Use of Healthcare IS by Multiple User Groups: An Empirical Study of a Medication Management System

Research-in-Progress

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Abstract

Integrated healthcare information systems, such as a closed loop medication management system (CLMMS), have been developed to support the inter-linked work of multiple user groups including doctors, pharmacists, and nurses. With the challenges faced in assessing the use and impact of such systems, there is limited research on this topic that takes into account the behaviors of multiple user groups. In particular, there is a lack of understanding of how system use by one user group affects the perceptions and outcomes of other groups regarding the system. This study develops a model to understand how the perceived appropriate use by one user group can affect the system satisfaction and impact of individuals of another group, based on the faithfulness of appropriation (FOA) concept from the Adaptive Structuration Theory. A pilot survey was conducted with 199 nurses, 76 doctors, and 36 pharmacists using a CLMMS in a public hospital. Use of the IS was found to affect both user satisfaction and individual impact in most cases, and user satisfaction in turn influenced individual impact. Doctors' FOA affected nurses' and pharmacists' user satisfaction and individual impact while pharmacists' FOA influenced doctors' user satisfaction but not individual impact. The expected contributions and remaining research plan are described.

Keywords: Healthcare information systems, IT impact, IS use, user satisfaction, faithfulness of appropriation, multiple user groups

Introduction

The deployment of information technology (IT) in healthcare used to lag behind other industries (Skinner 2003) but has taken off in recent years. Experts and policy makers consider the implementation of IT such as for managing electronic health records, to be critical to the transformation of the healthcare industry (Chaudhry et al. 2006). In spite of its considerable potential to enhance healthcare (Agrawal et al. 2007), it has proved challenging to assess healthcare IT use (Hennington et al. 2009) and impacts (Ng and Kankanhalli 2009).

One of the reasons behind this is the diversity of healthcare practitioners, with various user groups having different characteristics and needs. In healthcare organizations such as hospitals, IS users include physicians, nurses, pharmacists, administration, and even patients (Pare et al 2005). These user groups are diverse, as each group has its own perspectives and needs, yet they are often required to work in close cooperation on joint tasks (Krabbel et al. 1996).

Various IS have been developed for specific user groups in hospitals, such as computerized physician order entry (CPOE) for physicians and bar-code medication administration systems (BCMA) for nurses. While such individual systems can help hospitals to automate and manage critical processes such as medication administration, it is important to integrate isolated systems to obtain further benefits (Microsoft Amalga 2009). An example of an integrated system is a closed loop medication management system (CLMMS). A CLMMS includes electronic prescribing by doctors, online medication verification by pharmacists, barcode scanning to confirm patient identity and automated dispensing of medicine by nurses, and the overall use of electronic inpatient medication records (Franklin et al. 2007). While studies on the effectiveness of individual (CPOE and BCMA) systems show that their use can increase patient safety through the reduction of prescribing and medication administration errors (Bates 2000; Mekhjian et al. 2002), there is limited understanding of the effectiveness of these systems when they are integrated together (Chaudhry et al. 2006). Thus, research is needed to explore the use and impact of these systems particularly with respect to multiple user groups (Pare et al. 2005) and their mutual influences.

While IS research is rich in explaining technology adoption and use at the individual level, there is limited study of technology adoption by groups (Sarker et al. 2005) and the influence of one user group on another. Social influences have mainly been studied for the individual decision to adopt or use a technology through the concept of social norms (Venkatesh et al. 2003). However, understanding is lacking of how the system use by one user group affects the system satisfaction and impact (in terms of effectiveness) of users belonging to another group. This is particularly relevant in the context of multiple user groups (e.g., doctors, pharmacists, and nurses) using an integrated system (e.g., closed loop medication administration system) for inter-related work.

Also, recent studies have revealed that organizational adoption and even mandated use of healthcare IS does not necessarily lead to individual healthcare professionals using the system as intended. For example, usage may differ in terms of use time and mode of use (Hennington et al. 2009). Use of the system may also differ from the intended design and objectives. The faithfulness of appropriation concept from the Adaptive Structuration Theory (AST) refers to the extent to which users use the technology faithfully and consistently with the intended design of the system (DeSanctis and Poole 1994). In work settings with complex cooperation and joint tasks, the manner in which an integrated system is used by different user groups is an important issue to be addressed, as it is likely that the appropriateness of use by one user group can affect the system use and performance of individuals in another user group.

Thus, we aim to understand how an integrated healthcare information system is used by multiple user groups, and how the perceived appropriate use by one user group affects other user group's system satisfaction and impact. Our research question is "How does an individual's use, satisfaction, and the appropriate use by another (inter-related) user group affect the individual impact of the system?" To answer this question, we draw on the faithfulness of appropriation concept from the AST (DeSanctis and Poole 1994) to develop a model to explain individual satisfaction and impact of an IS and how it is affected

by other user groups[1]. While this model is applied at the individual level, it takes into consideration the perspectives of multiple user groups by testing the model on three different but related user groups, i.e., doctors, nurses, and pharmacists. This paper presents the results of a preliminary survey conducted on these three groups using a CLMMS in a public hospital. Since the survey is ongoing, we will present the current results with the aim to increase the sample size in future. The results are expected to contribute theoretical and practical insights on the use of integrated healthcare IS by multiple user groups.

Conceptual Background

Closed Loop Medication Management System

Due to the prevalence and critical consequences of medication errors, strategies have been suggested to reduce these errors (Aspden et al. 2007). The use of IS such as CPOE for physicians and BCMA for nurses has been found to reduce medication errors (e.g., Mekhjian et al. 2002, Paoletti et al. 2007). While these individual systems may reduce medication errors for users for that particular task, information may be lost when tasks are handed over between user groups and healthcare providers (Streitenberger et al. 2006). Hence, it is important to "close the loop" by using an integrated healthcare IS that can be used by doctors, pharmacists, and nurses to ensure the smooth and secure flow of patient medication information (Franklin et al. 2007; Microsoft Amalga 2009).

Table 1 shows the typical work flow in a CLMMS (Franklin et al. 2007; Paoletti et al. 2007). As described in the table, doctors and pharmacists co-operate in prescribing and verifying the medication orders, and nurses follow up with the medication administration based on the medication orders from doctors.

Table 1. Typical Workflow using the CLMMS
1. The physician prescribes medication orders using the CLMMS. Drug names are available in the CLMMS and default doses may be suggested.
2. The pharmacist reviews and verifies the medication orders. Inappropriate medication orders are highlighted by the CLMMS. In such cases, alerts may be triggered and the doctor may have to review or change the medication order.
3. Medication is automatically dispensed using automated cabinets and electronic drug trolleys, based on the medication orders indicated in the CLMMS.
4. The nurse follows the doctor's prescribed medication orders and administers the medication to the patient after scanning the barcode on each patient's wristband. The medication administration is recorded in the CLMMS and the nurse enters any additional remarks.

Recent studies show that such integrated systems can have a positive effect on medication errors (Franklin et al. 2007; Mahoney et al. 2007). However, there is a lack of understanding of different groups' usage, satisfaction, and individual impact from such systems. With the use by multiple groups working on cooperative tasks, how one group uses the system can affect the outcomes for another user group. For this purpose, the AST may be relevant since it can be extended to study how the faithful (or unfaithful) appropriation of the system by one user group can affect other group members' satisfaction and impacts.

Adaptive Structuration Theory

The AST is a framework for studying organizational change that occurs as advanced technologies are used (DeSanctis and Poole 1994). AST is based on the theories of structuration (Giddens 1979) and appropriation (Ollman 1971), and provides a viable approach to study the process by which individuals incorporate the use of technologies into their work practices. The AST has been applied in healthcare to understand the complex interactions between a healthcare IS and organizational processes (Schwieger et

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[1] We also draw from the IS Success Model (DeLone and McLean 2003) to model the relationships between system use, user satisfaction, and individual impact but we do not describe this aspect in detail since this is not the main focus of our study.

al. 2006). Structuration theory, which AST is based on, has also been applied to study the implementation of healthcare IS in primary care clinics (Kouroubali 2002).

According to the AST, advanced information technologies bring social structures, which may enable or constrain interaction in organizational work. Social structures can be described in two ways: the structural features of the technology and the spirit of the features. *Structural features* refer to the capabilities and resources provided by the technology. For example, for the CLMMS, structural features include electronic prescribing of medication with drop-down menus and online verification of drug interactions. *Spirit* refers to the general intent with regards to the goals underlying the structural features. It describes the appropriate use of the technology based on its design and intent. The spirit of the system can be highlighted to users in various ways, such as through training materials and presentations.

The structural features and the spirit form the technology's structural potential. *Structuration* refers to "the process by which social structures are produced and reproduced in social life" (DeSanctis and Poole 1994, p. 128). The structuration process can be captured by isolating a group's application of a specific technology's features within a specific context and time, i.e., appropriations of the technology. *Appropriation* refers to the manner in which technology structures are used (Reinig and Shin 2002). Adoption practices may vary as users may choose structural features from a large set of potential features. Users can opt to directly use technological features, relate the features to other structures, constrain or interpret the structures, or make judgments about the structures. Users may also choose to appropriate technology features faithfully or otherwise. *Faithful appropriations* of technology features are consistent with the spirit of the structural features, whereas unfaithful appropriations are not. The extent of faithfulness with which a group appropriates the technology can determine the group outcome (DeSanctis and Poole 1994).

Thus, *faithfulness of appropriation* measures whether an IS system is used in a consistent manner with its overall goals and objectives (Chin et al. 1997). This concept has been widely used to explain the adoption of group support systems (e.g., Dennis and Garfield 2003; Lagroue III 2008; Salisbury and Stollak 1999) and other IS such as audit support systems (Dowling 2007) and ERP systems (Sedera and Tan 2007). In this study, we will apply the concept of faithfulness of appropriation in the context of integrated healthcare IS and use it to understand how the appropriation of the system by one user group affects the satisfaction and impacts for users belonging to another group.

Research Model and Hypotheses

The proposed research model is shown in Figure 1. The independent variables are *use* and *another user group's faithfulness of appropriation*. The dependent variable is *individual impact* in terms of perceived effectiveness of the system. While the independent variables are expected to have direct effects on individual impact, their effects could also mediated by *user satisfaction*.

Figure 1. Proposed Research Model
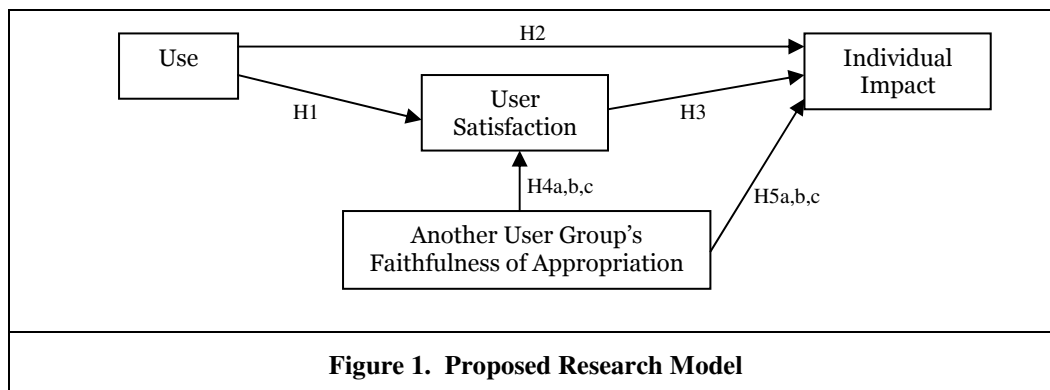
The extent of use of an IS can affect the degree of user satisfaction (DeLone and McLean 2003). In the case of mandated systems such as in this study, the extent of use is often conceptualized as the number of features of the system that are made use of (Burton-Jones and Straub 2006). It has been proposed that user satisfaction may explain intended use, while actual use (the focus in this study) explains subsequent user satisfaction (McGill et al. 2003). When an individual uses a system more, user satisfaction is also likely to increase as mastery is acquired over the system. Past studies in healthcare IS have also shown that use is positively related with user satisfaction (e.g., Jen and Chao 2008). In the context of our study, we expect that increased use of the CLMMS can increase user satisfaction for all three user groups. Hence,

> *H1: Use is positively related to user satisfaction (for doctors, nurses and pharmacists)*

Use has been proposed as a direct antecedent of individual impact (DeLone and McLean 2003). The more an individual uses a system e.g., in terms of features, the greater impact the user can expect to obtain from it. Previous research has empirically supported this relationship in different contexts (e.g., Iivari 2005) including for healthcare IS (Pare et al. 2005). Thus, we expect that the increased use of the CLMMS will lead to higher impact in terms of effectiveness of the individual's work. Hence, we hypothesize:

> *H2: Use is positively related to individual impact (for doctors, nurses and pharmacists)*

Similarly, user satisfaction has been proposed as an antecedent of individual impact (DeLone and McLean 2003). When an user is satisfied with the system, he is also likely to experience greater work benefits from the system. Past IS studies have found empirical support for this relationship (e.g., Iivari 2005; McGill et al. 2003). In a study of CPOE, doctors' user satisfaction with the system was correlated with patient care quality and reduction in errors (Lee et al. 1996). Hence, we expect that an user who is satisfied with the CLMMS is likely to perceive higher individual impact in terms of work effectiveness.

> *H3: User satisfaction is positively related to individual impact (for doctors, nurses and pharmacists)*

Past studies have shown that faithfulness of appropriation in the use of a group decision support system has a direct influence on satisfaction of the group's outcome (Chin et al. 1997). As users believe that they are using the technology in the intended manner, they are expected to be more satisfied with the use of the system. We extend this reasoning further by applying it in the context of multiple groups using an integrated healthcare IS. We propose that the manner in which one group uses the system can affect another user group's satisfaction with the system. An integrated system such as the CLMMS is used to facilitate the work of doctors, pharmacists, and nurses. As described in Table 1, doctors and pharmacists co-operate to determine the medication orders, and nurses administer medication orders on the advice of the doctors. If the nurses perceive that the doctors do not use the system as intended (e.g. prescribe medication appropriately through the system), it can frustrate them as they may not be able to obtain the necessary medication information through the system. This can affect their satisfaction in using the CLMMS. Hence, we hypothesize:

> *H4a: Doctors' faithfulness of appropriation is positively related to the nurse's user satisfaction*

Similarly, if doctors perceive that the pharmacists do not use the CLMMS as intended, it can dissatisfy them as they rely on pharmacists to use the CLMMS to view and verify the medications prescribed. Hence,

> *H4b: Pharmacists' faithfulness of appropriation is positively related to the doctor's user satisfaction*

Applying similar reasoning to pharmacists, doctor's use of the CLMMS can affect pharmacist's user satisfaction. If pharmacists perceive that the doctors do not use the system as intended to order medications, they may not be able to verify the medication orders and feel dissatisfied. Hence,

> *H4c: Doctors' faithfulness of appropriation is positively related to the pharmacist's user satisfaction*

Past studies have also shown that faithfulness of appropriation can affect the final solution derived through the use of the system (Chin et al. 1997). For example, a study on the use of a group support system found that faithful appropriation of the system influences the products developed by the users (Dennis and Garfield 2003). Also, perceived faithfulness of appropriation for group support systems was found to enhance meeting outcomes such as improved decision quality (Wheeler and Valacich 1996) and favorably influence decision confidence and decision scheme satisfaction (Salisbury and Stollak 1999). Extending this reasoning, we propose that the manner in which one group uses the system can impact another group's individual impact in integrated IS. For CLMMS, the objective of the system is to improve

patient safety and reduce medication errors. If doctors, pharmacists, or nurses do not use the CLMMS as intended, it can affect the system outcomes. For example, if nurses perceive that doctors do not use the system "correctly", they may feel that it affects their ability to care for the patients and improve patient safety. Hence, we hypothesize:

> *H5a: Doctors' faithfulness of appropriation is positively related to the nurse's individual impact*

If doctors perceive that pharmacists do not use the CLMMS as they should, they may feel that it hinders them in delivering patient care. Similarly, if pharmacists think that doctors do not use the CLMMS "correctly", they may perceive this as affecting their work. Hence, we hypothesize:

> *H5b: Pharmacists' faithfulness of appropriation is positively related to the doctor's individual impact*

> *H5c: Doctors' faithfulness of appropriation is positively related to the pharmacist's individual impact*

We did not hypothesize other inter-relationships between user groups since the above are the groups whose work directly affects each other as per Table 1.

Research Methodology

The survey methodology was used to empirically test the research model (Dooley 2001). The study was conducted in a public hospital with about 1000 beds and more than 5000 professional staff members. The hospital was chosen as it had recently implemented a CLMMS and the administrators had contacted the researchers to carry out an evaluation of the system use by multiple groups. At the time of the study, the system had been fully implemented for more than a year.

Survey Instrument

The constructs were mostly operationalized based on previously validated instruments from the IS literature and adapted to the context of the study. Typical ways to measure use include regularity of use (Davis 1989), frequency of use (Taylor and Todd 1995), and duration of use (Iivari 2005). However, these may not be meaningful measures of use in a mandated system (Jasperson et al. 2005) such as the CLMMS under study. Hence, we chose to measure the extent of *Use* through the number of features used (Burton-Jones and Straub 2006), which was also suggested as an useful measure in the healthcare IS literature (Hu 2003). An example of an item for this construct is "I use most of the features of the system". *User satisfaction* was measured using items such as "Overall, I am satisfied with the system" as per Rai et al. (2002). *Individual impact* was measured using self-developed items based on the objectives of the CLMMS which was to improve the effectiveness of medication management, e.g. "The system helps me to improve patient safety" and "The system helps me to reduce medication errors".

Our measure of *faithfulness of appropriation* was customized to the context of study based on discussions with a doctor, chief pharmacist, and nursing administrator who are familiar with the CLMMS and its intended usage. Examples of items include "Doctors are using the system in the correct way" and "Doctors use the system to order all medications for patients" (for the nurse's and pharmacist's questionnaires) and "Nurses are using the system in the correct way" and "Nurses document medication administration and remarks in a manner that is clear and easy to understand" (for the doctor's questionnaire).

Survey Administration and Demographics

The survey was administered at the hospital to the three user groups of the CLMMS, i.e., doctors, pharmacists and nurses. Three different versions of the survey were used that had the same constructs and items with the wordings modified to suit the particular user group. A small token amount ($10) was given to the respondents to encourage participation. The nurse managers of each ward were asked to administer the survey to nurses who have used the CLMMS for at least 3 months. At the time of reporting, there were 200 survey responses from nurses, but 1 was dropped because of missing values. Similarly, the pharmacists were contacted to participate in the survey. A few declined while several were not available. At this time, we have 36 responses after removing 4 responses with missing values. Doctors who have used the CLMMS for at least 3 months were asked to participate in the survey through their departmental

secretaries. At this time, there are 81 responses but 5 responses were dropped due to missing values. As data collection is still ongoing, the preliminary results are presented in this paper.

Table 2. Demographics of the Samples								
Nurses (N=199)			**Doctors (N=76)**			**Pharmacists (N=36)**		
Gender	*Female*	191 (96.0%)	**Gender**	*Female*	32 (42.1%)	**Gender**	*Female*	28 (77.8%)
	Male	8 (4.0%)		*Male*	44 (57.9%)		*Male*	8 (22.2%)
Age	*Mean*	31.4 years	**Age**	*Mean*	31.5 years	**Age**	*Mean*	25.9 years
Job Tenure	*Mean*	4.1 years	**Job Tenure**	*Mean*	2.7 years	**Job Tenure**	*Mean*	2.5 years

Table 2 shows the demographics of the three user groups. The majority of nurses are female, which reflects their typical population. Job tenure, number of years using computers, and level of computer experience are included as control variables in our model. For the nurses, 55.8% have used computers for more than 10 years and 87.4% rated themselves as regular computer users. For the doctors, 90.8% have used computers for more than 10 years and 96.0% rated themselves as regular computer users. For the pharmacists, 91.7% have used computers for more than 10 years and 94.5% rated themselves as regular computer users.

Data Analysis and Results

The survey data was analyzed using Partial Least Square (PLS). PLS was chosen as it is suitable for analyzing smaller sample sizes (Chin et al. 2003) such as ours (pharmacists sample size of 36) in a more robust way. SmartPLS 2.0 (Ringle et al. 2005) was used to analyze our data.

Instrument Validation

Cronbach Alpha and composite reliability scores were used to assess the reliability of the constructs (Straub et al. 2004). All Cronbach Alpha values and composite reliability scores far exceeded the required 0.707, indicating adequate reliability (Nunnally 1978). A confirmatory factor analysis was conducted to examine construct validity. Indicators loaded higher on their hypothesized factor than on other factors, and the square root of each factor's average variance extracted (AVE) was higher than its correlations with other factors, thus demonstrating convergent and discriminant validity (Straub et al. 2004). Table 3 shows the descriptive statistics, correlation values, and AVE for the constructs. Item loadings and cross loadings from the factor analysis are not shown here due to lack of space but can be provided on request. Due to a couple of high correlations, we tested for multicollinearity but the results indicate that this is not a problem. Common method bias tests indicate that this was not an issue in this study.

Results of Hypothesis Testing

The structural model results are presented in Table 4. For the nurse user group, results indicate that H2, H3, H4a and H5a are supported, while H1 is not supported. The R square value is 0.58. For the doctor user group, results indicate that H1, H2, H3 and H4b are supported, while H5b is not supported. The R square value is 0.60. For the pharmacist user group, all hypotheses are supported with R square value of 0.61. All control variables have no significant effect on the dependent variable, except for job tenure for the pharmacist user group.

Table 3. Descriptive Statistics, Correlation Values, and Average Variance Extracted					
Nurse	**Mean (SD)**	**USE**	**SAT**	**FOA**	**IMP**
USE	5.92 (0.88)	*0.89*			
SAT	5.40 (1.10)	0.29	*0.93*		
FOA	4.69 (1.33)	0.27	0.61	*0.81*	
IMP	5.82 (0.94)	0.37	0.72	0.60	*0.85*
Doctor	**Mean (SD)**	**USE**	**SAT**	**FOA**	**IMP**
USE	5.13 (1.23)	*0.84*			
SAT	4.76 (1.14)	0.32	*0.88*		
FOA	5.64 (0.83)	0.10	0.30	*0.85*	
IMP	5.44 (0.90)	0.43	0.75	0.18	*0.81*
Pharmacist	**Mean (SD)**	**USE**	**SAT**	**FOA**	**IMP**
USE	4.96 (1.40)	*0.86*			
SAT	4.88 (1.16)	0.42	*0.83*		
FOA	4.74 (1.00)	0.26	0.57	*0.74*	
IMP	5.61 (0.66)	0.60	0.53	0.53	*0.77*
Note: USE = Use, SAT = User Satisfaction, FOA = Faithfulness of Appropriation, IMP = Individual Impact. The diagonal elements (in italics) represent AVE values.					

Table 4. Structural Model Results				
Hypothesized paths	**User Group**	**Path coefficient**	**T value**	**Hypothesis supported**
H1: Use → User Satisfaction	Nurse	0.13	1.10	No
	Doctor	0.30**	3.02	Yes
	Pharmacist	0.32**	3.59	Yes
H2: Use → Individual Impact	Nurse	0.15*	1.81	Yes
	Doctor	0.21*	2.35	Yes
	Pharmacist	0.37***	5.56	Yes
H3: User Satisfaction → Individual Impact	Nurse	0.54***	5.29	Yes
	Doctor	0.68***	8.86	Yes
	Pharmacist	0.27***	3.68	Yes
H4a: Doctors' FOA → Nurse's User Satisfaction	Nurse	0.58***	5.87	Yes
H4b: Pharmacists' FOA → Doctor's User Satisfaction	Doctor	0.27**	2.56	Yes
H4c: Doctors' FOA → Pharmacist's User Satisfaction	Pharmacist	0.47***	5.79	Yes
H5a: Doctors' FOA → Nurse's Individual Impact	Nurse	0.23*	2.12	Yes
H5b: Pharmacists' FOA → Doctor's Individual Impact	Doctor	-0.03	0.38	No
H5c: Doctors' FOA → Pharmacist's Individual Impact	Pharmacist	0.32***	4.89	Yes
Control Variable: Job Tenure	Pharmacist	0.25**	3.18	Yes
* Significant at p < 0.05 level; ** Significant at p <0.01 level; *** Significant at p < 0.001 level (one-tailed test)				

Discussion and Conclusion

The results provide support for the usefulness of the faithfulness of appropriation concept from the AST combined with concepts from the DeLone and McLean IS success model (2003) in the context of integrated healthcare IT. Importantly, preliminary results indicate that each user group using the system as intended affects the satisfaction and individual impact of other inter-related user groups, for an integrated healthcare IS such as the CLMMS. In the nurse and pharmacist user groups, the way doctors use the CLMMS affects both their user satisfaction and individual impact. However, for the doctor user group, the way pharmacists use the CLMMS affects only their satisfaction of the system and not the impact of their work. This sheds light on how the different user groups view themselves and their work. While doctors may not feel satisfied with the system because pharmacists did not use the system as intended, it does not appear to affect their ability to render patient care and ensure patient safety (H5b is not supported). Another hypothesis that was not supported is the relationship between use and user satisfaction for nurses (H1). This could be because all nurses tend to follow the same routines during medication rounds, so more extensive use of features does not necessarily lead to increased satisfaction.

A current limitation of our study is the rather small sample size for doctors and pharmacists. This may be partly due to the overall size of the user group and that these users were more busy and difficult to contact. The future plan is to increase the sample size through extending the reach of our survey. We also plan to test the model for CLMMS in different hospitals and eventually with other healthcare IS involving multiple user groups. Last, we considered that the system is of adequate quality as was in our case and many other previous studies or else the relationships between use, user satisfaction, and individual impact may vary (DeLone and McLean 2003), but this assumption could be relaxed if needed.

Expected Outcome and Contributions

Through this study, we aim to contribute to IS literature by studying the use and impact of IS involving multiple user groups and mutual influences. We explore how the appropriate use of the system by one group can affect the satisfaction and individual impact of another user group, through the concept of faithfulness of appropriation from the AST. Further we contribute to research in the healthcare IS context, where different user groups work closely together for critical objectives such as patient safety. Preliminary results show the potential of adopting this approach to add to our understanding about multiple user groups influencing each other, and particularly in the healthcare IS context.

For practitioners, the study can provide insights on the importance of training users on the appropriate usage of healthcare IS. Effective training can help users to use the system correctly in the manner that is intended. It is also important to educate users on how their use of such IS affects the system satisfaction and impact of other inter-related user groups. As more healthcare IS are designed for multiple user groups, it is critical for users to understand the interdependency of their system use and impacts.

Acknowledgements

References

Agrawal, R., Grandison, T., Johnson, C., and Kiernan, J. 2007. "Enabling the 21st Century Health Care Information Technology Revolution," *Communications of the ACM* (50:2), pp. 35-42.

Aspden, P., Wolcoot, J., Bootman. J. L., and Cronenwett, L. R. 2007. *Preventing Medication Errors*, National Academy Press, Washington, DC.

Bates, D. W. 2000. "Using Information Technology to Reduce Rates of Medication Errors in Hospitals," *British Medical Journal* (320:7237), pp. 788-791.

Burton-Jones, A., and Straub, D. 2006. "Reconceptualizing System Usage: An Approach and Empirical Test," *Information Systems Research* (17:3), pp. 228-246.

Chaudhry, B., Wang, J., Wu, S., Maglione, M., Mojica, W., Roth, E., Morton, S. C., and Shekelle, P. G. 2006. "Systematic Review: Impact of Health Information Technology on Quality, Efficiency, and Costs of Medical Care," *Annals of Internal Medicine* (144:10), pp. 742-752.

Chin, W. W., Gopal, A., and Salisbury, W.D. 1997. "Advancing the Theory of Adaptive Structuration: The Development of a Scale to Measure Faithfulness of Appropriation," *Information Systems Research* (8:4), pp. 342-367.

Chin, W. W., Marcolin, B. L., and Newsted, P. R. 2003. "A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects: Results from a Monte Carlo Simulation Study and an Electronic Mail Adoption Study," *Information Systems Research* (14:2), pp. 189-217.

Davis, F. D. 1989. "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly* (13:3), pp. 319-339.

DeLone, W. H., and McLean, E. R. 2003. "The DeLone and McLean Model of Information Systems Success: A Ten-Year Update," *Journal of Management Information Systems* (19:4), pp. 9-30.

Dennis, A.R., and Garfield, M.J. 2003. "The Adoption and Use of GSS in Project Teams: Toward More Participative Processes and Outcomes," *MIS Quarterly* (27:2), pp.289– 323.

DeSanctis, G., and Poole, M.S. 1994. "Capturing the Complexity in Advanced Technology Use: Adaptive Structuration Theory," *Organization Science* (5:2), pp.121-47.

Dooley, D. 2001. *Social Research Methods*, Prentice-Hall, Upper Saddle River, NJ.

Dowling, C. 2007. "The Compensatory and Complementary Influence of Individual, team and Firm Level Factors on Appropriate Audit Support System Use" in *Proceedings of AAA Auditing Midyear Conference*.

Franklin, B. D., O'Grady, K., Donyai, P., Jackin, A., and Barber, N. 2007. "The Impact of a Closed-Loop Electronic Prescribing and Administration System on Prescribing Errors, Administration Errors and Staff Time: A Before-and-after Study," *Quality and Safety in Health Care* (16), pp. 279-284.

Giddens, A. 1979. *Central Problem in Social Theory*, Berkeley, CA: University of California Press.

Hennington, A., Janz, B., Amis, J., and Nichols, E. 2009. "Information Systems and Healthcare XXXII: Understanding the Multidimensionality of Information Systems Use: A Study of Nurses' Use of a Mandated Electronic Medical Record System," *Communications of the AIS* (25:1), pp. 243-262.

Hu, P. J.-H. 2003. "Evaluating Telemedicine Systems Success: A Revised Model," *Proceedings of the 36th Hawaii International Conference on System Sciences*.

Iivari, J. 2005. "An Empirical Test of the DeLone-McLean Model of Information System Success," *The DATA BASE for Advances in Information Systems* (36:2), pp. 8-27.

Jasperson, J., Carter, P. E., and Zmud, R. W. 2005. "A Comprehensive Conceptualization of Post-Adoptive Behaviors Associated with Information Technology Enabled Work Systems," *MIS Quarterly* (29:3), pp. 525-557.

Jen, W.-Y., and Chao, C.-C. 2008. "Measuring Mobile Patient Safety Information System Success: An Empirical Study," *International Journal of Medical Informatics* (77:10), pp. 689-697.

Kouroubali, A. 2002. "Structuration Theory and Conception-Reality Gaps: Addressing Cause and Effect of Implementation Outcomes in Health Care Information Systems," in *Proceedings of the 35th Hawaii International Conference on System Sciences*.

Krabbel, A., Wetzel, I., and Ratuski, S. 1996. "Participation of Heterogeneous User Groups: Providing an Integrated Hospital Information System," in *Proceedings of the Participatory Design Conference*, Cambridge, Massachusetts, pp. 241-249.

Lagroue III, H.J. 2008. "The Effectiveness of Virtual Facilitation for Supporting Group Decision Making," *International Journal of Information and Decision Sciences* (1:2), pp. 164-177.

Lee, F., Teich, J. M., Spurr, C. D., and Bates, D. W. 1996. "Implementation of Physician Order Entry: User Satisfaction and Self-Reported Usage Patterns," *Journal of the American Medical Informatics Association* (3:1), pp. 42-55.

Mahoney, C. D., Berard-Collins, C. M., Coleman, R., Amaral, J. F., and Cotter, C. M. 2007. "Effects of an Integrated Clinical Information System on Medication Safety in a Multi-Hospital Setting," *American Journal of Health-System Pharmacy* (64), pp. 1969-1977.

McGill, T., Hobbs, V., and Klobas, J. 2003. "User-Developed Applications and Information Systems Success: A Test of DeLone and McLean's Model," *Information Resources Management Journal* (16:1), pp. 24-45.

Mekhjian, H. S., Kumar, R. R., Kuehn, L., Bentley, T. D., Teater, P., Thomas, A., Payne, B., and Ahmad, A. 2002. "Immediate Benefits Realized Following Implementation of Physician Order Entry at an

Academic Medical Center," *Journal of the American Medical Informatics Association* (9:5), pp. 529-539.

Microsoft Amalga White Paper. 2009. "Closing the Loop in Medication Management".   url: http://download.microsoft.com/download/A/A/D/AAD187F7-943A-4540-8826-41720E146F6C/Amalga_CloseLoop_WhitePaper_040309.pdf (accessed April 15, 2011).

Ng, B.-Y., and Kankanhalli, A. 2009. "IT Impact on Individual Work: A Study in the Context of Healthcare Services," in *Proceedings of the 13th International Conference on Information Systems,* Phoenix, Paper 111.

Nunnally, J. C. 1978. *Psychometric Theory*, McGraw-Hill, New York.

Ollman, B. 1971. *Alienation: Marx's Conception of Man in Capitalist Society*, Cambridge: Cambridge University Press.

Paoletti, R. D., Suess, T. M., Lesko, M. G., Feroli, A. A., Kennel, J. A., Mahler, J. M., and Sauders, T. 2007. "Using Bar-code Technology and Medication Observation Methodology for Safer Medication Administration," *American Journal of Health-System Pharmacy* (64:1), pp. 536-543.

Pare, G., Lepanta, L., Aubry, D., and Sicotte, C. 2005. "Toward a Multidimensional Assessment of Picture Archiving and Communication System Success," *International Journal of Technology Assessment in Health Care* (21:4), pp. 471-479.

Rai, A., Lang, S. S., and Welker, R. B. 2002. "Assessing the Validity of IS Success Models: An Empirical Test and Theoretical Analysis," *Information Systems Research* (13:1), pp. 50-69.

Reinig, B.A., and Shin, B. 2002. "The Dynamic Effects of Group Support Systems on Group Meetings," *Journal of Management Information Systems* (19:2), pp.303-325.

Ringle, C. M., Wende, S., and Will, S. 2005. SmartPLS 2.0, Hamburg, http://www.smartpls.de

Salisbury, W.D., and Stollak, M.J. 1999. "Process Restricted AST: An Assessment of Group Support Systems Appropriation and Meeting Outcomes using Participant Perceptions," in *Proceedings of the 20th International Conference on Information Systems*, Paper 3.

Sarker, S., Valacich, J.S., and Sarker, S. 2005. "Technology Adoption by Groups: A Valence Perspective," *Journal of the Association for Information Systems* (6:2), pp.37-71.

Schwieger, D., Melcher, A., Ranganathan, C., and Wen, H. J. 2006. "Applying Adaptive Structuration Theory to Health Information Systems Adoption: A Case Study," *International Journal of Healthcare Information Systems and Informatics* (1:1), pp. 78-92.

Sedera, D., and Tan, F. 2007. "Reconceptualizing Usage for Contemporary Information Systems (ERP) Success," in *Proceedings of The 15th European Conference on Information Systems*.

Skinner, R. I. 2003. "The Value of Information Technology in Healthcare," *Frontiers of Health Services Management* (19:3), pp. 3-15.

Straub, D., Boudreau, M.-C., and Gefen, D. 2004. "Validation Guidelines of IS Positivist Research," *Communications of the Association for Information Systems* (13:1), pp. 380-426.

Streitenberger, L., Breen-Reid, K., and Harris, C. 2006. "Handoffs in Care: Can we Make them Safer?" *Pediatric Clinics of North America* (53:6), pp. 1185-1195.

Taylor, S., and Todd, P. A. 1995. "Understanding Information Technology Usage: A Test of Competing Models," *Information Systems Research* (6:2), pp. 144-176.

Venkatesh, V., Morris, M., Davis, G., and Davis, F. 2003. "User Acceptance of Information Technology: toward a Unified View," *MIS Quarterly* (27:3), pp. 425-478.

Wheeler, B.C., and Valacich, J.S. 1996. "Facilitation, GSS, and Training as Sources of Process Restrictiveness and Guidance for Structured Group Decision Making: An Empirical Assessment," *Information Systems Research* (7:4), pp.429–450.