MEDINFO 2010
C. Safran et al. (Eds.)
IOS Press, 2010

doi:10.3233/978-1-60750-588-4-1202

Usability of Clinician Order Entry Systems in Singapore: An Assessment of End-User Satisfaction

Yung Ming Tan[a], JVPG Flores[b], Mee Lee Tay[b]

[a] *Department of Clinical Informatics, Integrated Health Information Systems (IHIS) Ltd., Singapore*
[b] *Department for Chronic Disease Management, Integrated Health Information Systems (IHIS) Ltd., Singapore*

Abstract

Objectives: To gather end-user feedback and evaluate factors that influence end-user satisfaction of order entry systems used in the hospitals under National Healthcare Group, Singapore. Design: Questionnaires were sent to a randomly selected group of 100 doctors and nurses. Results & Conclusions: 52 doctors and nurses responded to the survey. The users' satisfaction with the clinical systems was average. (Mean satisfaction score is 3.85 on a scale of 1 to 7). Users generally agree that the systems could help reduce patient care errors and improve delivery of quality care to patients. System reliability, intuitive navigational capabilities and ease of use are strongly and positively correlated with user satisfaction. System response time however, is found to be strongly but negatively correlated with user satisfaction with a correlation coefficient of -0.717 ($p<0.001$). These findings suggest that more efforts should be made to improve these aspects in order to improve user satisfaction. These elements should also form important considerations in all future clinical systems development.

Keywords:

Medical informatics, Medical order entry systems, Attitudes of health personnel, Consumer satisfaction.

Introduction

Computerized physician order entry (CPOE) systems have been shown to significantly reduce medication errors and improve quality of care in many studies [1, 2]. However despite the benefits of CPOE systems, many implementations have failed or met with high levels of user resistance [3, 4]. Studies have shown that it is vital to understand the needs of clinical users, the various system and human factors that can impact user satisfaction [5- 7]. A study by Bailey [8] found that user satisfaction is an important predictor of a system's success.

In Singapore, despite the increasing number of implementations over the years in public tertiary hospitals, there is a paucity of studies covering user satisfaction and perceptions of CPOE. One recent study in Singapore reported generally high user satisfaction levels with an electronic prescription system used by a group of general practice clinics [9].

In National Healthcare Group (NHG), Singapore, a CPOE user feedback survey was planned in early 2009 as part of a post-implementation review. The CPOE system for laboratory, radiology and medication orders was designed, custom-built and implemented over four years in several of its tertiary hospitals. To date, there are more than a thousand doctors and nurses using them daily.

The aim of this study is to: (a) determine the overall satisfaction level of NHG users (doctors and nurses) with respect to their order entry systems; and (b) identify the constructs that are associated with user satisfaction

This study will contribute an Asian perspective into the current body of knowledge around CPOE implementation, and the findings should help hospitals learn about the factors that influence clinician user satisfaction. The results may also provide further insights into how order entry systems should be designed to improve adoption and reduce user resistance.

Methods

Fifty doctors and fifty nurses from various institutions under the National Health Care Group (NHG) were randomly selected and requested to complete a pretested questionnaire based on the study of Lee et al [10]. The doctors and nurses were from both medical and surgical departments. The only inclusion criterion was that the users (doctors and nurses) must have worked for at least six months in the group. This was to ensure that the user surveyed has sufficient experience with the systems to give effective feedback.

The questionnaire is composed of 16 questions respectively attached to a seven-point Likert scale, where '1' corresponds to 'never'; '4' corresponds to 'it varies'; while '7' corresponds to "always' . There was also an inclusion of 6 open ended questions in the questionnaire to ensure that the exercise can capture important user feedback that may not be reflected by the 16 standardized questions.

The initial draft questionnaire was tested with 2 doctors and 2 nurses from both medical and surgical disciplines for face validity. The final questionnaire was then derived subsequently for use.

The survey tool is designed to measure the users' perception of reliability, speed of the systems, ease of use of the applications, adequacy of training to use the system, impact on productivity, impact on patient care and overall satisfaction with the clinician order entry systems. The questionnaire is made available in hard copy which is hand-delivered to those selected participant. At the same time, the selected participants are sent emails to introduce them to the study as well as to instruct them on how they can participate either through the hard-copied questionnaire or through a web-based survey tool.

The questionnaire contains a simple introduction and instructions. The survey responses were anonymous and participants were told that no individuals will be identified in the study. All doctors and nurses selected in our random sample had the right to refuse to participate without prejudice. This study was further reviewed and endorsed by the NHG Electronic Medical Records committee as a form of post-implementation user feedback.

Once the questionnaire was completed, the data was validated, edited for consistency and encoded into a spreadsheet for analysis.

Results

A total of fifty-two users handed in their questionnaires. About 98% of these responders were doctors and nurses with a ratio of 1:1. These health care professionals come from Alexandra Hospital, NHG Polyclinics, The National University Hospital and Tan Tock Seng Hospital representing both the Inpatient and the Outpatient sectors of the medical group.

Cronbach alpha of the data collection tool is measured to assess internal consistency of the questionnaire, i.e. 0.656. Factor analysis of the data collection tool suggests four statistically significant components present in the questionnaire. These components pertain to the following user satisfaction constructs: ease of use; facilitating efficiency of work; promotion of quality of care and patient safety; and availability of prompt assistance whenever the users need it.

Further assessment of the tool likewise reveals that the consistency of responses are much more homogenous among nurses than among physicians ($p<0.001$). There is no sufficient evidence to say however that internal consistency of the questionnaire varies across gender, across institutions and whether the user is either in the in-patient or outpatient setting.

The mean overall satisfaction score of the study population is estimated to be 3.85 ± 1.39. Figure 1 illustrates the distribution of satisfaction levels among users.

It can readily be seen in Figure 1 that about 33% of the respondents (those who answered "Frequently" or "Almost Always") find the clinical systems to be consistently satisfactory. There is no evidence that the satisfaction levels are different between doctors and nurses. There is likewise no evidence to suggest that satisfaction levels vary across institutions from where the samples are selected.

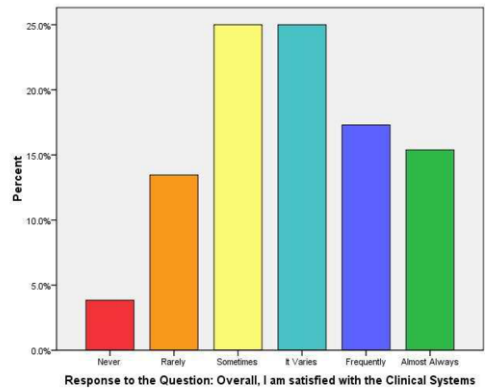

Figure 1- Distribution of Overall Satisfaction of Users on the Clinician Order Entry Systems, NHG Singapore, 2009.

Looking into some of the details, the study population has provided a good contrasting feedback, i.e. from good comments to areas of improvement. On one hand, the data suggest that the order entry systems are perceived not only to reduce patient care errors but also to improve delivery of quality of care to patients. As such, responders feel that the systems provide the necessary information for the health care providers to do their respective jobs better. Qualitatively, doctors like the fact that they can access clinical information remotely and that they can find information in "one place." Nurses likewise highlighted that with the clinical systems in place; they can readily access old laboratory results as well as monitor laboratory requests with pending results

On the other hand, the responders feel that the opening of multiple windows while using the applications can be quite annoying. They also said that the system response time has a lot of room for improvement. As the doctors are very adept in their habits in ordering, they are of the opinion that computerized order entry for tests and medications slow down their respective processes. Nurses, however, love the fact that they can readily and legibly read instructions from doctors. They also like the fact that they are being prompted by their respective systems when medications are due to be administered.

Correlation analysis is done to determine which facets of the order entry systems are strongly associated with user satisfaction. Table 1 shows the four factors with the strongest correlation found. System reliability, intuitive navigational capabilities and ease of use are strongly and positively correlated with user satisfaction. Correlation coefficient are estimated to be 0.736, 0.741 and 0.731, respectively ($p<0.001$). System response time however, is found to be strongly but negatively correlated with user satisfaction with a correlation coefficient of -0.717 ($p<0.001$). Test of heterogeneity suggest that inasmuch as the direction of correlation is the same for doctors and nurses, responses solicited from nurses are more homogenous than responses elicited from the physicians ($p<0.05$).

Table 1- showing the facets of the order entry systems that are strongly associated with user satisfaction (p <0.001)

Facets of the systems	Correlation coefficient
System reliability	0.736
Intuitive navigational capabilities	0.741
Ease of use	0.731
System response times	-0.717

Interestingly, there is no sufficient evidence suggesting that training of users for the systems of interest is associated with user satisfaction.

The summary scores of the responders are presented in Table 2 below.

Table 2 - Summary Table of Responses of Clinical System Users, NHG Institutions, 2009. (based on the 7 point Likert scale)

Question	Mean	SD
Q1 The systems are reliable - it does its job consistently.	4.35	1.14
Q2 The systems improve my productivity.	4.35	1.27
Q3 Navigating through the systems is intuitive and easy	4.13	1.44
Q4 The systems have a negative impact on patient care.	3.17	1.48
Q5 The systems reduce patient care errors.	4.71	1.27
Q6 The systems are easy to use.	4.25	1.40
Q7 Compared to paper ordering, computerized order entry for tests and medications slow me down	5.18	1.68
Q8 The systems give me information I need to do my job better.	4.87	1.34
Q9 I feel that I had adequate training on the systems	4.50	1.50
Q10 The systems improve the quality of patient care.	4.60	1.27
Q11 System response time is slow.	5.75	1.36
Q12 Opening multiple windows to access different applications can be annoying.	5.88	1.32
Q13 When I have a problem with the systems, I just ask someone for help.	4.81	1.34
Q14 I feel that I can benefit from refresher classes on the clinical systems.	3.79	1.63
Q15 When I need help on the system, I can find it.	3.96	1.30
Q16 Overall, I am satisfied with the systems.	3.85	1.39

Discussion & Conclusions

The relatively low response rate of this study can lead to some selection bias and thus be considered as one of its significant limitations. A number of non-responders told their department secretaries that they could not spare the time to answer the questionnaire. The implication of this response is that if the lack of time to answer the questionnaire is associated with non-satisfaction of the users, then the estimated overall satisfaction rate of the users will be significantly diminished. The converse is also true. If the lack of time to answer the questionnaire is associated with satisfaction of users, then the estimated overall satisfaction rate of the users will be significantly increased. Considering that the slowness of the system has been cited as one of the pain points and is associated with adequacy of time, it can be reasonable to assume that the study results can swing towards more user dissatisfaction. Future studies should consider the use of incentives eg. vouchers to improve response rates.

Moreover, the fact the Cronbach alpha of the questionnaire varies between doctor (0.514) and nurse (0.757) responders suggest that either the doctors have a different concept of user satisfaction compared to nurses or the data collection tool with its contents are more effective in measuring nursing constructs than doctor mindsets --- at least as far as assessing user satisfaction of the clinician order entry systems. Doctors and nurses have different job scopes which lead to different needs and expectations of the clinical systems. Therefore in healthcare IT development, it is imperative to involve both physicians and non-physicians.

Based on our correlation analysis, end-user satisfaction is strongly associated to four key system elements – reliability, intuitive navigation, ease of use, and system response time. These findings suggest that more efforts should be made to improve these aspects in order to improve user satisfaction. These elements should also form important considerations in all future clinical systems development.

Beyond optimizing clinical software design, hospitals need also to improve and maintain good IT infrastructure like hardware and network to improve the overall system performance.

While there are numerous studies [11-13] showing that proper user training can improve the success and acceptance of electronic medical records, our results do not show any correlation between training and user satisfaction. The is likely due to the fact that the last CPOE training session was conducted more than six months ago, and the impact of training on user satisfaction have waned with time.

In light of the study's findings, recommendations have been made to the software team for future enhancements, particularly the need to optimize system performance and usability. A further study on clinical users may be warranted to explore in-depth the issues uncovered here.

References

1. Ammenwerth E, Schnell-Inderst P, Machan C, Siebert U. The effect of electronic prescribing on medication errors and adverse drug events: a systematic review. J Am Med Inform Assoc 2008; 15:585-600.
2. Bates DW, Kuperman G, Teich JM. Computerized physician order entry and quality of care. Qua1 Manag Health Care.1994;2(4):8-27.
3. Ash JS, Gorman PN, Hersh WR. Physician order entry in U.S. hospitals. Proc AMIA Annu Symp. 1998:235–9.
4. Murff HJ, Kannry J. Physician satisfaction with two order entry systems. J Am Med Inform Assoc. 2001 Sep-Oct;8(5):499-509.
5. Papshev D, Peterson AM. Electronic prescribing in ambulatory practice: promises, pitfalls, and potential solutions. Am J Manag Care 2001; 7:725-36.
6. Scott JT, Rundall TG, Vogt TM, Hsu J. Kaiser Permanente's experience of implementing an electronic medical record: a qualitative study. BMJ 2005; 331:1313-6.
7. Gardner RM, Lundscaarde HP. Evaluation of user acceptance of a clinical expert system. J Am Med Inform Assoc 1994;1:428-38.
8. Bailey, J. E. Development of an Instrument for the Management of Computer User Attitudes in Hospitals. Methods in Informatics in Medicine 1990; 29:51-56.
9. Tan WS, Phang JS, Tan LK. Evaluating user satisfaction with an electronic prescription system in a primary care group. Ann Acad Med Singapore. 2009 Jun;38(6):494-7.
10. Lee F, Teich JM, Spurr CD, Bates DW. Implementation of Physician Order Entry: User Satisfaction and Self-reported Usage Patterns. JAMIA. 1996; 3:42-55.
11. Fullerton C, Aponte P, Hopkins R, Bragg D, Ballard DJ. Lessons learned from pilot site implementation of an ambulatory electronic health record. Proc (Bayl Univ Med Cent). 2006 Oct; 19(4):303-10.
12. Dagroso D, Williams PD, Chesney JD, Lee MM, Theoharis E, Enberg RN. Implementation of an obstetrics EMR module: overcoming user dissatisfaction. J Healthc Inf Manag. 2007 Winter;21(1):87-94.
13. Chisolm DJ, Purnell TS, Cohen DM, McAlearney AS. Clinician perceptions of an electronic medical record during the first year of implementaton in emergency services. Pediatr Emerg Care. 2010 Feb; 26(2):107-10.

Address for correspondence:
Yung Ming Tan.
6 Serangoon North Ave 5. #01-01
Singapore 554910
Email: tan.yung.ming@ihis.com.sg