Determinants of User Satisfaction with a Clinical Information System

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ABSTRACT

Clinical Information Systems (CIS) implementation has faced user resistance. Consequently, we aimed to assess the acceptability of an integrated CIS.

We designed an electronic survey instrument from two theoretical models (Delone and McLean, and Technology Acceptance Model). Dimensions hypothesized to be determinant of user satisfaction were: user characteristics, CIS use, quality, usefulness, and service quality. The questionnaire was administered to physicians, nurses and medical secretaries of the Georges Pompidou European university Hospital (HEGP) in Paris.

Answers were obtained from 324 users (93 physicians, 174 nurses, and 57 secretaries). Cronbach's alpha coefficients showed a correct reliability within each dimension. Secretaries and nurses were more satisfied with the CIS than physicians. Except for CIS use, after adjustment for confounders, female gender, perceived CIS quality, usefulness, and service quality were strongly correlated with user satisfaction.

This study reinforces the necessity of several models and dimensions to evaluate the acceptability of a complex CIS, with a specific approach for different user profiles.

INTRODUCTION

Clinical Information Systems (CIS) have often been promoted as an efficient means to deliver high quality care through rapid information retrieval and efficient data management. However, CIS have experienced high levels of user resistance [1,2]. The understanding of a successful CIS implementation is therefore critical to improved health care services as a whole [3,4].

Many factors affect the use of CIS components by health professionals [5]. Lee et al. evaluated user satisfaction with computerized provider order entry (CPOE) functions. They found that overall user satisfaction is one of the main determinants of user adoption. According to the technology acceptance model (TAM), perceived usefulness and perceived ease of use are two fundamental determinants of user satisfaction and utilization [6].

In this study we sought to identify the determinants of overall CIS user satisfaction. Building on the TAM and the DeLone & McLean Information System Success models [6,7], we focused on the following five dimensions: user characteristics, user satisfaction, use, system quality, perceived usefulness, and service quality. We report in this paper the results of the answers to an electronic questionnaire evaluating these dimensions according to the different viewpoints of physicians, nurses, and medical secretaries of the Georges Pompidou University hospital.

METHODS

Study Setting

The investigation was performed at the "Hôpital Européen Georges Pompidou" (HEGP) in Paris, an 825-bed university hospital in southwest Paris. HEGP is divided in three major departments: emergency and internal medicine, cardiovascular and oncology [7]. HEGP opened in July 2000 with a park 1500 PCs and 350 shared printers. After six years of operating, HEGP now possesses a computer fleet of more than 2400 active fixed PCs (of which 150 are mobile laptops) and 500 shared printers. In clinical routine investigations, more than 2000 health professionals use the health record components of the HEGP, with more than 1000 simultaneous users at peak hours. All medical units share the same integrated CIS functions.

The HEGP CIS components

The HEGP CIS consists of a set of business components integrated through an enterprise application integration (EAI) platform [7]. Health-related components cover the following functions: Patient Portal (PP) giving access to the permanent life-long record and the other CIS functions, Admission, Discharge and Transfer (ADT), multimedia EPR, CPOE, appointment and patient scheduling (APS). The CIS manages both administrative and clinical data [7]. The EAI platform includes the single-sign on and security component, the HL7/CCOW management, the message communication middleware, and a reference manager (including hospital structures, dictionaries and nomenclatures, and protocol management).

Survey Instrument

The survey consisted of 42 to 56 questions, depending on whether the respondent was a physician, a nurse or a

secretary (Table 1). Questions were selected among items of previously published/validated instruments and used), and used seven-point Likert scales whenever possible [9]. The survey was designed to measure user characteristics, user satisfaction, CIS use, quality, usefulness, and service quality. We focused on eighteen CIS functions requested by system users. It was hypothesized that the "User characteristics", the CIS quality and usefulness, and the Service Quality were individually associated with *User satisfaction* (H1) and *CIS Use* (H2), as illustrated in Figure 1. This paper mainly addresses hypothesis H1.
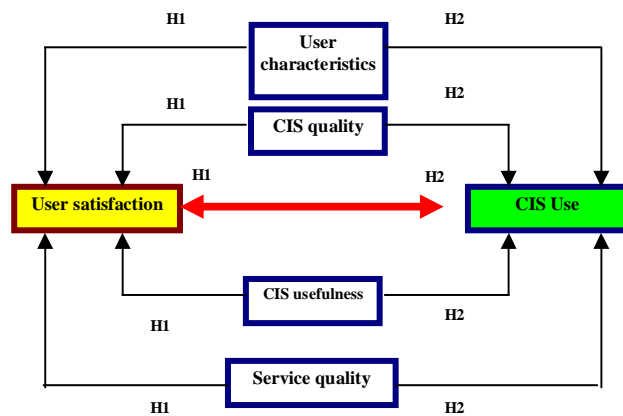

Figure 1: Theoretical Model

User characteristics asked users for personal information. **User satisfaction** was assessed for each major CIS component *(PP, EPR, CPOE, and APS)*. The item "CIS vs.Paper System" was assessed by the question: "*I am satisfied with the current CIS as compared to a paper-based system*", on a Likert scale, where 1=Strongly disagree, 2=Disagree, 3=Somewhat disagree, 4=Neutral (neither disagree nor agree), 5=Somewhat agree, 6=Agree, 7=Strongly agree. The last item measured the satisfaction level for time spent with the CIS. **CIS use** assessed the frequency of use of each CIS function, using a Likert scale, where 1=Very rarely, 2=Rarely, 3=Rather rarely, 4=Occasionally, 5= Rather frequently, 6=Frequently, 7=Very frequently. Perceived **CIS quality** measured the main characteristics of the IS including its ease of use, the response time, the time to access information (connection time), and the perceived degree of confidentiality of data. The sub-dimensions (constructs) such as perceived ease of use and response time were evaluated according to the functionalities used in daily practice by each category of users. Perceived **CIS usefulness** focused on two impact levels, perceived improvement of effectiveness at work and perceived improvement of care quality. For the second impact level, in order to apply the item to medical secretaries, we modified the item addressing physicians and nurses to: "the CIS

improves my quality of work for the patient". Perceived S*ervice quality* assessed the quality of the CIS support including the quality of the hotline support, the training quality, and the availability of PCs at workplace.

Table 1: Description of survey (number of items)

Constructs		Nb. questions		
		P†	N†	S†
User characteristics	Sex	1	1	1
	Age (years)	1	1	1
	Senior grade	1	1	
	Previous computer experience	1	1	1
	Seniority at work	1	1	1
	Working unit	1	1	1
	Incentives from hierarchy	1	1	1
	Perceived use by other colleagues	1	1	1
User satisfaction	*Satisfaction with CIS components*	3	2	4
	Current CIS vs. paper	1	1	1
	Perceived time spent on computer	1	1	1
CIS use	*Frequency of use*	12	7	12
Perceived CIS Quality	*Perceived ease of use*	11	7	11
	Response times	11	7	9
	Connection time	1	1	1
	CIS confidentiality	1	1	1
Perceived CIS Usefulness	Improved work effectiveness	1	1	1
	Improved care quality	1	1	1
Perceived Service Quality	Quality of the hotline support	1	1	1
	Speed to repair	1	1	1
	CIS training in the computing department	1	1	1
	CIS personalized training at work place	1	1	1
	Availability of PC	1	1	1
Total number of questions		**56**	**42**	**54**

† *Questionnaire type: P=physicians, N=nurses, S=secretaries*

Administration procedure

The survey population consisted of all physicians (600 different physicians representing 400 full-time equivalents), nurses (n = 1300) and medical secretaries (n = 180) believed to be regular users of the CIS at the time of the survey. An e-mailed letter containing a direct link to the survey was sent to all physicians, nurses, and secretaries, *i.e.* all hospital staff who have an access login to the CIS.

Users were encouraged to directly respond to the questionnaire online through the Intranet. The survey of physicians and nurses was conducted between April and May 2004, and medical secretaries in May 2004. Each week, systematically, targeted reminders were sent out to all the CIS users.

Method of analysis

Description of answers

Analyses focused on the success of a particular dimension. Mean answers with their standard deviations (SD) were calculated for sets of questions pertaining to a similar domain. For the sub-dimensions including frequency of use, perceived ease of use, and response time, which assesses the various functions of the CIS, we computed an aggregated variable for the EPR, CPOE and APS functions respectively. The

aggregated variables for the satisfaction, quality, and usefulness dimensions were named respectively overall CIS satisfaction (OCS), quality (OCQ), and usefulness (OCU).

Mean answers of the different user profiles were compared by F tests. Relationships between overall satisfaction and items within the different dimensions were examined using correlation analysis. To address our research hypothesis, we performed separate univariate and multivariate regression analyses using overall satisfaction as the dependent variable and all other variables as independent variables. Only the significant variables in the univariate analyses were selected for the multivariate regression model. Analyses were performed using the statistical packages STATVIEW® and STATA®.

Validity of the instrument

We evaluated the content and validity of the questionnaire in a pre-test phase, i.e. the questionnaire was administered to a small group of potential respondents (10 physicians, 20 nurses and 8 medical secretaries), in order to collect a structured feedback on the content of each measure, the length of the instrument, the format of the scale, and the clarity of the questions.

The reliability for each dimension and sub-dimension (e.g., component satisfaction, perceived ease of use) was calculated on the final set of answers (n=324) using Cronbach's alpha coefficients (Table 2). In general all values were at least equal to 0.6, except in one case for nurses (0.37) and secretaries (0.40). The values above 0.6 were in an acceptable range with respect to previous studies and most were above 0.80 which was considered very good. [10,11].

Table 2: Validity of the instrument (Cronbach's Alpha)

Constructs	Physicians (n=93)	Nurses (n=174)	Secretaries (n=57)
USE	0.83	0.72	0.40
User Satisfaction	0.83	0.37	0.74
Satisfaction with components	*0.77*	*0.83*	*0.84*
Perceived CIS Quality	0.77	0.60	0.76
Perceived Ease of Use	*0.87*	*0.82*	*0.94*
Response Time	*0.95*	*0.90*	*0.60*
Perceived CIS Usefulness	0.91	0.79	0.98
Perceived Service Quality	0.69	0.78	0.77
Support Quality	*0.83*	*0.78*	*0.87*
Training Quality	*0.77*	*0.79*	*0.80*

RESULTS

Description of answers by dimension

User characteristics

A total of 324 users responded to the survey. The response rate was 16%, 13% and 32% for physicians, nurses and medical secretaries, respectively. Most respondents were females (75.7%), 49% were aged between 31 and 45 years, and 69.3% had two-year

seniority or more at HEGP. The level of computer experience differed greatly between the three professional groups ($p < .0001$).

User satisfaction

As shown in table 3, users were overall satisfied with the CIS components (mean = 4.64). Secretaries were more satisfied with the CIS functions than the nurses and physicians ($p < .001$). All groups declared to prefer the CIS to a paper-based system with the highest score in the nurse group (p<0.001). Furthermore, compared to nurses and secretaries, physician had the perception of spending more time using the CIS (p<0.001).

Table 3 Factors describing the User Satisfaction Dimension - Means (SD)

	Physicians (n=93)	Nurses (n=174)	Secretaries (n=57)	Total (n=324)	p
CSAT*	4.15 (1.42)	4.72 (1.53)	5.14 (1.37)	4.64 (1.51)	<.001
CSP*	4.48 (1.80)	5.72 (1.92)	4.93 (1.74)	5.22 (1.93)	<.001
TSC*	3.32 (1.80)	3.69 (1.71)	4.47 (1.81)	3.73 (1.79)	<.001
OCS	**3.93 (1.58)**	**4.69 (1.50)**	**4.86 (1.36)**	**4.50 (1.38)**	*<.001*

*CSAT=Component Satisfaction, CSP= CIS vs Paper,
TSC = Time Spent on Computer, OCS= Overall CIS satisfaction;*

Use

As shown in table 4, secretaries were the most frequent users of the CIS functions, and the only users of the appointment and scheduling functions (mean = 5.41). CPOE use concerned all the clinical, investigation and therapeutic orders for physicians and the nursing orders for nurses.

Table 4 Factors describing the CIS Use Dimension - Means (SD)

	Physicians	Nurses	Secretaries	Total	p
PP	2.68 (2.11)	2.69 (2.20)	4.88 (2.44)	3.11 (2.38)	<.001
EPR	4.88 (1.41)	5.81 (1.39)	5.10 (1.40)	5.42 (1.46)	<.001
CPOE	5.19 (1.98)	4.27 (2.63)		4.65 (2.42)	<.001
APS			5.81 (1.64)	5.81 (1.64)	
USE*	**4.31 (1.38)**	**4.69 (1.63)**	**5.41 (1.13)**	**4.70 (1.52)**	*<.001*

CIS functions use PP=Patient Portal, EPR= Electronic Patient Record, CPOE=Computer Provider Order Entry, APS=Appointment and Patient Scheduling

Perceived CIS quality

The item concerning *ease of use* received very good overall scores (mean = 5.00) (Table 5).

Table 5 Factors describing the CIS Quality Dimension - Means (SD)

	Physicians	Nurses	Secretaries	Total	p
Ease of use	4.61 (1.30)	5.07 (1.61)	5.41 (1.35)	5.00 (1.51)	<.01
PP	*4.06 (1.88)*	*3.72 (2.04)*	*5.76 (1.41)*	*4.30 (2.04)*	*<.001*
EPR	*4.84 (1.28)*	*5.68 (1.36)*	*5.33 (1.64)*	*5.38 (1.43)*	*<.001*
CPOE	*4.53 (1.54)*	*4.80 (2.14)*		*4.69 (1.92)*	*NS*
APS			*5.24 (1.63)*	*5.24 (1.63)*	
RT*	4.08 (1.56)	4.33 (1.66)	3.92 (1.52)	4.19 (1.61)	NS
CT*	3.49 (1.70)	3.89 (1.78)	4.07 (1.72)	3.82 (1.76)	NS
Confidentiality	3.32 (1.80)	3.69 (1.71)	4.47 (1.81)	3.73 (1.79)	<.001
OCQ*	**3.81 (1.26)**	**4.42 (1.27)**	**4.60 (1.29)**	**4.06 (1.38)**	*<.001*

*RT = Response Time; CT = Connection Time;
OCQ= Perceived overall CIS quality*

However, it was better perceived by secretaries and nurses (p<0.01) than by physicians.

Response and connection times to the CIS were considered to be acceptable, reducing the overall perception of the CIS quality. Secretaries' general

perception of the CIS quality was better than that of nurses and physicians (p<.001).

Perceived CIS usefulness

Perception of the system usefulness was high especially among nurses (Table 6) with a highly significant difference among professions (p<0.001).

Table 6: Factors describing System Usefulness (**SYSU**) Means (SD)

	Physicians	Nurses	Secretaries	Total	*P*
IEW[*]	4.12 (1.95)	6.31 (1.29)	5.04 (1.98)	5.45 (1.90)	<.001
ICQ[*]	3.89 (1.84)	4.30 (2.20)	5.12 (1.97)	4.33 (2.10)	.001
OCU*	**3.97 (1.84)**	**5.31 (1.28)**	**5.08 (1.96)**	**4.88 (1.69)**	<.001

[*]IEW=Improve Effectiveness of Work, ICQ= Improved Care Quality OCU= Overall perceived CIS usefulness

Perceived service quality

Quality of support (i.e. quality of the hotline support, speed to repair) was considered low according to the hospital objectives (Table 7). "*Training quality*" was averagely acceptable (mean = 4.16) with higher values in the physician and secretaries groups (p<.05).

Table 7: Factors describing Service Quality - Means (SD)

	Physicians	Nurses	Secretaries	Total	*P*
MSQ[*]	3.41 (1.65)	3.54 (1.74)	3.98 (2.04)	3.58 (1.78)	*NS*
MTQ[*]	4.41 (1.72)	3.90 (1.92)	4.47 (1.89)	4.16 (1.87)	*<.05*
PCA*	3.57 (2.18)	3.98 (1.77)	4.81 (2.16)	4.01 (2.01)	*<0.001*
OSQ*	**3.77 (1.38)**	**3.79 (1.37)**	**4.42 (1.51)**	**3.90 (1.42)**	*<.01*

[*]MSQ=Mean support quality; MTQ=Mean training quality; PCA= PC availability at workplace; OSQ= Overall service quality

Determinants of overall satisfaction

Table 8 presents the univariate correlation coefficients between "overall CIS satisfaction" considered as the dependent variable and the other as independent variables. In the overall population (n=324), satisfaction was positively and significantly correlated with two environment variables (incentive to use the system from the hierarchy and perceived use by colleagues), with perceived system quality, perceived usefulness and perceived quality of services (support, training and PCs availability at workplace). Female users better accepted the system than male users. Satisfaction was not correlated with age, seniority at work or the type of medical unit. Similar correlations were observed in the three professional groups. Influence of gender could only be interpreted in the group of physicians since the number of male nurses and secretaries was too small to infer conclusions.

Table 9 summarizes the results of multivariate analysis on the overall satisfaction. The percentage of variance explained by our model was high for this analysis (54.3% in the overall group), with the best results in the physician group (80.0%). The degree of use, computer experience, incentive from the hierarchy, and perceived use by other colleagues were not significant. Male sex was the only determinant that remained significant. The CIS

quality, perceived usefulness and the service quality remained significant determinants of overall CIS satisfaction.

Table 8: Correlation coefficients with the **O**verall CIS Satisfaction

	Physicians	Nurses	Secretaries	Total
	r (p)	*r (p)*	*r (p)*	*r (p)*
USE	.17 (NS)	.27 (.001)	.45 (.001)	.30 (<.001)
User characteristics				
Male Sex	-.32 (.01)			-.28 (<.001)
Age	-.07 (NS)	.07 (NS)	.18 (NS)	-.02 (NS)
CEXP	-.13 (NS)	-.05 (NS)	-.06 (NS)	-.09 (NS)
SW	-.10 (NS)	.03 (NS)	-.04 (NS)	.01 (NS)
SU	-.16 (NS)	-.09 (NS)	.15 (NS)	-.02 (NS)
ER	.04 (NS)	-.08 (NS)	.12 (NS)	-.01 (NS)
MU	.06 (NS)	.10 (NS)	-.12 (NS)	.01 (NS)
IH	.10 (NS)	.33 (<.001)	.27 (NS)	.23 (<.001)
PUC	.28 (NS)	.45 (<.001)	.55 (<.001)	.26 (<.001)
OCQ*	**.79 (<.001)**	**.54 (<.001)**	**.78 (<.001)**	**.68 (<.001)**
*PEU**	*.70 (<.001)*	*.40 (<.001)*	*.71 (<.001)*	*.55 (<.001)*
Response time	*.81 (<.001)*	*.44 (<.001)*	*.59 (<.001)*	*.56 (<.001)*
Connection time	*.68 (<.001)*	*.43 (<.001)*	*.73 (<.001)*	*.56 (<.001)*
Confidentiality	*.30 (0.01)*	*.34 (<.001)*	*.48 (0.001)*	*.40 (<.001)*
OCU*	**.83 (<.001)**	**.38 (<.001)**	**.60 (<.001)**	**.63 (<.001)**
*IEW**	*.83 (<.001)*	*.32 (<.001)*	*.61(<.001)*	*.58 (<.001)*
*ICQ**	*.77 (<.001)*	*.26 (.001)*	*.58 (<.001)*	*.48 (<.001)*
OSQ*	**.56 (<.001)**	**.39 (<.001)**	**.59 (<.001)**	**.48 (<.001)**
*MSQ**	*.22 (<.05)*	*.26 (.001)*	*.54 (<.001)*	*.32 (<.001)*
*MQT**	*.40 (.001)*	*.29 (.0002)*	*.51 (<.001)*	*.33 (<.001)*
*PCA**	*.54 (<.001)*	*.40 (<.001)*	*.29 (.0287)*	*.45 (<.001)*

*CEXP=Computer experience, SW= Seniority at work, SU=Surgical unit, ER=Emergency/Intensive care unit, IH=Incentives from my hierarchy, PUC=Perceived use by other colleagues, OCQ=Perceived Overall CIS quality; OCU= Perceived overall CIS usefulness; PEU=Perceived ease of use; OSQ= Overall service quality; MSQ=Mean support quality; MTQ=Mean training quality; PCA= PC availability at workplace

Table 9: Multivariate regression analysis on Overall CIS satisfaction

	Physicians		Nurses		Secretaries		Total	
	B	*p**	*B*	*p**	*B*	*p**	*B*	*p**
USE	-.08	(NS)	.06	(NS)	.12	(NS)	.02	(NS)
Male sex	-.46	.0033	-.06	(NS)	-.30	(NS)	-.31	.0224
*CEXP**	.02	(NS)	.02	(NS)	-.08	(NS)	.02	(NS)
*IH**	-.13	.0235	.05	(NS)	-.03	(NS)	-.02	(NS)
*PUC**	.13	.043	-.01	(NS)	.04	(NS)	-.01	(NS)
OCQ*	.34	.0006	.21	.012	.53	<.0001	.37	<.0001
OCU*	.46	<.0001	.21	.0025	.13	(NS)	.30	<.0001
OSQ*	.08	(NS)	.21	.0077	.22	.036	.19	<.0001
R² (%)	*80.0*		*26.0*		*63.3*		*54.3*	
P	*<.0001*		*<.0001*		*<.0001*		*<.0001*	

* Same abbreviations as above

DISCUSSION

This electronic survey was designed to investigate the determinants of CIS user satisfaction for physicians, nurses, and secretaries at the Georges Pompidou university hospital. Our results suggest that users are globally satisfied with the CIS, as compared with a paper-based information system. The different CIS components were used by all user profiles but satisfaction was higher in the group of medical secretaries than in the nurses and doctors' groups. Global satisfaction of all CIS users was significantly associated with CIS quality, CIS use and service quality, which supports our first hypothesis based on

the Delone & Mclean model [7].

The survey reported by Lee et al. referred to close dimensions as determinants of satisfaction (ease of use, frequency of use, response times, and individual user characteristics) [5]. They also found that doctors were more satisfied than nurses, which does not correspond to our findings. Conversely, Laerum et al. observed that secretaries generally used HIS functionalities more frequently in their daily tasks and were more satisfied than nurses or doctors [11]. In the multivariate analysis, the CIS use dimension did not appear anymore as a significant determinant of overall CIS satisfaction, thus partly invalidating our hypothesis derived from the TAM and Delone & Mclean models.

Some subjective norms (e.g. "incentives from hierarchy", "perceived use by other colleagues") reported as predictive of the selection and adoption of new information technologies in previous studies [12, 13] were not significantly associated with satisfaction in our data, after adjustment for confounders in multivariate analysis.

Several limitations of our study have to be emphasized. The understanding of the determinants of success influencing the overall satisfaction of physicians, nurses and secretaries is important for the improvement and future developments of a Clinical Information System. The theoretical models used to account for the satisfaction and adoption of information technology are based on general constructs such as perceived ease of use, quality, subjective norms, etc. Since CIS is a complex system, which supports various functionalities and tasks for various user profiles, we found it necessary to design an evaluation instrument, which addressed these different dimensions, across all main components of the CIS. Thus, the evaluation instrument was necessarily adapted to our context and reflected the integration of the functionalities of the CIS in the daily routine for each user profile considered. However, the overall response rate was low (less than 25%). Paramedics were also excluded from this study. Nevertheless, three user profiles could be investigated and aggregation of items enabled to measure and gain insight into determinants influencing satisfaction with a CIS. This approach is supported by the concept of combining several CIS research models [14] and may be useful for hospital based research studies.

Future perspectives of this work are to consolidate the validation of the instrument by a test-retest in the same hospital, and by evaluating its applicability in other academic hospital contexts. In parallel, determinants of use should be further analyzed to better grasp the complex relationships between the acceptability and use dimensions.

REFERENCES

1. Van Der Meijden TH, Troust J, Hasman A. Determinants of Success of Inpatient Clinical Information System: A Literature Review. *J. Am Med Inform Assoc*, 2003. 10: 235-243.
2. Banta HD. Embracing or rejecting innovations: clinical diffusion of health care technology. In Anderson JG, Jay SJ (eds). *Use and impact of computers in clinical medicine*. New York. Springer Verlag, 1987.
3. Sicotte C, Lehoux P, Champagne F. Computer-based patient record challenges towards timeles and spaceless medical practice. *J. Med Sys*, 1998. 22: 237-56.
4. Lehoux P, Denis J. Assessment of a computerized medical record system: Disclosing scripts to use. *Eval Progr Plan*, 1999. 22: p. 439-53.
5. Lee F, Spurr CD, Bates DW. Implementation of Physician Order Entry: User Satisfaction and Self-reported Usage Patterns. *J Am Med Inform Assoc*, 1996. 3: 42-55.
6. Davis FD, Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, 1989. 13: 319-339.
7. DeLone WH, McLean E., The DeLone and McLean Model of Information Systems Success: A Ten-Year Update. *J. Management Info System* 2003. 13: 9-30.
8. Degoulet P, Marin L, Lavril M et al. The HEGP component-based clinical information system. *Int J Med Inform.* 2003; 69: 115-26
9. Bailey JE, Pearson SW. Development of a tool for measuring and analyzing computer user satisfaction. *Manag Sci* 1983; 29: 530–45.
10. Cork RD, Detmer WM, Friedman CP. Development and initial validation of an instrument to measure physician's use of knowledge about, and attitudes toward computers. *J. Am Med Inform Assoc*, 1998. 5: 164-76.
11. Laerum H, Karlsen TH, Faxvaag A. Use of and attitudes to a hospital information system by medical secretaries, nurses and physicians deprived of the paper-based medical record: a case report. *BMC Med Inform Decis Mak*. 2004; 4: 18.
12. Chau PYK, Hu PJH. Investigating healthcare professionals' decisions to accept telemedicine technology: an empirical test of competing theories. *Information & Management*, 2002. 39: 297-311.
13. Karahanna E, Chervany NL. Information Technology Adoption Across Time: a Cross-Sectional Comparaison of Pre-Adaption and Post-Adoption Beliefs. *MIS Quarterly,* 1999. 23: 183-213.
14. Despont-Gros C, Mueller H, Lovis C. Evaluating user interactions with clinical information system: A model based on human-computer interaction models. *J. Bio Inf* 2005; 38: 244–55.

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