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User Acceptance of Electronic Health Records: Cross Validation of Utaut Model

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Abstract

With an increase trend in digitalization, e-health services playing a very significant role in today's economy. As Health service is considered to be the basic obligation or need to mankind, the demand for e-health services is augmenting in the past recent years. In most of the Western countries, health service is given prominence and everyone is insured. The birth rate of westernized countries was 12-13 births per 1000 population; infant mortality rate of India and United States reaches out to 44 and 6 people respectively and average life time is also considered to be very high when compared to India. When it draw closer to India the doctor patient ratio is said to be 1:1000 which means one doctor for every 1000 patients, yet it accounts for four lakh more of doctors by 2020. Most of multi speciality hospitals and health services are restricted to urban areas and there is a lot of scarcity in rural and interior areas. So use of technology would fetch more to the doctors in order to serve up the patients. Hence the study aims to identify the perception of doctors in adopting the usage of Electronic Health Records. According to Orhun M. Kök et al. (2011) applied qualitative study to identify the major factors that impinges on usage of Electronic Health Records by interviewing the doctors. In our quantitative study, we would like to empirically validate UTAUT model by administering the questionnaire to doctors in private hospitals to identify the factors that affects on usage of EHR to identify the purpose.

Keywords: e-Health services, Electronic Health Records, usage, UTAUT, Technology

Introduction

After independence during the first five year plan (1951-56) of India the state of public health is reflected in the wide prevalence of disease and the high rate of mortality "in the community as a whole and in particular among vulnerable groups such as children and women in their reproductive age period. A large part of this represents preventable mortality. It is estimated that in 1951 there were 8,600 medical institutions in the country with about 113,000 beds; in 1955-56 the number of institutions may be about 10,000 with about 125,000 beds. These figures represent an increase during the first plan of 16 per cent in institutions and of 10 per cent in beds. The doctor population ratio though satisfactory on an average in the country (1977), varies widely from 1 doctor for 8333 in Meghalaya to 1 doctor for 1400 in Delhi. The bed population ratio has also improved but varies widely in urban and rural areas. In the early 21st century new types of transplant were performed. In 2005 the first face transplant took place. Then in 2011 the first leg transplant was carried out. Finally in 2012 the first womb transplant was carried out. At present e-health services like Electronic Health Records, Clinical Decision Support, Telemedicine, Consumer Health Informatics, Knowledge management, m-Health and Health Care Information Systems are becoming prominent. And consecutively in the Eleventh Five Year Plan will provide an opportunity to restructure policies to achieve a New Vision based on faster, broad-based, and inclusive growth. One objective of the Eleventh Five Year Plan is to achieve good health for people, especially the poor and the underprivileged.

As on 1st March 2011, Indian population was 121 crore, out of which 83.3 crore(68.84%) live in rural areas while 37.7 crore(31.6%) live in urban areas, as per census of India. According to the Deloitte report of 2015, the estimation of expenditures allotted to this sector is five percent of Gross Domestic Product (GDP) in 2013 and it is anticipated to remain stable till 2016. In terms of infrastructure, India has only one bed for every 1050 patients and yet it accounts for 100000 beds at present decade with an investment of about $50 billion. The prevalent of computerized systems and Information Technologies in all the organizations has been enlarged spectacularly. In the late 1980's, 50 percent of investment has been invested in Information Technology (Westland and Clark, 2000). As technology adoption model carries a prominent role in the Information System literature, the user acceptance of this technology model is relatively higher.

Statement of the Problem

The access of healthcare services is not yet achieved fully in many developing countries, even though it is guaranteed for all people throughout the world. Particularly in rural area of developing countries are unable to access health care services. The report states that, doctor-patient ratio is considerably lower in India than World Health Organization statistical report the ratio of India is about 0.7 doctors and 1.5 nurses per 1000 people which is comparatively lower than 2.5 doctors and nurses per 1000 people. And it also lacks in qualified medical professionals to efficiently diagnose the diseases through proper delivery of services. As there is a scarcity

of doctors and nurses in India, opting for traditional method of services is seem to be not effective and difficult for patients to access to it. The problem also includes traditional consultation process which is very lengthy and time consuming in urgency cases, long distance travel times, improper and inefficient delivery of services and non technology up gradation in the past. All these factors contributed to the significant adoption of Electronic Health Records in India. Mary E. Mortan (2009) would like to know the doctors' perception on the acceptance of electronic health records and tried to identify the technical, social and individual characters influence on the technology adoption; tested on TAM model. The doctors' personal characters include age, experience, prior computer usage, health system affiliation and health system portal, where as social factors include management support, physician involvement, physician autonomy, training and doctor patient relationship. It was identified that there was acceleration in the usage of electronic health records due to government policy but the complexity in implementation should be properly understand. The developers should understand the requirements of the doctors and workflow. Unless and until the developers understand the clinicians and doctors the adoption of electronic health records cannot be promoted. As the study was conducted only on the doctors perspective the future study can be conducted from the perspective of other users of hospitals like clinical staff and nurses; the study tried to address the efficiency and workflow of clinicians from the doctors perspective using technology adoption model it can also be tested using unified theory of adoption and use of technology from the perspective of doctors, nurses and clinical staff. Emily Beth Devine et al (2010) studied about the strong inner feelings of doctors on the adoption of electronic health records in primary healthcare. The study covers finesse, intention to use, perceived usefulness and perceived ease of use and identified a shift from manual prescription to e-prescription. As per the changing environment and intentions to use is voluntary. Some problems identified during initial stages such as anxiety, hesitation, confusion, apprehension and usage of computer. The study is successful in recognizing the beneficiaries of technology adoption. The future study can be carried out on the requirements of doctors and staff.

Review of Literature

Anson O (1989) studied on gender differences in health and pattern of health services, and revealed that in developed countries women were utilizing almost all health services than men. Identified financial barriers to access to primary health care differed between genders.

Lynne P. Baldwin et al., (2002), investigates the challenges entail in human communication and illustrates how the information technology enriches the interactions between patients and among who were engaged in their health and finds out there is a difference in treating patients by doctors, specialists and consultants. In traditional method, they will treat the patients with extreme care and in this study they act as advocates. Further research can be undertaken to determine the nature of the communication and how effective it would be when it is supported by the technology.

David Gans et al (2005) et al studied about nationally representative sample of medical group practices to assess their current use of technology. The methods used to do it is by conducting survey of a random sample of a medical group about 34,490. The result of this suggests the adoption of electronic health records is progressing slowly in smaller practices than larger practices. Future research has to include interviews and case studies including spending time with clinicians, administrators and patients so that we can understand the problems faced by them.

INFORM PRIM CARE et al (2006) studied about e-health. It refers to organization and delivery of health services and information using the internet and technologies .Twenty participants from different profession were selected for an interview based on computer usage .Analysis of interview reported that primary health is better than e-health.

Micheal F. Chiang et al (2008) studied about assessing the current state of health record use by ophthalmologists including adoption rate and user satisfaction. Methods used were surveying the randomly selecting people based on geography to participate in a study of EHR adoption. Results from this are adoption rate of ophthalmology practices is low. The satisfaction of those who were already using is high. Future research has to be done on user satisfaction with electronic health recording systems.

Ward R Stevens (2008) studied about the attitudes of health care staff to the development of information technology in practice. Methods used to do this research are twelve databases were searched for identifying research related to information technology. Result of this is the attitudes of practitioners is important in acceptance of IT practice and also suggests that education and training was a factor for encouraging the usage of IT systems. Further research should done qualitatively and quantitatively into the approaches.

Anant R Koppar et al (2009) predicts that operation of Electronic Health Records would result in failure as due to intricacy in usage of this system. It can also suggest that the quality of health care services is ameliorated by using Information Technology. This failure rate is due to the improper maintenance of patient's records which results in ineffective treating of patients by the doctors. The study also identifies that traditional method is opted for maintaining patient's record in tracking in the course of patient history. Employable Electronic Health Record (EEHR) systems can be practised in rural areas as it offers basic functionality of the system which stimulates the doctors to use the system effectively in order to serve in rural patients. The study proposes EEHR work flow solution to improvise health care delivery.

Mary E. Mortan (2009) would like to know the doctors' perception on the acceptance of electronic health records and tried to identify the technical, social and individual characters influence on the technology adoption; tested on TAM model. The doctors' personal characters include age, experience, prior computer usage, health system affiliation and health system portal, where as social factors include management support, physician involvement, physician autonomy, training and doctor patient

relationship. It was identified that there was acceleration in the usage of electronic health records due to government policy but the complexity in implementation should be properly understand. The developers should understand the requirements of the doctors and workflow. Unless and until the developers understand the clinicians and doctors the adoption of electronic health records cannot be promoted. As the study was conducted only on the doctors perspective the future study can be conducted from the perspective of other users of hospitals like clinical staff and nurses; the study tried to address the efficiency and workflow of clinicians from the doctors perspective using technology adoption model it can also be tested using unified theory of adoption and use of technology from the perspective of doctors, nurses and clinical staff. The objective of this study was to determine the individual characteristics and the social and technical factors that may contribute to physician acceptance of EHRs.

Emily Beth Devine et al (2010) studied about the strong inner feelings of doctors on the adoption of electronic health records in primary healthcare. The study covers finesse, intention to use, perceived usefulness and perceived ease of use and identified a shift from manual prescription to e-prescription. As per the changing environment and intentions to use is voluntary. Some problems identified during initial stages such as anxiety, hesitation, confusion, apprehension and usage of computer. The study is successful in recognizing the beneficiaries of technology adoption. The future study can be carried out on the requirements of doctors and staff.

Holden, R. J., & Karsh, B. T. (2010) stated that the use of electronic health records and telemedicine was tested on technology adoption model from the perspective of doctors, nurses and clinical staff and the need to be tested on extended model TAM i.e. UTAUT.

Praveen Kumar Kannoju and K.V.Sridhar,Prof K.S.R Prasad, (2011) this paper introduces the innovative concept of developing an efficient Electronic Health Record (EHR) used to implement Telemedicine by utilizing the advances made in both Information technology and Communication systems. This application acts as a bridge between skilled doctors and the rural people. Computer based patient record is likely a solution to be looked at to avoid problems due to lack of proper knowledge about a patients medical history. Electronic Medical Record (EMR) is a solution to such a problem. It was initially limited to large organizations, but it has improved the doctor patient ratio drastically. This record has also reduced the number of health risks and the number of patients thereby decreasing the number of the doctors needed. The EMR's contain information such as observations, laboratory tests, and diagnostic imaging reports, treatments, therapies, drugs administered, patient identifying information, legal permissions, and allergies. Currently, this information is stored in various proprietary formats through a multitude of medical information systems available on the market. This system is thus interoperable. Transferring patient information automatically between care sites will speed delivery and reduce duplicate testing and prescribing. Automatic reminders will reduce errors, improve productivity, and benefit patient care.

Carolyn S. Harmon et al (2012) studied about the use of Electronic Medical Record should be educated among nurses. They are recommended to improve their communication skills and the use of Electronic Medical Record should be practiced by nurses and the analysis of results a risks and safety should be educated to nurses survey was conducted to gain knowledge on nurses' perceptions of an electronic health record. This study was performed at 165 hospitals. Results shown that implementation of an EHR informs recommendations for clinical decision which supports within the organization and the future research has to be undertaken on time motion of the study.

Randike Gajanayake et al (2013) examine how perceived usefulness and attitude persuades the overall acceptance of using Electronic Health Records by health care professionals and they found there exists an intricate relationship when compared with the past research. It also shows a curvilinear relationship between perceived usefulness and attitude on the intention to espouse to the system and attitude moderately mediates the association. Further research can be done on the student perspective prior and post exposure of using EHR systems and also to make a comparison on the result acquired with the current study result attained by health care professionals.

Parvin Lakbala and Kavoos Dindarloo (2014) revealed that the healthcare efficiency, healthcare service quality and satisfaction of patients can be achieved through electronic health records technology implementation. The success in terms of improved service delivery and improved monetary growth of the system depends on the proportion of usage of technology by doctors. Out of the total 133 respondents majority of the doctors stated that overall practice quality, work life quality and productivity of healthcare will increase through usage or implementation of electronic medical records. It was also emphasized significantly that the diagnosis entry, prescribing medicines, regular alarm/alerts regarding medicines and drugs and proper dosage monitoring can be done efficiently. The entire world is worried about providing quality healthcare accessibility, it can be achieved with less doctors or available doctors for less cost, but it can be successfully adopted when there is a support from the others, organizations and government policies.

Research Question

What is the relation that the performance expectancy, effort expectancy and social influence have on behavioural intentions and relationship of facilitating conditions on usage as well as the impact of behavioural intention on usage from doctor's perspective?

Research Objective

To find out the significant relation that the performance expectancy, effort expectancy and social influence have on behavioural intentions and relationship of facilitating conditions on usage as well as the impact of behavioural intention on usage from doctors perspective.

Hypothesis

H_1: There is a significant impact/relation of performance expectancy, effort expectancy and social influence on behavioural intention and facilitating conditions influence on usage and behavioural intention impact on usage among doctors (UTAUT Model -Venkatesh et al, 2003).

Research Methodology

The type of research employed in this study is descriptive research as it describe factors influencing the usage of Electronic Health Records of doctors. As it is an adopted structured instrument from Venkatesh et al., (2003) exploratory factor analysis is not applied but, the dimensions in questionnaire were tested for the reliability and validity with the appropriate statistical techniques. The validated constructs of performance expectancy, effort expectancy and social influence and their effect on behavioural intention and usage behaviour as well as facilitating conditions effect on usage behaviour were empirically examined. The hospital employees especially doctors are the sampling units for the study. In particular doctors, technical/clinical staff and nurses from Vellore District in Tamilnadu have been selected s the sampling unit for the study. Healthcare sector has been chosen as the study purpose of the research. A sample of 770 for doctors were contacted for elucidating their responses, out of which 537 doctors willingly filled up the questionnaire after filling the missing values with mean series all the respondents have been chosen for the final study. Purposive sampling is espoused as the study undertaken in doctor's perspective and the data were collected from the doctors from specified hospitals in Vellore district.

In the present research, compiles of both primary as well as secondary data sources. The secondary data sources include database of referred journals from Emerald publishers, EBSCO, IEEE, MIS quarterly etc. other secondary data sources like government reports, conference proceedings and other sources. The primary data associated to the demographic and the perceptions of respondents on performance expectancy, effort expectancy, social influence, facilitating conditions, behavioural intention and usage behaviour of electronic health records were collected by administering through structured questionnaire with doctors of Vellore District – Vellore, Ambur, Ranipet, Walaja etc.

Demographic Details of the Doctor's

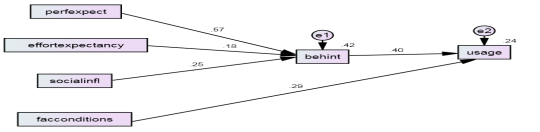
Table 1: Socio demographic profile of the participants

Demographic Details of Doctor's		Number of Participants (537)	
		Freq.	%
Gender	Male	188	35
	Female	349	65
Age	20 – 25	453	84.4
	26 – 30	65	12.1
	31 – 35	10	1.9
	36 – 40	9	1.7
	41 – 45	-	-
	46 – 50	-	-
	Above 50	-	-

Experience	0-5	489	91.1
	6-10	30	5.6
	11-15	9	1.7
	16-20	9	1.7
	21-25	-	-
	26-30	-	-
	Above 31	-	-

Table 1 shows the demographic details of the doctors in the health care services. Out of five hundred and thirty seven appropriate responses 65 per cent (349) are female doctors and 35 per cent are male doctors (188), belongs to the age group of between 20-40 years. The greater part of the respondents is from 20-25 years (84.4 per cent) and 26-30 years (12.1 per cent) age group. The other age groups are from 31-35 years (1.9 percent), 36-40 years (1.7 per cent) respectively. The experience/service in the medical field reported to be 91.1 per cent (486) with 0-5 years, 5.6 per cent (30) with 6-10 years, 1.7 per cent (9) with 11 – 15 years, and 1.7 per cent (9) with 16-20 years respectively.

Testing Model to determine the direct effect of doctors perceptions on performance expectancy, effort expectancy and social influence upon their behavioural intention as well as the effect of behavioural intention and facilitating conditions on usage behaviour.



Note: perfexpect = Performance Expectancy, effortexpectancy = Effort Expectancy, socialinfl = Social Influence, behint = Behavioural Intention, facconditions = Facilitating Conditions and usage = Usage Behaviour or Likely to Use.

Table Regression Weights: (doctors - Default model)

Regression Weights	Estimate	S.E.	C.R.	P
Behavioural Intention <--- Performance Expectancy	.517	.030	17.315	***
Behavioural Intention <--- Effort Expectancy	.209	.038	5.585	***
Behavioural Intention <--- Social Influence	.261	.035	7.496	***
Usage <--- Facilitating Conditions	.357	.046	7.732	***
Usage Behavioural <--- Behavioural Intention	.514	.049	10.599	***

Standardized Regression Weights: (doctors - Default model)

Standardized Regression Weights	Estimate (Beta Sig.)
Behavioural Intention <--- Performance Expectancy	.570
Behavioural Intention <--- Effort Expectancy	.184
Behavioural Intention <--- Social Influence	.247
Usage <--- Facilitating Conditions	.291
Usage Behavioural <--- Behavioural Intention	.398

Variances: (doctors - Default model)

Variances	Estimate	S.E.	C.R.	P
Behavioural Intention <--- Performance Expectancy	.585	.036	16.371	***
Behavioural Intention <--- Effort Expectancy	.372	.023	16.371	***
Behavioural Intention <--- Social Influence	.431	.026	16.371	***
Usage <--- Facilitating Conditions	.533	.033	16.371	***
e1	.280	.017	16.371	***
e2	.609	.037	16.371	***

Squared Multiple Correlations: (doctors - Default model)

Dependent Variables	Estimate (Combined Variance)
Behavioural Intention	.419
Usage Behaviour	.243

INTERPRETATION

[Behavioural Intention = (0.57*Performance Expectancy) + (0.18*Effort Expectancy) + (0.25*Social Influence)]

The above formula shows that one unit change in Performance Expectancy will result in 0.57 unit change in Behavioural Intention(Azen 1991; Davis et al., 1989; Fishbein and Azjen 1975; Matheisen 1991; Taylor and Todd 1995a, 1995b, Thompson et al., 1991;Moore and Benbasat 1991; Rai Zheng et al., 2005 and Syed Tabish R Zaidi, 2008; Venkatesh et al., 2003) , one unit change in Effort Expectancy will result in 0.18 unit change in Behavioural Intention and one unit change in Social Influence will result in 0.25 unit change in Behavioural Intention. It was found that all the three factors have positive effect on Behavoural Intention to accept and use of electronic health records and telemedicine. The R-Square value for Behavioural Intention is 0.42; it shows that 42 per cent of variance or performance in Behavioural Intention is together explained by these three Factors. It clearly shows that by bringing positive perception on the three factors can alone cause 42 per cent of Behavioural Intention to use electronic health records and telemedicine and among the three factors Performance Expectancy seems to be more important.

[Usage Behaviour = (0.29*Facilitating Conditions) + (0.40*Behavioural Intention)]

The above formula shows that one unit change in Facilitating Conditions will result in 0.29 unit change in Usage Behaviour (Ajzen 1991; Taylor and Todd 1995a, 1995b; Thompson et., 1991; More and Benbasat 1991) and one unit change in Behavioural Intention will result in 0.40 unit change in Usage Behaviour. It was found both the factors have positive effect on causing Usage Behaviour or likely to use behaviour (Venkatesh et al., 2003). The R-Square value for Usage Behaviour is 0.24; it shows that 24 per cent of variance or performance in Usage Behaviour is together explained by these three Factors. It clearly shows that by bringing positive perception on these two

factors can alone cause 24 per cent of Usage Behaviour on electronic health records and telemedicine and among the two factors Behavioural Intention seems to be more important.

All the variables are statistically significant at 5% level ($p<0.05$). From the standardized regression weights table the results of hypotheses are given below:

Determinants of Usage Behaviour	Beta (Sig.)	T - Values	P	Results
Behavioural Intention <--- Performance Expectancy	.570	17.315	***	Accepted
Behavioural Intention <--- Effort Expectancy	.184	5.585	***	Accepted
Behavioural Intention <--- Social Influence	.247	7.496	***	Accepted
Usage <--- Facilitating Conditions	.291	7.732	***	Accepted
Usage Behavioural <--- Behavioural Intention	.398	10.599	***	Accepted

Note: *** Less than 0.01 Significance Level and ** Less than 0.05 Significance Level

Results and Discussions

As per doctors; one unit change in Performance Expectancy will result in 0.57 unit change in Behavioural Intention(Azen 1991; Davis et al., 1989; Fishbein and Azjen 1975; Matheisen 1991; Taylor and Todd 1995a, 1995b, Thompson et al., 1991;Moore and Benbasat 1991; Rai Zheng et al., 2005 and Syed Tabish R Zaidi, 2008; Venkatesh et al., 2003) , one unit change in Effort Expectancy will result in 0.18 unit change in Behavioural Intention and one unit change in Social Influence will result in 0.25 unit change in Behavioural Intention. It was found that all the three factors have positive effect on Behavioural Intention to accept and use of electronic health records and telemedicine. The R-Square value for Behavioural Intention is 0.42; it shows that 42 per cent of variance or performance in Behavioural Intention is together explained by these three Factors. It clearly shows that by bringing positive perception on the three factors can alone cause 42 per cent of Behavioural Intention to use electronic health records and telemedicine and among the three factors Performance Expectancy seems to be more important. Again one unit change in Facilitating Conditions will result in 0.29 unit change in Usage Behaviour (Ajzen 1991; Taylor and Todd 1995a, 1995b; Thompson et., 1991; More and Benbasat 1991) and one unit change in Behavioural Intention will result in 0.40 unit change in Usage Behaviour. It was found both the factors have positive effect on causing Usage Behaviour or likely to use behaviour (Venkatesh et al., 2003). The R-Square value for Usage Behaviour is 0.24; it shows that 24 per cent of variance or performance in Usage Behaviour is together explained by these three Factors. It clearly shows that by bringing positive perception on these two factors can alone cause 24 per cent of Usage Behaviour on electronic health records and telemedicine and among the two factors Behavioural Intention seems to be more important.

Hospital Managements were reluctant in sharing the data. The current study was carried out to determine the doctor's perception on the usage of Electronic Health Records in Private hospitals of Vellore district. Out of the dimensions of UTAUT model, performance expectancy is said to have more significant influence on behavioural intention and in the point of usage of Electronic Health Records, behavioural intention has more significant impact on the usage dimension. This prediction helps doctors to update the health status of patients electronically and provide utmost care to the patients and in turn helps patients to ameliorate self care capacity to efficiently check and control diseases. The adoption of EHR in health care sector will augment the motivation and commitment of learning of end user in the usage of EHR system. The success of adoption of this system depends upon when the system meets the end user requirement.

Implications

The success of EHR implementation depends upon the positive mindsets of hospital employees which are to be bought by the management and collaboration in the employees to effectively work on the usage of EHR systems. The EHR systems can be effectively adopted in rural communities where people are lagging with basic hospitality facilities which reduces the costs of hospital visits, frequency of visits, saves time, and recording of patient's data electronically and effectively, privacy and security concerns will be ameliorated. This study benefits management to improve the security and privacy issues and helps doctors to effectively provide health care by using EHR systems to patients.

Conclusion

As this research was carried out in government and private hospitals of Vellore district, future study can be done on other sector and there is no generalization of findings, as the study was restricted to Vellore district. The electronic health records of health technologies were only studied and there are other ehealth technologies need to be tested. The perceptions of hospital employees towards acceptance and use of electronic health records was studied; the perceptions of pharmacists, medical representatives and patient's perspective can also be studied in the upcoming future. The relationships in UTAUT model was confirmed but the mediating and moderating variables can also identified and can test its validity from Indian context.

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