Acceptance and Use of Electronic Medical Records in Sri Lanka

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Abstract- **Electronic Medical Record (EMR) provides means to create legible and organized recordings that allow access to clinical information about an individual patient. They are essential tool for improving the safety and quality of healthcare. However, despite emerging evidence about the benefits of EMRs, there are considerable barriers to acceptance and use. The slow rate of adoption suggests that resistance among physicians must be strong as they are the main front line user group of EMR system. It is important to study the physicians' perception towards accepting and using EMRs in the medical practices as they have a great impact on the overall adoption of EMRs in healthcare settings. This study attempts to identify the factors that affect the adoption of EMRs in the Teaching Hospitals of Sri Lanka. The study model is based on the Unified Theory of Acceptance and Use of Technology which has been used on several organizations of different industries to study the perception of users towards using new technology. The study is conducted on a randomly selected sample of physicians who serve at Teaching Hospitals in Sri Lanka. The results indicate that Behavioral Intention affects the Actual Use of the EMR while Performance Expectancy and Effort Expectancy significantly affect the Behavioral Intention of the physicians to use EMR system in the healthcare settings in Sri Lanka.**

Index Terms- **Adoption, Electronic Medical Records, Physicians, Teaching Hospital, UTAUT**

I. INTRODUCTION

Recording of patient information in many hospitals in developing countries has been on papers. The paper-based medical records are illegible, ambiguous, incomplete, unavailable, fragmented and poor in quality [1]. Laerum et al. cite that recording of patient information on papers impedes the continuity and quality of medical care offered to the patients [2]. Additionally, paper-based systems have limited functionality; many people cannot view the same record at the same time [3]. Patient records have been stored in papers for centuries and have consumed increasing space and notably delayed access to efficient medical care [4]. In contrast, Electronic Medical Record (EMR) stores clinical information of each patient electronically, enables instant availability of his medical information to all providers in the healthcare chain and assist in providing coherent and consistent care.

EMR supports medical professionals in the process of decision-making and improves operating efficiency, thus improving the quality of medical care [5]. In order to reduce medical errors, provide more effective methods of communicating and sharing information among doctors and better manage patient medical records; we need to embrace Information Technology to healthcare administration. Since paper records can be easily lost, misplaced or often illegible, the use of technology to record information electronically eliminates many of these issues and lead to major improvements in the health and safety of patient care [6].

EMRs are computerized Medical Information Systems that collect, store and display patient information. They are means to create legible and organized recordings and to access clinical information about individual patients. Further, EMRs are intended to replace existing paper medical records which are already familiar to practitioners [7]. The perceived advantages of EMRs can be summarized as optimizing the documentation of patient encounters, improving communication of information to physicians, improving access to patient medical information, reduction of errors, optimizing billing and improving reimbursement for services, forming a data repository for research and quality improvement, and reduction of paper [8]. EMRs are viewed as having a great potential for improving quality, continuity, safety and efficiency in healthcare, they are being implemented across the world.

Despite the high expectations and interest in EMRs worldwide, their overall adoption rate is relatively low and they face several problems [9]. For instance, they are seen as contrary to a physician's traditional working style, they require a greater capability in dealing with computers and installing a system absorbs considerable financial resources [10]. Although, the complete EMR system does not currently exist in Sri Lanka, portions of the medical records are being computerized. Kulathilaka cites that the government hospitals focus on automating the in and out patient care units [11]. The most commonly available computerized function is issuing the tokens/passes, briefing of required tests to be done and reporting of laboratory results.

II. RESEARCH PROBLEM

A large number of commercial and open source medical record systems already cater to the need for EMRs worldwide. The implementation and use of EMRs has become high priority for healthcare providers, organizations, and government agencies. Developers of such systems report that many of these implementations are successful, and that their services have improved tremendously after the adoption of EMRs. However, there has been little interest in leveraging the success of EMRs in Sri Lanka. The attempts to incorporate computer-based solutions and electronic communication into the healthcare settings in Sri Lanka could not be sustained.

According to Meinert, the slow rate of adoption suggests that resistance among physicians must be strong as they are the main frontline user-group of EMRs [12]. It is obvious that physicians have a great impact on the overall adoption of EMRs within the practice environment. As it requires physicians to actively support and use EMRs, to benefit from them, it is essential to understand the potential factors that affect the adoption of such systems. Although there is already a body of literature on such factors, there has been no systematic overview of these studies that are underpinned to a well-established theory. There has been no study that analyzed the perception of physicians in Sri Lanka regarding the acceptance and use of EMRs. Thus, this study focuses on identifying the factors that affect the adoption of EMRs by the physicians who work at Teaching Hospitals in Sri Lanka by using a well-established theory in the Information Systems research community.

Although the government of Sri Lanka runs different types of hospitals such as National Hospital, Teaching Hospitals, Provincial General Hospitals, District General Hospitals, Base Hospitals of type A and B, Divisional Hospitals of type A, B, and C, Primary Medical Care Units, Dispensaries and Maternity Homes, only Teaching Hospitals are selected for this study. The reason for selecting the Teaching Hospitals is that they widely deal with any type of disease. Therefore, in general they provide variety of services through different units. It is desirable to have EMRs accepted in such service providing organizations as there could be one individual who is undergoing treatment from different units of a hospital and his medical records need to be preserved and exchanged among different units within or between two or the hospitals.

III. OBJECTIVES

The study is underpinned to the Unified Theory of Acceptance and Use of Technology (UTAUT). It mainly focuses on studying the physicians' perspectives on each variable that measures a particular construct which is described in the theory. Thus, the main objective of the study is to identify the factors that affect the adoption of EMRs by physicians in Teaching Hospitals of Sri Lanka. The sub objectives are:

- To assess the association between the variables that measure:
    - Behavioral Intention and Actual Use of EMRs
    - Facilitating Conditions and Actual Use of EMRs
- To measure the strength of the relationship between constructs
- To determine the factors affecting Behavioral Intention
- To determine the factors affecting Actual Use of EMRs

The study focuses on adding knowledge to the existing literature on how well the country keeps pace with the technology advancement in health sector by adopting EMRs into its prevailing healthcare systems.

IV. THEORY

A wide body of literature focuses on identifying factors affecting people's intentions to use new technologies and how these intentions predict actual usage [13]. At present, many user acceptance models with different determinants are created to measure the user agreement of Information Systems [14]. Venkatesh et al. proposed and tested a comprehensive model called UTAUT to measure the variety of perceptions of Information Technology innovation. The theory aims to explain the user intentions to use a new computer technology and related usage behavior by integrating significant elements across eight prominent user acceptance models, and formulates a unique measure with core determinants of user behavioral intention and usage of a technology in place. The theory is developed though a review and consolidation of eight theories that were used in the literature to explain the behavioral patterns in using a new technology. The eight underlying theories are: Theory of Reasoned Action, Technology Acceptance Model, Theory of Planned Behavior, Motivational Models, Combined Theory of Planned Behavior and Technology Acceptance Model, Model of Personal Computer Utilization, Innovation Diffusion Theory and Social Cognitive Theory. UTAUT suggests four core constructs such as Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions as determinants of acceptance and use of technology. Gender, age, experience, and voluntariness are the moderating factors [15].

V. RESEARCH MODEL

This research uses UTAUT model to study acceptance and use of EMRs by physicians in Teaching Hospitals of Sri Lanka. In accordance to UTAUT model, four major factors such as Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions influence the adoption of the system. The study does not consider the moderating effect of gender, age, experience, and voluntariness due to the fact that the adoption is mandatory and the moderators cannot be controlled. Therefore, few alterations are made to the original model to suit the context.

The model can be viewed as 2 sub modules:

Model A: Determination of factors that affect Behavioral Intention
Dependent variable: Behavioral Intention
Independent variables: Performance Expectancy, Effort Expectancy and Social Influence
Model B: Determination of factors that affect Actual Use
Dependent variable: Actual Use of the system
Independent variables: Behavioral Intention and Facilitating Conditions

The following hypotheses formulated for this study:
H1: Performance Expectancy affects user's Intention to use EMRs.
H2: Effort Expectancy affects user's Intention to use EMRs.
H3: Social Influence affects user's Intentions to use EMRs.

H4: Facilitating Conditions affect user's Actual Usage of the system.

H5: User's Behavioral Intentions to use an EMR system affect the Actual Use of such system.

VI. METHODOLOGY

Participants and setting:

The study is limited to the physicians working at Teaching Hospitals in Sri Lanka. All 21 Teaching Hospitals are put into 6 groups based on the services offered, permitting the study to cover hospitals that provide different kind of services and also located in different provinces and districts. Even though, approximately 6400 physicians are employed in all Teaching Hospitals, not all units of the hospitals are equipped with an EMR system, and not all physicians who are employed in these Teaching Hospitals are using EMRs. Therefore, the population of interest is 505. This count is based on the approximate value provided by the Medical Officer – for Planning of a particular Teaching Hospital, at the time of data being collected.

Sample:

The sampling is done in two levels. First, the unit and the physicians who are exposed to the EMRs are identified through Snowball Sampling techniques. From that group, physicians are randomly picked for this study. The precondition is that the hospital has at least one unit that uses EMR.

Data collection and analysis:

Questionnaire is used as the tool to collect data from the respondents. The questionnaire consists of 33 self-administered questions, in which 24 questions reflect the UTAUT concepts. Each question is measured using a five point Likert scale where, 1 corresponds to strongly disagree, 2– disagree, 3– neutral (neither disagree nor agree), 4– agree and 5– strongly agree. Constructs and statements relevant for the study are adopted from Venkatesh et al. (2003) and modified to suit the research context. The questionnaire is developed only in English. 270 questionnaires are distributed among the selected sample of physicians, 249 responses are received. However 12 questionnaires have been rejected due to the missing values found in the questionnaire related to the major constructs. This indicates the response rate as 87.7%, which is fairly high. Data is collected from December 2014 to March 2015 and analyzed using SPSS 20.

Chi- square test, correlation test and regression analysis are performed to identify the factors that affect the adoption and use of EMRs by physicians at Teaching Hospitals in Sri Lanka.

VII. FINDINGS

The sample is gender balanced as it has 51.5% males and 48.5% females. 33.8% of respondents represented the Consultants while 66.2% represented Medical Officers (General Physicians and Medical Interns). The constructs in this study yield the Cronbach's Alpha values, such that confirming a high level of reliability for the construct with this specific sample, as their respective statistics fall well above 0.70. Therefore, all constructs in the model have adequate reliability.

It is evident that the physicians believe using EMRs will help them attain gains in job performance. The value of the Performance Expectancy construct is computed using the average of variables which relates to usefulness of the system, job-fit, productivity of the care provider and quality of service. At the same time, closely 80% of physicians agreed that the

system is easy to use. Average value of the variables relating ease of use and perceived ease of use yield the value for the Effort Expectancy construct. Also, the physicians believe that important others believe that they should use the system in their medical practice. The external pressure towards using a new system could be possibly from the hospital administration or peer. It could also be due to the fact that the hospitals give importance to the services driven by technology. Similarly, the physicians agree that the resources and technical support is available to use the EMR in their workplace.

The outcome indicates that in general, physicians are using the EMR system that is implemented in the hospital. However, it is important to note that there are considerable number of individuals (less than 20%) who are reluctant to use the EMR. Actual use in this context is provided by calculating the average of values for extensive use, regular use and user's opinion on the existence of the system. Therefore, it is important to see how data is distributed on each of the variable of interest. User opinion refers to the perception of the user on the existence of the EMR concept. A higher value (4 being agree and 5 being strongly agree), represents that the physicians believe that implementation of EMR is a good idea. Even though, more than 80% of individuals believe that having an EMR is good, a considerable number of individuals think that implementing or using such system is useless. This perception affects the regular usage of EMR in the medical practice.

The Mann-Whitney U test is performed to understand the actual use of the EMR system differs with gender i.e., the dependent variable being actual use of EMRs and independent variable being gender, which has two groups: male and female. The test results indicate that there is difference in the actual usage of the system for males and females. At the same time, the actual use behavior is checked among the Consultants and other Medical Officers (General Physicians and Medical Interns). The test statistics indicate that the actual use of the system is different among Consultants and Medical Officers too.

In this study, Kruskal-Wallis test is used to understand whether actual use of EMRs differs among individuals of different age groups. The results indicate that the actual use of EMR differs with the individuals of different age groups. However, this test cannot tell which specific groups of the independent variable are statistically significantly different from each other; it only tells that at least two groups are different.

As the main objective of this study is to determine the factors that contribute for the adoption and use of EMRs by the physicians at the Teaching Hospitals in Sri Lanka, it is important to carry out a test that measures the constructs Behavioral Intention, Facilitating Conditions and Actual Use. For this purpose a Chi-square test is conducted. The research model suggests that the Behavioral Intention and Facilitating Conditions are the factors that affect the adoption and actual use of the EMR system. Intention to use the system within next 6 months (B1), Intention to use the system continuously in the future medical practice (B2) and Intention to use the system to improve the job performance (B3) are the items that measure the major construct Behavioral Intention. Similarly, the other major construct Facilitating Condition is measured using the items such as Availability of hardware/software/network resources (F1), Presence of required knowledge (F2),

Availability of technical support (F3), Existence of policies/regulations/protocols (F4) and Provision of adequate training for employees (F5). The Actual Use of a system is measured through the items such as Extensive use of the system (A1), Regular use of the system (A2) and the User opinion (A3) on having EMR system.

The Chi-square test is used to check whether there is statistically significant association between variables. The results is that the variables B1, B2, B3, F1, F2, F3, F4 and F5 are associated with the variables A1, A2 and A3; considering a pair at any given time.

Scatter plots are drawn to show the association between constructs mentioned in Model A and B. All plots indicated a positive slope. The Pearson's correlation test was conducted on these pairs to measure the strength and direction of association that exists between two constructs. The test results suggest that the correlations are significant, $p < 0.05$ in all cases; confirming all hypotheses constructed for this study. The Pearson's Correlation value for the constructs in this research model is high and positive.

To identify which constructs exactly predict the behavior of the other, the Regression test was carried out. There are two models that are tested under this domain.

Model A: Determination of factors that affect Behavioral Intention
Dependent variable: Behavioral Intention
Independent variables: Performance Expectancy, Effort Expectancy and Social Influence
Model B: Determination of factors that affect Actual Use
Dependent variable: Actual Use of the system
Independent variables: Behavioral Intention and Facilitating Conditions

Outcome for Model A indicated that only Performance Expectancy and Effort Expectancy significantly affect the Behavioral Intention to use the EMR system in the healthcare settings of Sri Lanka. Social Influence does not significantly affect the Behavioral Intention in the presence of Performance Expectancy and Effort Expectancy. Similarly, Model B is regressed and it provided evidence that only Behavioral Intention significantly affects the actual use of the EMR system.

Overall, it can be concluded that, Behavioral Intention affects the Actual Use of the EMRs; whereas, Performance Expectancy and Effort Expectancy significantly affect the Behavioral Intention to use the EMR in the Sri Lankan healthcare settings.

VIII. CONCLUSION

Despite the high expectations and interest in EMRs worldwide, their overall adoption rate is relatively low. This slow rate of adoption suggests that resistance among physicians must be strong as they are the main frontline user group of EMRs. This study attempts to identify the factors that affect the adoption of EMRs by the physicians who work at Teaching Hospitals in Sri Lanka. The study is underpinned to the UTAUT. In accordance to UTAUT, the study model is constructed reflecting the four major constructs such as Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions that influence the adoption of the system. The research model of this particular study can be viewed as two sub modules. One, a model that determines the factors that affect physicians' intention to use the EMR (Model

A) and the other, to determine the factors that affect the actual use of EMRs (Model B). The study is conducted on a randomly selected sample of physicians who serve at Teaching Hospitals in Sri Lanka. The results indicate that Behavioral Intention significantly affect the Actual Use of the EMR system while only Performance Expectancy and Effort Expectancy significantly affect the Behavioral Intention of the physicians to use the EMR system in the healthcare settings of Sri Lanka.

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