The development and evaluation of a nursing information system for caring clinical in-patient

Mei-Hua Wang (1st Affiliation)
Graduate Institute of Medical Informatics
Taipei Medical University
Taipei, Taiwan, R.O.C.

Yvonne Yu-Wen Fang (2nd Affiliation)
Department of Nursing
Hsin-Sheng College of Medical Care and Management
Taoyuan, Taiwan, R.O.C.

Shu-Fen Chen (3rd Affiliation)
Department of Nursing
Far Eastern Memorial Hospital
Taipei, Taiwan, R.O.C.

Chien-Tsai Liu (Corresponding),*
Graduate Institute of Medical Informatics
Taipei Medical University
Taipei, Taiwan, R.O.C.

Abstract—Purpose：The research aimed to develop a nursing information system in order to simplify the admission procedure for caring clinical in-patient, enhance the efficiency of medical information documentation. Therefore, by correctly delivering patients' health records, and providing continues care, patient safety and care quality would be effectively improved.

Methods：The study method was to apply Spiral Model development system to compos a nursing information team. By using strategies of data collection, working environment observation, applying use-case modeling, and conferences of Joint Application Design (JAD) to complete the system requirement analysis and design. The Admission Care Management Information System (ACMIS) mainly included: (1) admission nursing management information system. (2) inter-shift meeting information management system. (3) the linkage of drug management system and physical examination record system. The framework contained qualitative and quantitative components that provided both formative and summative elements of the evaluation. System evaluation was to apply information success model, and developed questionnaire of consisting nurses' acceptance and satisfaction. The results of a total 309 questionnaires were: users' satisfaction, the perceived self involvement, age and information quality were positively to personal and organizational effectiveness.

(65.3% effectiveness =0.771+.550× users' satisfaction +.238×Nurses'involvement+.110×age+.114× NIS quality).

According to the results of this study, the Admission Care Management Information System was practical to simplifying clinic working procedure and effective in communicating and documenting admission medical information.

key words：admission care；in-patient；nursing information system

I. INTRODUCTION

Nursing information systems (NIS) are computer systems that manage clinical data from a variety of healthcare environments, and made available in a timely and orderly fashion to aid nurses in improving patient care. There has been rapid growth and expectations of health care information systems and technology in health care settings. The study's purpose is to develop and evaluate the nursing information system to enhance for admission in-patients care and patients' safety.

A. Literature Review

The spiral model was defined by Barry Boehm in his 1988 article "A Spiral Model of Software Development and Enhancement". This model was not the first model to discuss iterative development, but it was the first model to explain why the iteration matters. As originally envisioned, the iterations were typically 6 months to 2 years long. Each phase starts with a design goal and ends with the client (who may be internal) reviewing the progress thus far. Analysis and engineering efforts are applied at each phase of the project, with an eye toward the end goal of the project. The steps in the spiral model iteration can be generalized as follows:

1. The new system requirements are defined in as much detail as possible. This usually involves interviewing a number of users representing all the external or internal users and other aspects of the existing system.
2. A preliminary design is created for the new system. This phase is the most important part of "Spiral Model". In this phase all possible (and available) alternatives, which can help in developing a cost effective project are analyzed and strategies are decided to use them. This phase has been added specially in order to identify and resolve all the possible risks in the project development. If risks indicate any kind of uncertainty in requirements, prototyping may be used to proceed with the available data and find out possible solution in

order to deal with the potential changes in the requirements.

3. A first prototype of the new system is constructed from the preliminary design. This is usually a scaled-down system, and represents an approximation of the characteristics of the final product.

4. A second prototype is evolved by a fourfold procedure:
   (1) evaluating the first prototype in terms of its strengths, weaknesses, and risks;
   (2) defining the requirements of the second prototype;
   (3) planning and designing the second prototype;
   (4) constructing and testing the second prototype.

II. RESEARCH DESIGN AND METHODS

A. Design and Methods

The study method was to apply Spiral Model development system to compos a nursing information team. By using strategies of data collection, working environment observation, applying use-case modeling, and conferences of Joint Application Design (JAD) to complete the system requirement analysis and design 【figure1】. The Admission Care Management Information System (ACMIS) mainly included: (1) admission nursing management information system. (2) inter-shift meeting information management system. (3) the linkage of drug management system and physical examination record system 【figure 2】. The framework contained qualitative and quantitative components that provided both formative and summative elements of the evaluation. System evaluation was to apply information success model, and developed questionnaire of consisting nurses' acceptance and satisfaction.

B.. Some of the features that are provided by Nursing Information Systems includ|e:

▪ Patient Charting: A patient's vital signs, admission and nursing assessments, care plan and nursing notes can be entered into the system either as structured or free text. These are the stored in a central repository and retrieved when needed.

▪ Staff Schedules: Nurse can self schedule their shifts using scheduling rules provided in shift modules. The shifts can later be confirmed or changed by a scheduling coordinator or manager. Shift modules are designed to handle absences, overtime, staffing levels and cost-effective staffing.

▪ Clinical Data Integration: Here clinical information from all the disciplines can be retrieved, viewed and analysis nursing staff and then integrated into a patient's care plan.

▪ Decision Support: Decision support module can be added to Nursing Information Systems, and they provide prompts and reminders, along with guides to disease linkages between signs/symptoms, etiologies/related factors and patient populations. Online access to medical resources can also be made available.

III. RESULT

The results of a total 309 questionnaires were: users' satisfaction, the perceived self involvement, age and information quality were positively to personal and organizational effectiveness. 【Table 1】 【Table2】 【Table 3】:

User involvement in questionnaire，the "system quality" showed that（$r = .517$, $p<.01$），the "information quality" showed that（$r = .483$, $p<.01$），"services quality"（$r = .517$, $p<.01$），the "user attitudes" showed that（$r = .523$, $p<.01$），the "user satisfaction" showed that（$r = .560$, $p<.01$），and "personal /organizational effectiveness" showed that（$r = .638$, $p<.01$）. User satisfaction and experiences are other areas of interest within nursing literature on Nursing Information Systems evaluation research. Nurses' attitudes have been defined as a key element for implementation success. Although, conflicting results make conclusions difficult, agreement can be found regarding satisfaction with the timely and efficient retrieval of results with Nursing Information Systems. Time-consuming, no clinically relevant and system problem described by users. Attitudes studies have also analysed the correlation between nurses' attitudes and satisfaction with demographic data such as age, prior experience with computers, experience in nursing, educational background, with conflicting results.

There are benefits to be enjoyed by implementing Nursing Information Systems and they include:

▪ Improved workload functionality: Staffing levels and appropriate skill mix per shift can be more easily determined by the shift modules. This leads to less time spent in designing and amending rosters.

▪ Better care planning: Time spent on care planning is reduced, while the quality of what is recorded is improved. This makes for more complete care plans and more complete assessments and evaluations.

▪ Better drug administration: Electronically prescribed drugs are more legible, thus making it less likely that drugs would be wrongly administered to patients.

IV. CONCLUSION

The nursing occupation depends on accurate and timely access to appropriate information to perform the great variety of professional activities involved in patient and community care. Nursing information integrates technical knowledge, quality control, and the clinical and administrative documentation of services provided. Nurses need information about available resources, science development, and patient needs for decision making. Nurses need access to information for program planning, for the operation and supervision of clinical and management interventions and to evaluate the outcomes of care

The effectiveness and efficiency of nursing can be evaluated by assessing how patient outcomes are affected by nursing practice. Nursing sensitive outcomes refer to observable and measurable changes in the health status or behaviors of patients as a result of nursing actions.

REFERENCES

Anthony MK, Preuss G. Models of care: The influence of nurse communication on patient safety. Nursing Economics 2002; 20(5): 209~215.

Ballard EC. Improving information management in ward nurses' practice. Nursing Standard 2006; 20(50): 43-48.

Bates DW, Gawande AA. Improving safety with information technology. The New England journal of medicine 2003; 348(25): 2526-2534.

Bridges AK. Welcome to the Dark Side: How Nurses in Information Systems Contribute to Patient Care. CIN : Computers, Informatics, Nursing 2007; 25(3): 127-130.

Charters KG. Nursing Informatics, Outcomes, and Quality Improvemen. AACN 2003; 14(3): 282-294.

Courtney KL, Alexander GL. Information Technology: Changing Nursing Processes at the Point-of-Care. Nursing administration quarterly 2005; 29(4): 315-322.

DeLone WH, MeLean ER. The DeLone and McLean Model of Information Systems Success: A Ten-Year Update. Journal of Management Information Systems 2003; 19(4): 9-30.

Hansten R. Streamline change-of-shift report. Nursing Management 2003; 34(8): 58-59.

Kalisch BJ, Hurley P, Hodges M, Landers D, Richter G, Stefanov S., et al. PI tool patches broken communication. Nursing Management 2007; 38(4): 16,18.

Nemeth C, Nunnally M, O'Connor M, Klock PA, Cook R. Getting to the point: Developing IT for the sharp end of healthcare. Journal of Biomedical Informatics 2005; 38(1): 18-25.

Sensmeler J. Survey says: care, communication enhanced by IT. Nursing management 2006; 37(10): 2-6.

Simpson RL. Patient and nurse safety: how information technology makes a difference. Nursing administration quarterly. 2005; 29(1): 97-101.

Simpson RL. Evidence-based Practice: How Nursing administration Makes IT Happen. Nursing administration quarterly 2006; 30(3): 291-294.

Speas J. Bolster staff relations with shift report. Nursing Management 2006; 37(10): 82-83.

Yi MY, Hwang Y. Predicting the use of web-based information systems : self-efficacy, enjoyment, learning goal orientation, and the technology acceptance model. Int. J. Human-Computer Studies 2003; 59: 431-449.
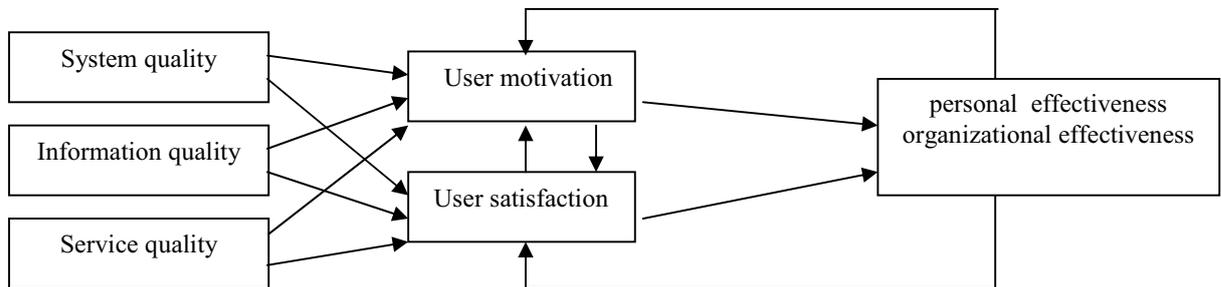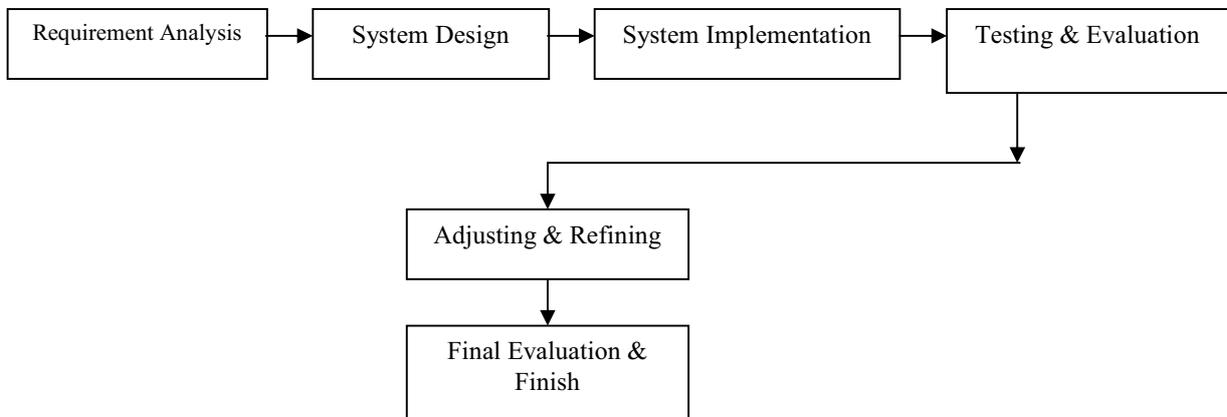
FIGURE 1: DELONEA & MCLEAN PROCESS MODEL

FIGURE 2: WATERFALL PROTOTYPING PROCESS MODEL

TABLE 1: INFORMATION SYSTEM SUCCESS MODUL EXPLANATION

		after R-square	F metage	significance	Durbin-Watson metage	factor Beta-measure	t	significance	Collinear statistics allowable error	VIF
Model 1 Dependent variable	User motivation	.677	4.354	.038	1.843					
Independent variable	(**Transact-SQL**)					.414	3.170	.002		
	User satisfaction					.366	6.854	.000	.397	2.516
	System quality					.232	4.259	.000	.380	2.630
	Service quality					.233	4.733	.000	.467	2.141
	Information quality					.110	2.087	.038	.408	2.450
Model 2 Dependent variable	User satisfaction	.649	18.767	.000	2.037					
Independent variable	(**Transact-SQL**)					.416	2.578	.010		
	User motivation					.489	9.855	.000	.500	2.000
	Information quality					.262	5.377	.000	.521	1.920
	User Attitude					.183	4.332	.000	.694	1.441
Model 3 Dependent variable	personal / organizational effectiveness	.653	5.565	.019	1.852					
Independent variable	(**Transact-SQL**)					.771	4.780	.000		
	User satisfaction					.550	10.674	.000	.461	2.170
	User attitude					.238	5.447	.000	.638	1.567
	age					.110	3.092	.002	.967	1.034
	Information quality					.114	2.359	.019	.520	1.924

TABLE：2 ANALYSIS OF SYSTEM EVALUATION

	items	Pre-evaluation Mean	SD	order	Post-evaluation Mean	SD	order	Paired-T t
1	System quality	3.19	.625	3	3.25	.622	6	1.220
2	Information quality	3.15	.675	4	3.37	.666	3	3.926
3	Service quality	3.19	.612	2	3.41	.656	2	5.077 *
4	User involvement	3.30	.593	1	3.47	.655	1	3.756 *
5	User satisfaction	3.09	.663	5	3.31	.705	5	3.941
6	personal /organizational effectiveness	2.94	.738	6	3.31	.764	4	5.885

explanation：* $p < .05$ ** $p < .01$

TABLE：3 ANALYSIS OF USER INVOLVEMENT AND STASFACTION

	items	Not so great （n=4）		Fair （n=25）		Good （n=157）		Great （n=103）		Excellent （n=17）	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	System quality	2.25	.957	2.65	.543	3.06	.485	3.61	.514	3.88	.645
2	Information quality	2.25	.957	2.68	.734	3.20	.509	3.72	.529	4.12	.719
3	Service quality	2.25	.957	2.75	.538	3.23	.532	3.79	.511	4.18	.611
4	User involvement	2.00	.707	**2.85**	**.634**	**3.28**	**.533**	**3.86**	**.460**	4.13	.695
5	User satisfaction	1.25	.500	2.52	.563	3.11	.535	3.75	.479	4.12	.638
6	personal/organizational effectiveness	1.19	.239	2.31	.528	3.06	.525	3.84	.440	**4.40**	**.707**