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Physicians' satisfaction with computerized physician order entry (CPOE) at the National Guard Health Affairs: A preliminary study

Basema SADDIK[1] and Manahil M. AL-FRIDAN
College of Public Health and Health Informatics,
King Saud Bin AbdulAziz University for Health Sciences, Saudi Arabia

Abstract. *Introduction:* The use of CPOE in hospitals offers many advantages and benefits including improved quality of care and improved efficiency and workflow. However despite the reported benefits of CPOE, the rate of CPOE adoption still remains low especially in developing countries. User satisfaction with CPOE is a commonly reported predictor of compliance with CPOE use. This study measures overall physician satisfaction with CPOE and investigates the factors associated with satisfaction and physicians' perceptions on CPOE characteristics. *Methods:* A survey was developed measuring physician satisfaction with CPOE on a likert scale. *Results:* More than half of the physicians reported overall satisfaction with CPOE and perceived that CPOE improved patient quality care and efficiency. Physicians also reported positively on the ease of use of CPOE. *Conclusions:* CPOE characteristics were strongly correlated with physician satisfaction, in particular, efficiency and quality of care. Additional studies are needed to assess physicians and other users' satisfaction with further CPOE implementation.

Keywords. CPOE, user satisfaction, efficiency, usability

Introduction and Background

A computerized physician order entry (CPOE) system is a clinical application that allows health care providers to electronically enter orders (laboratory, medication, imaging etc.) for patient care [1]. The use of CPOE in hospitals offers many advantages and benefits including order entry at the point-of-care, improved clinician workflow, reduced errors related to illegible handwriting or verbal communication, inventory management support, opportunity for error checking and follow-up, possibility for automatic billing and most importantly, improving quality of patient care by supporting physicians in clinical decision making such as alerting them about medication interactions, allergies and wrong dosing. [2-3].

However, despite the reported advantages of CPOE and the improvements it has brought to healthcare, the rate of CPOE implementation still remains low at less than

[1]Corresponding Author: Assistant Professor, Department of Health Informatics, College of Public Health and Health Informatics, KSAU-HS, PO Box 22490 Mail Code:2350 Riyadh 11426, Kingdom of Saudi Arabia. Email: saddikb@ksau-hs.edu

20% adoption in Western Countries [4]. This may be attributed to the challenges associated with CPOE implementation such as change of workflow, technical issues, associated costs, user resistance and non-compliance [5-6]. This is no different in Saudi Arabia where implementation of health information systems including CPOE has been especially challenging for Saudi hospitals because of high implementation costs, technical complexity, lack of information and communication technology (ICT) infrastructure, and lack of well-trained employees and non-compliance [7-8]. Previous studies have shown that physician satisfaction with CPOE tends to increase with higher levels of training [9-10] and that user satisfaction with CPOE is an important predictor of compliance with CPOE use [6].

CPOE was implemented at the National Guard Health Affairs (NGHA) – Eastern Region in September 2009 as part of an intended complete CPOE roll-out to all NGHA hospitals in the Central, Eastern and Western Regions of Saudi Arabia. A pilot project in a department of the Central Region hospital was confronted by multiple barriers including physician resistance, lack of internal expertise in health IT, small IT team sizes and major expansion of the hospital at the time. It is expected that by the middle of 2012, CPOE will be implemented in all NGHA departments and hospitals [8].

It is important to recognize that not all CPOE systems have the same characteristics and that including users in the selection of CPOE characteristics will improve overall user satisfaction with the system [3]. Previous studies on user satisfaction with CPOE systems have found that user satisfaction relies more on users' opinions about CPOE features related to efficiency such as ease of use, speed and provider productivity [1] than on features related to quality of care such as reducing errors or giving information [5]. Hence it is essential that users' perceptions on CPOE characteristics reflect the users' opinions and their needs, to ensure effective use, less non-compliance and better satisfaction [11-12]. Despite the number of studies which have measured CPOE characteristics, few studies have evaluated user satisfaction with CPOE systems overall and to date; no study has measured physician satisfaction with CPOE since its implementation in the Eastern Region in Saudi Arabia. This study will measure overall physician satisfaction with CPOE and investigate the features associated with satisfaction by measuring physicians' perceptions on CPOE characteristics such as clinicians' workflow, efficiency and usability and patient safety.

1. Methods

1.1 Study setting

This study was conducted at a 112 bed hospital of the NGHA Medical City-Eastern Region. The hospital provides services in General Surgery, Internal Medicine, Gastroenterology, Paediatrics, Obstetrics and Gynaecology, Family Medicine, Ophthalmology, Dentistry, Endocrinology, Orthopaedic Surgery, Pulmonary, and Neurology. More than 7000 patients (both inpatient and outpatient) are seen monthly in the hospital. The CPOE system used at NGHA is an integrated feature of the existing Computerised patient record (CPR) and not a "stand alone" clinical information system. CPOE had been implemented in all units of the hospital at the time of this study. Following implementation of CPOE, all physicians were required to attend a training session and on-call support following implementation was available 24 hours a day to support CPOE users.

1.2 Study participants

The study's target population was all physicians who were working and using CPOE in the hospital at the time of the study, which were one hundred and one physicians. Convenience sampling was the sampling technique used due to the small number of physicians in the hospital and it was considered that any further sampling methods would result in a smaller sample size. An 80% response rate was targeted and considered acceptable for this study.

1.3 Survey instrument

This study is a cross-sectional exploratory study which utilised a questionnaire to collect data on physicians' satisfaction with CPOE. The questionnaire consisted of three domains: the first one collecting demographic data such as (age, gender, position, area of specialty, years of experience and nationality), the second domain collected information on user characteristics such as (physician attendance to CPOE training sessions, physicians' use of computers and perceived physician competency with data entry skills). The third domain measured physicians' opinions on statements that concerned clinicians' workflow, efficiency and patient safety. Clinicians' workflow was measured by statements on timeliness and technical support, efficiency was measured by statements on system response time, information retrieval, ease of using system and clear screen design, and patient safety was measured by statements on patient care errors. These were measured on a 5-point Likert scale with the options "strongly disagree" and "strongly agree" at the two extremes [13].

Face validity of the questionnaire was measured by an expert panel consisting of health professionals, physicians, and health informatics professionals. The expert panel reviewed the contents of the questionnaire in terms of content accuracy, clarity and comprehensiveness and agreed that the questionnaire met its objectives. A pilot study was carried out to ensure the clarity and reliability of items in the questionnaire. The questionnaires for the pilot study were given to the heads of surgery, paediatric, and internal medicine departments for completion. No further modifications were made to the questionnaire following the pilot study. Questionnaires were distributed by hand to the physicians or the physician's secretary. One hundred and one questionnaires were distributed and eighty one questionnaires were completed and returned giving this study a response rate of (80.2%).

1.4 Research approval

Research approval was granted by the University scientific research committee in September 2010 and by the National Guard Health Affairs Hospital – Eastern Region in April 2010

1.5 Data Analysis

All data were analysed using the Statistical Package for Social Sciences (SPSS) version 17.0. We used descriptive statistics including frequencies and percentages for demographic variables, user characteristics and perceptions of physicians to different CPOE characteristics. For the second part of the analysis we used Mann-Whitney U and Kruskal Wallis tests [14] to compare mean scores between the demographic

variables and physicians' satisfaction of the CPOE system. In addition, relationships between overall satisfaction and perceptions of physicians to different CPOE characteristics were examined using correlational analyses. All *p* values quoted are two-sided; with an alpha level of 0.05.

2. Results

Physician demographic characteristics are listed in Table 1. In total, 81 physicians were included in the analysis. The majority of the physicians were male staff physicians between the ages of 30 - 39 years and the most common physician specialities were surgery, emergency, internal medicine and obstetrics/gynaecology. Almost all of the physicians had undertaken CPOE training, were regular computer users and had good to very good data entry skills.

Table 1. Demographic characteristics of physicians

Characteristics		**Frequency N (%)**
Gender	Male	67 (83)
	Female	12 (15)
Age	Under 30 years	2 (3)
	30-39 years	37 (46)
	40-49 years	26 (32)
	50 – 59 years	16 (20)
Position	Consultant	19 (24)
	Assistant / Associate	13 (16)
	Staff physician	49 (60)
Area of specialty	Family medicine	2 (3)
	Surgery / anaesthesia	28 (35)
	Internal medicine	11 (14)
	Obs/gyn/paediatrics	21 (26)
	ER	13 (16)
	Other	6 (9)
Nationality	Asian – non Arabian	23 (28)
	Arabian	51 (63)
	European	6 (7)
Years of experience	Less than 1-5 years	8 (10)
	6 -10 years	25 (31)
	11- 15 years	17 (21)
	More than 15 years	30 (37)
Training sessions for CPOE	Yes	75 (93)
	No	6 (7)
Use of computers	I use it occasionally	7 (9)
	I am a regular user	74 (91)
Data entry skills	Excellent	9 (11)
	Very good	37 (46)
	Fair/Good	34 (42)

Figure 1 presents physicians' perceptions on CPOE characteristics and their overall satisfaction with specific features of CPOE. Positive and negative perceptions were measured by combining agree and strongly agree as a positive and by combining

disagree and strongly disagree as a negative perception. Neutral remained the same. Almost all of the physicians perceived that CPOE reduced patient care errors and that the order system was easy to use. However, an equal number of physicians reported a positive and negative perception that laboratory data retrieval is fast. Overall, more than half (60%) of physicians stated that they were satisfied with order entry system. This was measured by physicians' response to the survey item, "Overall I am satisfied with the order entry system". The Kruskal Wallis and Mann-Whitney U tests showed that there were significant differences between the satisfaction of physicians of CPOE characteristics based on their demographic characteristics (age p=0.016, area of speciality p= 0.039 and nationality p=0.047). Physicians who were surgeons, were younger and had an Arabic Nationality were most satisfied with the CPOE characteristics. No significant differences were found between CPOE characteristics and attending training sessions, data entry skills or regular use of computers.

The item measuring overall satisfaction with CPOE was strongly correlated with satisfaction with specific CPOE characteristics (Table 2). Overall satisfaction was significantly correlated with ratings of impact on patient care and quality, speed, clarity and reliability ($p \leq 0.001$). Overall satisfaction was most strongly correlated with characteristics related to locating items on the system (r=0.65), clarity (r=0.58), correcting mistakes (r=0.52) and ease of use (r=0.52). Characteristics relating to external features such as availability of technical support, reference materials and usefulness of error messages were less strongly correlated (r=0.29, r=0.38, r=0.34, respectively), although these correlations were still significant. Whilst the characteristic retrieval of radiology data was weakly correlated with overall satisfaction(r=.035), this correlation was still statistically significant.

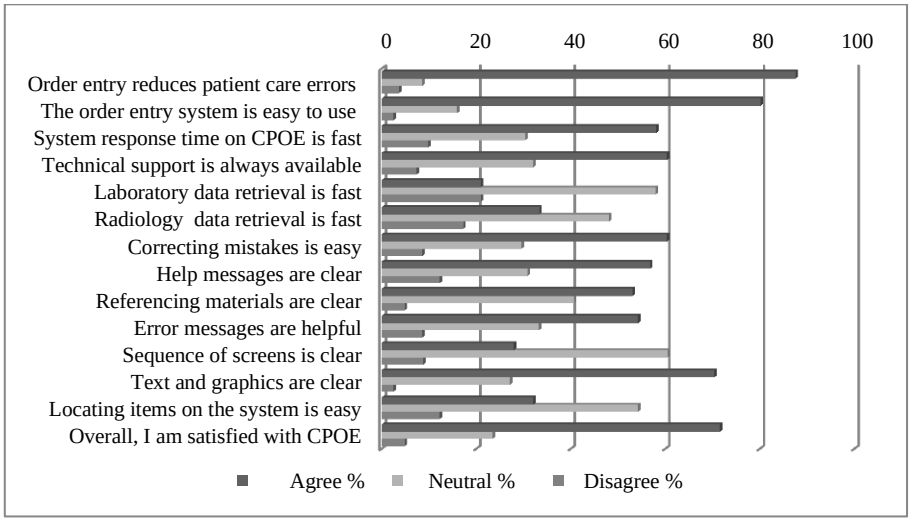

Figure 1. Physicians' perceptions on CPOE characteristics

Table 2. Correlation of physicians' satisfaction and CPOE characteristics

CPOE characteristic	Correlation with Satisfaction
Order entry reduces patient care errors.	0.402*
The order entry system is easy to use.	0.520*
System response time on CPOE is fast	0.348*
Technical support is always available	0.299#
Laboratory data retrieval is fast	0.422*
Radiology data retrieval is fast	0.035*
Correcting mistakes is easy	0.518*
Help messages are clear	0.450*
Referencing materials are clear	0.381*
Error messages are helpful	0.354*
Sequence of screens is clear	0.585*
The meaning of text and graphics are clear	0.451*
Locating items on the system is easy	0.650*

* $p \leq 0.001$ # $p \leq 0.05$

4. Discussion

The results of this study demonstrate that physicians at NGHA-Eastern region were more likely to be male, staff physicians; were generally young and had more than 15 years of experience. The majority of physicians attended the training sessions for the CPOE system around implementation and they reported being regular users of computers. Physicians' age, area of specialty and nationality were significantly related to physicians' satisfaction with the system, however, training sessions, use of computer and data entry skills did not show to impact on overall physicians' satisfaction with CPOE. Our results are similar to previous research which has found that satisfaction is not necessarily influenced by factors such as training sessions, use of computer skills or data entry skills [5-6]. However almost all of the physicians in this study had received CPOE training so it is difficult to differentiate between those that had or hadn't received the training; further studies should address this.

Physicians in our study were positive about the CPOE's ease of use and its ability to reduce patient care errors. It has been previously shown that the perceived ease of use by users and maximised efficiency of a system lead to user satisfaction and adaptation which are important predictors of CPOE use [15]. Similarly, another important determinant of user satisfaction with CPOE is the success of the integration of the system in the workplace and the ruling out of technical issues which may impede the systems performance and workflow [6, 15-16]. In our study, physicians were less positive on certain functionalities within the system such as slow laboratory and radiology data retrieval and radiology data retrieval weakly correlated with overall satisfaction with the system. These technical issues should be seen as areas for improvement in order to ensure continued efficiency, improved clinician workflow and use with the system.

5. Limitations

This study has limitations. The cross-sectional design of the study, and the sampling technique may have influenced responses and difference of opinion between responders

and non-responders, however the high response rate of this study is encouraging. Also, the timing of the study, shortly after implementation of CPOE may reflect the perspectives of physicians who are still beginning to use and learn the system and perceptions may change with experience and time.

Additionally, physician satisfaction was measured by a single questionnaire item as this study was seen as a preliminary exploratory study to assess initial acceptance and we wanted to keep the questionnaire as relatively short and simple as possible. Although previous research has revealed that single items used to measure satisfaction can be valid, a longer survey with more items measuring overall satisfaction would make a more consistent measure of satisfaction [5]. However with these limitations in mind, the results from this preliminary study should not be ignored as they provide us with baseline results which will inform further research in this area after complete rollout of CPOE at the other NGHA hospitals.

6. Conclusion

User satisfaction is an important predictor for the efficiency, usability and workflow of any CPOE system. The results of this study demonstrate that physicians are satisfied overall with the new CPOE system at a hospital of the NGHA – Eastern region. Physicians' age, area of specialty and nationality impacted on physicians' satisfaction with CPOE. Furthermore our study shows that, CPOE characteristics were strongly correlated to physician satisfaction, in particular, efficiency and quality of care. Further studies are needed to assess whether user satisfaction results of this study are similar to other NGHA sites.

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