An exploratory study to identify the Drivers and Inhibitors for the use of Wireless Technology in Healthcare Setting: A case of Pakistan

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ABSTRACT

Among various technological developments, the use of wireless technologies is emerging rapidly in the developing and industrialized economies. Healthcare environment is no exception to this phenomenon, whereas the healthcare environments have unique characteristics and uptake of wireless handheld technologies in a healthcare environment is complex and exceptional. For example in healthcare environment, individuals are trying to save lives instead of making profit. Researcher in information systems domain agreed that use of wireless handheld technology in healthcare environment could improve quality of care, cost reduction, error reductions, and better quality of information. Awareness and use of information communication technologies (ICT) are on the rise in Pakistan and uptake of the wireless technology in healthcare environment is relatively slow. This paper present the initial finding of the data collected from Pakistani healthcare professionals regarding their opinions and views about the use of wireless handheld technology in healthcare environment. Total of 300 surveys were distributed and 97 useable surveys were returned, data was analysed through SPSS software. Factor analysis through SPSS analysis clearly shows that Pakistani healthcare professionals are concerned about the usefulness and outcome offered by the technology itself.

Key Words: Pakistani healthcare systems; adoption of wireless; use of wireless technology. PDAs; handheld computers
JEL Classification: I11; I12; O14

INTRODUCTION

Pakistan's ministry for healthcare has predicted that Pakistan is realising significant advantages from the emerging information economy. This is reflected in the recent infrastructure investment

and other technological developments. Despite this development, it appears that Pakistan is lagging behind in healthcare service provision. This may be due to the fact that Pakistan is slow to adopt wireless technology and this slow adoption can be attributed to the lack of management support, lack of training and perhaps lack of policies(Gururajan et al., 2005b, Lu et al., 2005, Gururajan et al., 2005a) the perceived lack of complexity and cost (Lu et al., 2005, Houston et al., 2003, Lu et al., 2003); sensitive nature of information and logistic involved in a healthcare facility (Eastes, 2001, Li et al., 2005); nature and type of risk involved (Davenport, 2005, Lu et al., 2003)pressure for high quality of care, high litigation cost and lack of infrastructure, the extent of integration with existing health systems(Li et al., 2005) and necessity for other resources to support technology infrastructure (Davenport, 2005, Lu et al., 2003).

Further, there is limited empirical research available into the adoption of wireless technologies in the healthcare system specific to Pakistan. While it is possible to find information on the technical and operational areas of wireless technology, there is limited empirical research on the areas relating to the factors that would lead to the successful adoption of wireless technologies applicable to Pakistan's healthcare industry. Therefore, any knowledge of these factors of adoption of wireless technology will help the healthcare administrators to develop appropriate policies in order to address the ever-increasing demands of heath services in Pakistan. This has given impetus to this study. The main research question asked in this study, thus, is:

What factors influence the use of wireless technologies for healthcare in Pakistan? This research does not study the decision making process for the use of wireless technology, rather it assumes that a decision has been made at some stage to use the wireless technology. While the decision to use is a preliminary phase only, the actual use may happen over a period of time. During this time, factors such as familiarity, infrastructure, cost, clinical process, quality of care, management support, policies and procedures, security, availability of appropriate wireless application, trust and knowledge of the technology will facilitate the adoption and hence the use.

Methodology

An examination of IS studies indicated that there is a necessity for a suitable research method, as has indeed been confirmed by (Straub, 1989) who called for new efforts to validate the instruments that IS researchers were using. In Boudreau and his team in 2001, (Boudreau et al., 2001), after a review of MIS Quarterly, Communications of the ACM and Information & Management over the period 1997 and 1999, published in MIS Quarterly (vol. 25, p1) the statement that 'findings suggest that the field (of IS) has advanced in many areas, but, overall, it appears that a majority of published studies are still not sufficiently validating their instruments'. Therefore, we felt that if technology issues were to be studied with respect to a specific domain, then user involvement with the technology issues forms a major part in establishing the factors influencing such a study. This was actually endorsed by (Rowlands, 2005) in the statement that '… knowledge is gained, or at least filtered, through social construction such as language, consciousness, and shared meanings (p.81)'.

The research question posited in this study dictates the need to have quantitative research methods, while the behavioral component of the same investigation dictates qualitative research

methods. In essence, to answer our research question, we require both methods. Qualitative methods will help us to understand the domain and the context in a practical sense. Quantitative methods will assist us to generalize our findings. The rationale for this approach is based on the notion that behavioral components require a thorough understanding of how users apply wireless technology in a given organizational setting in order to understand the behavioral issues. This is best extracted or accomplished by a qualitative approach, as we need to extract a number of 'tacit' aspects. A quantitative instrument then can be developed (from the qualitative data) to extract the quantitative aspects such as the opinion scores.

Considering the above, the suitability of one research method over the other had to be carefully weighed. Based on these, this study identified the exploratory approach to be suitable as an initial investigation. This approach is particularly favourable in confirming the direction of the study and the variables chosen for the study, as well as helping to refine the literature. The exploratory approach allows the researcher to eliminate irrelevant variables as they are identified and to include new relevant variables as they emerge.

Thus the principles of each method were applied to this study. The initial exploratory phase was borrowed from earlier research by one of the authors of this paper. The research was conducted using a qualitative approach to establish the direction for the study based on the Indian healthcare environment. Indian and Pakistani healthcare environments are very similar in the context of culture, social values, economic and ICT infrastructure. This was then followed up with a main study using the quantitative approach. The uniqueness of this approach is the development of the instrument from the qualitative interviews, using the statements provided by interview participants. This has provided relevance and reliability to our quantitative instrument.

Qualitative Data Collection & Results

As argued, the qualitative approach (individual interviews) was used to collect initial sets of themes for the adoption of wireless technology by the physicians in the Indian healthcare systems. For this purpose, the first stage of the data collection concentrated on randomly identifying 30 physicians from India with some form of wireless technology experience. They were drawn from both private and government hospitals. These physicians were interviewed by an independent member (external to the team) to identify the attributes for the adoption of wireless technology by physicians in the Indian healthcare systems. This approach was deliberately taken to avoid the criticism that there may be 'bias' in the interview process. Further, due to linguistic issues, we required a person with proficiency in Indian language as well as English in order to schedule appointments etc. The interview questions were derived from existing literature and other studies conducted in Australia and Taiwan by one of the researchers of the team. The questions covered aspects such as the participants' experience in using wireless technology, their perceived opinions on various benefits and problems, their opinions on how this technology would fit-in their workplace functional requirements, and whether the technology would yield significant benefits.

The interviews were conducted (in English) over a 45 - 60 minute period and recorded using a digital recording machine. The recorded interviews were then transcribed into a computer file. No editing was done on the transcripts and the transcripts contained grammatical errors, as

some physicians interviewed were not overly competent in English. Thus qualitative data collected from the Indian healthcare environment and literature review in the domain of healthcare have helped in identifying the following list of drivers and inhibitors in general for the use of wireless technology in the subcontinent healthcare environment.

Drivers	Inhibitors
• Savings in time	• Legal barriers
• Improved clinical flow	• Administrative constraints
• Efficiency in communication	• Communication with physicians
• Delivery of high quality information	• Patient education
• Better quality of service	• Communication with colleagues
• Saving effort	• Problems in obtaining lab results
• Improved clinical performance	• Complications in note taking due to difficult to read & write screens
• More contact time with patients	
• Improved delivery of information	• Electronic medical records
• Reduced overall cost	• Device usage barrier
• Positive impact on patient safety	• Benefit evaluation barrier
• Reduced inaccuracies	• Resource barrier
• Improved public image	• Electronic prescribing
• Reduced medical errors	
• Easy access to data	
• Attract more practitioners	
• Reduced workload	

Figure 1: Themes emerged from the qualitative data analysis

Quantitative Data Collection

This study developed a survey instrument from the interview data. The main reason for this behavioural approach was that previously tested instruments were found to be inadequate in healthcare settings for India and Pakistan. The data from the interviews were used to develop a specific range of questions to gather more detailed view from the wider population. This survey instrument was pilot tested to capture the information reflecting the perceptions and practices of those adopting wireless technology in the Indian healthcare system. It was particularly focussed on what internal and external environmental factors shape the adoption of wireless technology and the extent of their influence.

This survey was then distributed to over 300 physicians in Pakistan. The samples were randomly chosen through local health departments. A cover letter explained the objectives and goals of the research. A total of 97 completed surveys were received. The survey responses were then transcribed into a spreadsheet file. A Visual Basic interface was written to generate numerical codes for various elements of the survey for data analysis using SPSS. The coded spreadsheet file was then copied into a SPSS file format for further data analysis.

After descriptive/explorative analysis, a reliability analysis was conducted on the complete questionnaire; the value of "Cronbach's Alpha" was 0.894, which shows very high level of reliability. Therefore, data collected from the survey was consider suitable for further statistical analysis.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.894	.894	47

Figure 2: Results of Reliability Analysis of Pakistan Survey data

An initial factor analysis was conducted on the data to identify factor groupings. An iterative process was employed to finally arrive at the following five factors. In deciding the factors, a loading value of 0.6 was set with varimax rotation. The groups were given appropriate titles in an arbitrary fashion based on the type of factors. The left most components starting with letter Q refers to the question number used in the survey instrument. This final factor grouping is shown in the table 1 below.

Descriptions	Technology Management	Data Management	Improved Outcomes	Efficiency	Software Limitations
Save Time				.829	
Save Effort				.759	
Enhance Clinical Flow				.784	
Enhance Clinical			.878		
Attract More Patients			.751		
High Quality Information			.774		
Easy Access to Data			.800		
Improve Patient Safety			.776		
Electronic Medical Record		.822			
Medical database referral		.834			
Electronic Prescribing		.801			
Daily scheduling of		.794			
Obtain lab results		.845			
Billing and account		.802			
Disease State Management		.766			
Administrative purposes		.815			
Generating "Exceptions"		.771			
Patient education		.695			
Note taking		.720			
Drug administration		.642			
Communication with		.662			
Communication with		.678			
lack of solution					.748
Inadequate resources					.693
Migration issues					.684
Device stolen	.680				
Connection problems	.757				
Slow transfer rates	.756				
Interference with medical	.772				
Not able to access main	.817				
Not able to operate with	.779				
Frequent breakdown	.763				
Short battery life	.806				
Screen too small	.691				
Image not clear	.827				
Limited storage capacity	.665				
Not enough wireless	.811				
Not enough processing	.783				
Wireless device heavy to	.692				

Table 1: Results of factor analysis on the Pakistan Survey data

From the factor analysis, a preliminary framework for the adoption of wireless handheld technology in Pakistani healthcare environment can be drawn as follow:
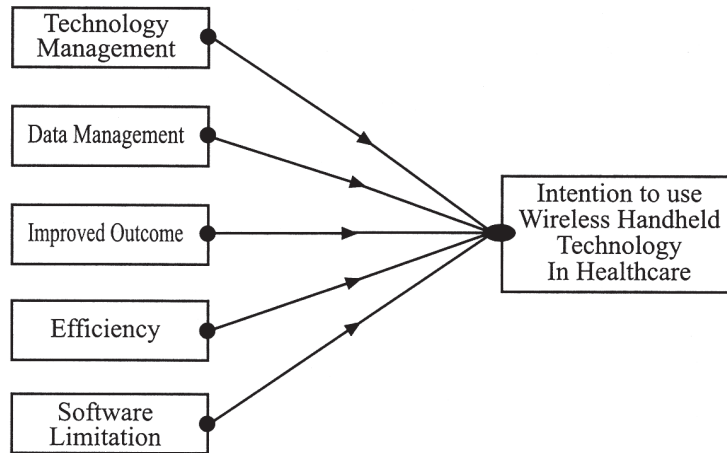

Figure 3 : Initial Framework for the Adoption of Wireless in Pakistani HC

Regression Analysis

To understand the relationship between variables identified through factor analysis and healthcare professionals intention to use the wireless handheld technology a multiple regression analysis technique was adopted. We conducted multiple regression analysis though "Enter Method" for the independent variables (Technology Management, Data Management, Improved Outcomes, Efficiency, and Software limitation) and dependent variable "Intention to use" from the data collected from Pakistani healthcare professionals for adoption of the wireless handheld technology. Multiple regression analysis helps to understand amount of variation explain in the dependent variable "Intention to use" by the variation in the dependent variables "Technology Management, Data Management, Improved Outcomes, Efficiency, and Software limitation".

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.724[a]	.524	.498	.42245	.524	20.013	5	91	.000

a. Predictors: (Constant), SoftwareLimited, TechnologyManagement, Efficiency, ImprovedOutcomes, DataManagement

Figure 4: Regression Model Summary for Pakistan data

It can be seen from the figure 4 above regression R=. 724, with p<.05, shows that there is a significant level of relationship between the dependent and independent variables. The adjusted r-square, r=. 524, shows that 52.4% of variation in the dependent variable "Intention to Use" is explained collectively by the variation in independent variables "Technology Management, Data Management, Improved Outcomes, Efficiency, and Software Limitations".

ANOVA [b]

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17.858	5	3.572	20.013	.000[a]
	Residual	16.240	91	.178		
	Total	34.098	96			

a. Predictors (Constant), SoftwareLimitation, TechnologyManagement, Efficiency, ImprovedOutcomes, DataManagement

b. Dependent Variable: Intention ToUse

Figure 5: ANOVA and analysis for Pakistan data

F-statistics shows that degree of freedom F (5, 91) is 20.0 at significant level p< .05, that means the independent variables are significantly related to the dependent variable, hence multiple correlation coefficient is significant as well. Coefficient analysis below, also shows that independent variable "Efficiency, and Improved Outcomes" are significant, p<.05 with "Beta value .35, and .49" respectively. Whereas the independent variable "Data management, Technology Management, and Software Limitation" are not significant at t = -1.248, t = 1.583 and t = -.669, p>.05 respectively in relation to dependent variable "Intention to Use". Therefore independent variable "Efficiency and Improve Outcomes" add something to explain the variance in the dependent variable "Intention to use" for the wireless handheld technology in the Pakistani healthcare environment.

Coefficients [a]

	Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.123	.235		4.778	.000
	Efficiency	.257	.057	.354	4.523	.000
	ImprovedOutcomes	.349	.055	.492	6.360	.000
	DataManagement	-.030	.024	-.118	-1.248	.215
	TechnologyManagement	.044	.028	.153	1.583	.117
	SoftwareLimitation	-.092	.137	-.049	-.669	.505

Figure 6: Coefficients analysis for Pakistan data

DISCUSSIONS

Multiple regression analysis clearly indicate that factors such as efficiency and improve outcome are able to explain variation in the intention to use wireless handheld technology in the Pakistani healthcare environment. Our analysis also showed that efficiency and improve outcomes highly impact the dependent variable "Intention to use" 35.4%, p<0.05 and 49.2%, p<0.05. respectively. Whereas the correlation of "Data Management, Technology Management, and Software Limitation" is not significant as p>.05. Therefore it can be summarized that Pakistani healthcare professional will use the wireless technology if it provide efficiency and have an ability to improve their day-to-day activities, that is their perception of usefulness of the wireless technology. Such activities may include, time saving, easy clinical process, quality of information, and ability to provide quality of care are few to mention. Apparently, it seems that in Pakistani environment the determinants of technology and data management do not poses any threat to their attention to

use the wireless technology in healthcare setting. Such a view may be due the nature of their job and level of confidence with handling the technology.

However, it is evident from the data analysis that Pakistani healthcare professionals believes that variation in the variable "Intention to Use" can be explained by the efficiency offered by wireless handheld technology and positive benefits offered by the use of wireless handheld technology in the healthcare setting. In summary, five factors identify by the factor analysis cover wide rage of issues relating to technology and management. Even though through the multiple regress analysis some variables were not significant, but it is crucial to understand that Pakistani healthcare professionals are looking for immediate outcome from the wireless technology in healthcare environment. Such perceptions and beliefs can be very crucial for any implementation strategy of wireless handheld technology in Pakistani healthcare environment, as evidence from the statistical data analysis presented in the paper. Another implication from the data analysis is that Pakistani healthcare professionals believes that usefulness of the technology is crucial in the clinical domain and ability of any wireless device to be perceived as useful will have an impact on the management and attitude of healthcare professionals. Therefore, we can conclude that if the technology is useful in clinical setting than the healthcare professionals will be motivated to use the technology, which can transforms into technology adoption, which is supported by the data analysis presented in this paper.

CONCLUSION

This study clearly identifies variables with empirical evidence, factors that contribute to the adoption of wireless handheld technology in Pakistani healthcare setting. Through the factor analysis the major contribution of the study is to identify the determinants, which can play vital role in determining the use of wireless handheld technology in healthcare. Data collected in this study was based on the views and opinions of the healthcare professionals and we did not measure the actual usefulness/use of the wireless handheld technology. It is anticipated finding of this research can help government and other stakeholders to formalize policies and strategies for implementation of wireless handheld technology in healthcare domain. Therefore, there is a need to do further validation through real time usefulness of the determinants in healthcare setting as this study only relay on the perception. Future research can concentrate on the multi-group analysis, sample size, and other cultural and social issues associated with the adoption of technology in healthcare domain.

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