medical occupations. Content analysis of open questions highlights three factors influencing these constructs: ergonomics, errors in the documenting process and insufficient compatibility with the medical department or the occupation. While the results are consistent with literature, they show medical occupations do not report the same low rate of perceived usefulness and ease of use. The main explanation consists in the medical risk in the prescription process for anesthesiologists, surgeons and physicians.

Keywords. Hospital, Hospital Information Systems, Electronic Medical Records, Ergonomics.

Introduction

The implementation of Healthcare Information systems, such as Computerized Physicians Order Entry (CPOE), Clinical Information Systems (CIS) or Electronic Medical Records (EMR) and, more recently, Hospital Information System (HIS), is supposed to have various benefits for the medical practices, as providing easy access to documentation of patients records and accurate them \cite{1}, billing management \cite{2}, reducing potential medical errors \cite{3}, and improving the quality of patient care \cite{2}.

However, previous studies have shown the use of HIS has led to unintended consequences in the actual work practices, such as increased documentation time \cite{4, 5}, incompatibility with clinical workflow \cite{6}, increasing more interruptions in medical work \cite{5} and system-introduced errors in patients care \cite{5}.

How can we explain the gap between the expected benefits and the conclusions of these different studies? We suggest an explanation related to the fact that the perceived utility and the perceived ease of use are not taken into account by the management during the post implementation stage. We base this idea on a survey driven in a French University hospital using a HIS. This survey provides new insights into the perceived utility and ease of use in order to propose improvement actions of the HIS.
1. Theoretical framework

The concepts of perceived usefulness and ease of use are the main concepts of the Technology Acceptance Model (TAM) [7], which is considered a “gold standard” in the research on the evaluation of the information systems [8]. Perceived ease of use (PEOU) refers to “the degree to which a person believes that using a particular system would be free of effort” [9]. Perceived usefulness (PU) is defined as “the degree to which a person believes that using a particular system would enhance his or her job performance” [9].

TAM was developed in the 1980’s, in order to enlighten the factors that shaped one’s intentions to use an Information Technology (IT). Organizations would manipulate those factors for increasing acceptance, and thus increase IT use. This model states the perceptions (which are utility and ease of use) and attitudes (acceptance) of users can predict the intention to use technology [8, 9]. Several criticisms have been made to the TAM. They point to:

- Parsimony concerning categories and their too generic definitions [10] although extensions of this model have tried to take into account this review.
- TAM is based on binary variables and it was studied especially in connection with simple technologies [11]. More generally, adoption is envisaged as a binary mode: an individual uses or uses not the technology. However, complex information systems, including Enterprise Resource Planning (ERP), give rise to more or less advanced uses. Some functionalities may be used, while others not.
- TAM was designed and principally used to evaluate the intention to use in voluntary contexts, but the ERP uses are mandatory in organizations.

For these reasons, we believe that TAM is not suitable for understanding the HIS acceptance specifically in a context where its use is mandatory.

Furthermore, previous research in the healthcare based on the TAM use and focused on physicians, have found a positive relationship between perceived utility and acceptance but a non-significant relationship between ease of use and acceptance or ease of use and intention to use [8].

Nevertheless, we do believe that the key concepts of the model are relevant to assess users’ perceptions and we propose to gather quantitative measures of these items. Besides, the quantitative measures cannot provide explanations about their rates and identify problems incurred on the daily use of HIS. For this reason, we propose to evaluate also the users’ opinions about the use of HIS.

2. Research method and design

2.1. Context

The survey was conducted in a large French University hospital. The target was composed by the care staff (8,000 employees), including anesthesiologists, physicians, surgeons, medical secretaries, nurses, auxiliary nurses, midwives, residents, physiotherapists, social workers, pharmacists. The aim was to measure the users’ perceptions related to the daily use of the HIS, 18 months after the HIS implementation. This information system incorporates computerized physicians order entry, medical
and nursing observation, laboratory tests results, medical prescription, operating room process management, planning and billing management.

2.2. Method

We designed a questionnaire based on the items of perceived utility and perceived ease of use tested by Chau & Hu in the health sector [12]. All items were measured in a 7-point Likert's scale, with 1 as strongly disagree and 7 as strongly agree. We added two open questions in order to investigate users’ perceptions about the advantages and the disadvantages of this information system.

This questionnaire was sent for pre-test to a panel of 20 volunteers. This pre-test and adaptation of the questionnaire prevented the definition of indicators according to the representations of researchers and thus allowed the contextualization of the issues [10].

The questionnaire was developed and administered online to the care staff, during the month of December 2013. 1,942 questionnaires were collected.

We use the across-method triangulation [13], consisting in the combination of three methods:

- Statistical correlations of the responses to the closed questions, which were assessed by Chi-Square test, using the Sphinx software;
- Content analysis using Alceste, a French textual data analysis software;
- Content analysis of the open answers, which were coded independently by two researchers (the reliability was measured by the kappa coefficient).

3. Results

We found a very strong correlation of all the items with occupations

- Item Perceived Ease of Use (PEOU)
  chi2 = 160,48, ddl = 30, P< 0.01, Cramer’s V : 20,42%
  48% of the health care staff agree (vs. 35% disagree). The majority of anesthesiologists (61% disagree, 25% agree), of physicians (56% disagree), of midwives (55% disagree) and of surgeons (52% disagree) and the half of nurses disagree with the statement “the HIS is ease of use”. At the opposite, the medical secretaries (50% agree) consider the HIS is ease of use.

- Item Perceived Utility (PU)
  chi2 = 168,61, ddl = 30, P< 0.01, Cramer’s V : 19,65%
  The medical staff consider the software is useful or very useful (42% agree or strongly agree, vs. 34% disagree). Besides, nurses (30% agree or strongly agree), midwives (32% agree or strongly agree) and anesthesiologists (38% agree or strongly agree) have the lowest rate of PU. In contrast, pharmacists (71% agree or strongly agree), medical secretaries (63% agree or strongly agree), residents (61% agree or strongly agree) and nurses managers (57%) state the software is useful or very useful.

Furthermore, we identified 4 classes of speech by the Alceste software:
Class 1 (majority) "Treatment plan". At the center of this class are prescription and treatment plan, related to the difficulty to understand the computerized prescription and treatment sheet, which may lead to errors of treatment.

Class 2 "Lack of ergonomics". These speeches are related to the ergonomics software, considered as flawed. Some users describe as "a disaster" loss of staff time to the detriment of his care tasks. Software bugs are also highlighted.

Class 3 "Reports and examinations". The speech emphasized reporting and planning modules, which are described as unusable, as well as the non-readability of biological results.

Class 4: "Find and view information". This class focuses on the difficulties of entering and viewing documents external to the University Hospital and the difficulty to find relevant information. Many people feel that the information is misfiled.

The difficulties related to the HIS may be classified into three categories, as follows:

- Software ergonomics. The HIS is viewed as a usability-faulty system. Overload of information on the screen drowns relevant information and increase the risk of error.
- Insufficient use of documentation rules in the clinical workflow and misfiled information driving to errors in patient care.
- Insufficient compatibility with the clinical workflow in the departments (e.g. Hematology, Emergency, Pediatrics and especially Psychiatry) and for different medical occupations (anesthesiologists, physicians, surgeons, midwives), because the possibility of settings and customization was not effectively made.

4. Discussion

The low score of PU and especially of PEOU for the anesthesiologists, the surgeons and the physicians may be explained by the answers to the open questions. Based on the first class of speech, we have to consider the prescription module as the key point of the HIS use. Three factors make it difficult to find the relevant information and, thus, drive to prescription errors, as assessed by the content analysis: the lack of ergonomics, the errors in the documenting process associated to the misuse of indexation rules for patients’ files and the insufficient compatibility to the clinical process for each medical department. In this context, anesthesiologists assesse the lowest score of PEOU because they are the clinical occupation for which the medical error (especially prescription error) may have the most rapid dramatic consequences. Basically, anesthesiologists, physicians, surgeons and midwives are the most concerned by this point, contrary to the medical secretaries.

Each factor, i.e. ergonomics [14], errors in the documenting process [1, 4] and the insufficient compatibility with specific medical process [4, 5], were identified in the literature as a medical error risk. Our mixed method shows these factors are very connected. Furthermore, ergonomics and usability, correlated to a low rate of PEOU, are a key point, in contrast with studies suggesting physicians’ ability to learn to use the technology by themselves [15] and their relative disinterest in usability.
5. Conclusion

Our study showed perceived usefulness and ease of use are correlated to medical occupations. Furthermore, it outlines three main points that may explain this correlation: ergonomics, errors in the documenting process and insufficient compatibility with specific clinical care process. Generally, information systems are implemented according to a standard vision of the workflow. Our research results suggest that the HIS have to be settled and customized taking into account particular clinical care process. In addition, these results can help planners, managers and healthcare software editors to understand key considerations affecting HIS perceptions and use.

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