Can Ease of Use and Usefulness perception be influenced by physicians characteristics in the adoption of technology innovations?

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Abstract

Ease of use and Usefulness are the two attributes of Technology Acceptance Model – TAM. These attributes are the basis of this article that comprises the results of a survey with 221 physicians located at Santa Casa de Misericordia de Santos - SCMS, in the state of São Paulo, Brazil regarding the use of an innovation technology tool like Electronic Medical Record. The method was based on a questionnaire specially developed for this study, based on the literature review and the results show that the younger and the newer to the profession, besides those who began to use voluntarily and those who had academic preparation to use this kind of tool showed greater perception of both attributes, what led them to a faster adoption of Electronic Medical Record and its funcionalities like clinical decision support and big data. It was also identified that gender, amount of training and instructors do not influence the perception of attributes leading to adoption, but the familiarity with informatics influence the perception of ease of use as though as professional ties influence the perception of usefullness.

Keywords: Electronic Medical Record, Technology Acceptance Model, Sociological behavior.

Introduction

The Technology Acceptance Model – TAM was developed by Fred Davis and indicates the existence of two attributes: ease of use and usefulness, which, when perceived by the users, induce a behavior leading to the adoption of the technological innovation.

Usefulness is the perception an user has that the technology presented may help him or her to better perform their work and ease of use is the degree to which a person perceives being able to use a particular innovation with minimal effort to learning and adaptation. (Davis, 1989)

Davis points out that external variables to an information system, such as: system features, co-workers influence and achievement of goals, lead to the perception of these attributes.

TAM has been improved with the contributions of Venkatesh, in 2000 and Venkatesh and Bala, in 2008, who added inductive motivations to the usefulness perception, such as: professional image, job relevance,

output quality and results demonstrability. (Venkatesh, et al., 2000), (Chuttur, 2009)

Neumeier (Neumeier, 2013) reports that, despite the benefits gained with innovation technologies such as EMR, its adoption has been slow and highlights that there are many potential barriers to its implementation, with the most notable being the ones related to the change management.

This article aims to present the results obtained in a survey performed on the physicians working at Santa Casa de Misericordia de Santos - SCMS, in the state of São Paulo, Brazil, to gather their perception regarding the use of EMR based on the attributes of the Technology Acceptance Model, because, although physicians have been gradually adopting this kind of tool, not all of then know how to obtain the best from it. Features such as clinical decision support, data collected from wearables and artificial intelligence are underused and can be better explored if the different characteristics of physicians in the perception of ease of use and usefulness are considered.

Objectives

This study aims to identify the perception of physicians at SCMS regarding to the two attributes of TAM. SCMS was founded in 1543 and is the largest hospital in its metropolitan region. It receives patients from the nine cities that compose the region and also from adjoining cities; it has about 660 beds; more than 3,600 professionals and a clinical body of 480 medical doctors, being a reference in traumatology, cardiology, nephrology and ophthalmology. (Santa Casa de Misericordia de Santos, 2015)

This hospital was chosen for this study due to its characteristics and its similarity with other healthcare facilities linked to the Brazilian Confederation of Santas Casas de Misericordia, Philanthropic Hospitals and Entities – CMB, which includes about 1,787 institutions with similar characteristics and which may benefit from the obtained results.

The Electronic Medical Record system was adopted in February, 2006 and its use became mandatory from August of the same year. Currently it is available for all the hospital departments, although not all the functionalities are fully in use.

Materials and Methods

This explanatory study aims to identify the correlations between the variables: age, gender, time from graduation, time working at SCMS , degree of familiarity with informatics, mandatory usage, professional ties, length of training, instructors involved and academic preparation, and the attributes of Technology Acceptance Model (ease of use and usefulness) by means of a quantitative approach, in order to discover if the perception of physicians using EMR, towards these attributes, are influenced by the former.

The 480 medical doctors included in the official listing of the SCMS clinical staff received a printed questionnaire and, among them, the ones who had an e-mail registered in the organization, received also an invitation to respond to the questionnaire, alternatively, on the Web. Banners were distributed to the places highly frequented by the physicians and, one month before the collection deadline, the Clinical Director sent out an official communiqué urging the physicians who still had not taken part, to participate on the final stage and fill the questionnaire. With these actions the response rate was 46% (221).

The questionnaire was elaborated with multiple-choice questions based on variables collected on the

literature review. Divided in three parts, the first one serving to identify the respondent (4 questions), the second part was directed to the doctors who self-identified as users (18 questions) with the goal of characterize them and identify the facilitating and hindering factors perceived by these professionals in the use of the system, and the third part was directed to the ones who self-identified as non-users of the EMR (4 questions).

The questions of the second part were formulated affirmatively and graduated on the Likert scale in a numerical range from +2 (full agreement) to -2 (full disagreement).

After the 120 days of data collection period, the data went through a preparation that consisted on: 1. Complementation of information left blank; 2. Data entry and consistency check with the returned envelope count, and age and gender totals; 3. Preparation of data, due to requirements of the software used for analysis.

Once the data was prepared, the study advanced to the data analysis phase, considering first the identification of normal distributions for the definition of tests to be used. This first step was performed based on the Shapiro-Wilk normality test, which results ($p<0.05$), led to the use of non-parametric tests for the analysis of correlations between variables.

Therefore, Spearman Correlation tests were used to verify the relationships between quantitative variables, such as: age, time from graduation, time working at SCMS, degree of familiarity with informatics, length of training and the attributes of TAM. The tests resulting in p-value < 0.05 indicated the existence of the correlation between variables and attributes. The Spearman "S" complemented the results indicating if the correlation is positive, that is, the higher the characteristic indicator for the doctor, the higher the perception of the attribute.

For the verification of correlation between quantitative and qualitative variables with two groups, to wit: gender (male or female), mandatory usage (voluntary or mandatory) and instructors (yes or not), the Mann-Whitney test was used and the groups median indicated which of them tends to each end of the Likert scale. Finally, the Kruskal-Wallis test was applied for the verification of relationships between the quantitative and qualitative variables with three or more groups, to wit: professional ties (residents, outsourced personnel and employees) and academic preparation (at least one class or lecture, one class along one semester, no classes and "I don't remember"). The result was also measured based on p-value < 0.05, indicating the existence of a difference between the groups and the tendency for each group was examined based on multiple comparisons of p-value.

Results

Among the 221 respondents, 169 (75.47%) was self-identified as EMR users and 52 (23.53%) as non-users. The physicians that made up the sample are, on average, 48 years old, with 22 years since graduation and work at SCMS for 19 years. The majority (76%) are hired as freelancers or outsourced personnel, began to use the system voluntarily as soon as it became available (76%), after a single training session (67.4%) headed for the most part by the internal IT team.

A noticeable piece of data is that 72.7% of the physician users reported not having received even one class or lecture about electronic patient records in their graduate or postgraduate training, which is not surprising,

since Meade *et al.* (2009) remind that most of the current crop of physicians graduated before the arrival of this kind of system and graduation courses usually take a relative long time to adapt to the needs of the marketplace. (Meade, et al., 2009)

Analysis of the Correlation between Physicians Characteristics and TAM Attributes
For the comparison of the TAM attributes, the question indicative of complexity perception of the EMR use was formulated to identify ease of use and, considering that the term usefulness may be understood in a wide range, the question that indicated better treatment quality was formulated. The influence of each variable can be viewed below (Table 1):

Table 1 - Influence of physicians' characteristics on TAM attributes perception

	Age	Gender	Time from Grad.	Time at SCMS	Famil. w/ Inf.	Mand. use	Prof. ties	Length of Train.	Instruc-tors	Acad. Prep.
Ease of use	●	○	●	●	●	●	○	○	○	○
Usefulness	●	○	●	●	○	●	●	○	○	●

Legend: ● *Influences;* ○ *Do not influence*

The results of the correlation of variables age, time from graduation and time working at the hospital with TAM attributes indicated that the younger ones have a higher perception of the attributes, which means they tend to adopt HER earlier.

The gender variable has also not presented differences between groups, as well as the length of training and instructors responsible for training.

The correlation of the degree of familiarity with informatics to the attributes ease of use and usefulness yielded a value of $p<0.05$ only for the first attribute, indicating therefore that the most familiar ones have a higher perception of ease of use, while for the perception of usefulness the familiarity with informatics is not statistically significant.

Among the ones who started using voluntarily and the ones who started after it became mandatory, there are also perception differences. Although the medians have resulted in equal values (1.00), the difference can be observed on the averages. The ones who started voluntarily have a higher perception of ease of use and, regarding usefulness, seen from the view of patient care quality, the average of the ones who started voluntarily (1.12) compared with the average of the ones who started after it became mandatory (0.35) points to a higher perception of usefulness among the volunteers.

The three types of professional ties: residents, outsourced personnel and employees do not see a difference in the perception of ease of use, but perceive in different ways the attribute usefulness of the system. Considering the average of the postings, the residents have a higher perception of usefulness (134.0) than the outsourced (87.2) which, in turn, have a higher perception than employees (71.7).

Regarding the academic preparation for the use of an EMR system, the surveyed physicians perceive in different ways the attribute usefulness ($p<0.01$) and the mean rank indicates that the ones who had one or

two classes or lectures about the theme electronic medical records have a higher perception of usefulness (110.41) than the ones who didn't have any information during their period of graduation or post-graduation (79.49).

Discussion

In this survey, as previously mentioned, significant differences between genders were not observed, however, a study by Ma and Yuen (2006), regarding the perception of ease of use and usefulness by professors of both genders reported that women are influenced by both attributes in a balanced way, while men are more strongly influenced by the usefulness attribute.

With a lesser degree of similarity to this study, since it was based on the Theory of Planned Behavior, different results were gathered in a survey by Morris, Venkatesh and Ackerman (Morris, et al., 2005), in which the authors detected that the differences between men and women in the technology acceptance process accentuate with age.

The same authors highlight also that older women are more strongly influenced by social rules of their environment, a variable denominated on TAM 2 as Subjective Norm, while for men this factor has little influence.

Venkatesh and Morris (Venkatesh, et al., 2000), in a study with 342 workers who had initial contact with a new software, demonstrated that the usefulness perception is more accentuated on men, while the perception of ease of use is more evident to women.

Length of training, in particular, presented as little relevant for the perception of these attributes, which does not mean that the training is unnecessary, but just that the number of sessions has little influence on the perception, corroborating therefore study performed by Morton and Wiedenbeck (Mortom, et al., 2009) who also used TAM and Diffusion of Innovations as a theoretical basis for their survey and detected the influence of the training variable on the perceptions of usefulness and ease of use is not statistically significant.

Also reported low or no statistical significance the correlation between training and perception of ease of use and usefulness, Gadd and Penrod (Gadd, et al., (2000), in a survey with doctors after six months from the implementation of an EMR system, and Abdekhoda *et al* (Abdekhoda M, 2015) in a TAM-based survey in an Iran universitary hospital.

Another study performed in two hospitals, one of them in Brazil and other in Spain, by Farias *et al* (Farias, et al., 2011), detected that the higher the knowledge of informatics of the professional, the higher the chance for adaptation to the use of EMR. This result was confirmed by van der Meidjen *et al* (Van der Meijden, et al., 2001), who identified the previous experience with informatics as a determining factor for the acceptance of an EMR system. In the present study, considering that the perception of ease of use were more strongly observed by the users with higher degree of familiarity with informatics, it's possible to infer that these users tend more strongly to adhere to the use of this kind of system than the ones who do not have this perception.

Conclusions

As can be seen on Table 1, the IT Team has to pay attention on younger and newer at the institution, as well as those who began to use voluntarily and motivate them to influence their peers to the adoption of EMR. Other influencers must be those who have more familiarity with informatics, residents and outsourced personnel, that can integrate the training and deployment team. Important note is that the length of training does not interfere on physicians' perception towards both of TAM attributes, but cannot be discarded. Considering that the current study had as reference a single healthcare institution, its findings are limited to that institution. Nevertheless, since the beginning of the work it was known that other institutions have the same problems to disseminate the adoption of EMR and promote the use of all its functionalities and, surely, the results obtained will serve as a reference for these entities in other parts of the world.

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