Impact of CPOE on Physicians and Dentists' Work Performance at King Saud Medical Complex Hospital: A Case Study

Deena M. Barakah,   Sami S. Alwakeel

Abstract - **It is widely acknowledged that information technology plays a critical role in improving patient safety. Computerized Physician Order Entry (CPOE) systems are widely recognized for their potential in reducing the frequency of medication errors, and for improving the quality of medical care [1,2], yet little is known about their adoption by attending physicians or community hospitals. A few hospitals in Saudi Arabia have recently introduced these systems using commercially available products. In the light of the importance of successfully implementing CPOE systems in such settings, we assessed the adoption of CPOE by attending physicians and dentists at the King Saud Medical Complex (KSMC) hospital, Ministry of Health, at Riyadh in Saudi Arabia. Our study involves the examination of physician satisfaction associated with the use of the system to place orders, and the evaluation of CPOE impact of on their work performance in providing a quality medical care.**

Keywords: **medical software, CPOE systems, clinical software**.

I. INTRODUCTION

CPOE systems are electronic versions of medication ordering systems. They replace handwritten notes and prescriptions, and help streamline the processes around order entry. The use of CPOE in reducing errors during the prescription-ordering phase of care has been established with success [3]. Most advanced hospitals employ such systems to help manage their patient loads, as CPOE systems offer complete and accurate drug information, automatic dose calculations, and appropriate clinical decision support at the point of care. Decision support could include such items as checking for drug–to-drug interaction, allergy checking, and access to the latest evidence-based practice protocols.[5] The benefits of CPOE have been well-documented. CPOE has been successfully implemented in long-term care facilities to reduce adverse events and prescribing errors [3]. The use of guidelines and dose selection functions present in CPOE systems have been shown to significantly increase adherence to prescribing regimens that then translate into improved patient safety and lower costs. For today's hospitals, CPOE is considered the ultimate goal of clinical information systems [6].

II. SETTING AND PARTICIPANTS

CPOE is a software system used for direct entry of various clinical orders, such as diagnostic tests, medications, patient care and referrals, into a computerized physician database by an authorized prescriber such as a nurse (Jonathan et al., 2004). For today's hospitals, CPOE is considered the ultimate goal of clinical information systems [6,7]. King Saud Medical Complex (KSMC) adopted this system in its 1424-bed hospital, administrated by the Ministry of Health, at Riyadh in Saudi Arabia. KSMC has approximately the following statistics: OPD Visits = 900, average daily census = 840, number of doctors = 1552, and average daily number of emergency patient registrations from all ER = 800. The KSMC hospital adopted a vendor supplied (MEDISYS SYSTEM CO. LTD) CPOE that was implemented by three programmers and ten technicians in 2008. The system provides a structured format for the creation of medication, laboratory, and radiology orders, and contains thousands of pre-constructed medication order sentences and hundreds of order sets designed to standardize ordering for common diagnoses and procedures. Physicians are alerted by pharmacists of potential drug–allergy and drug–to-drug interactions. Clinical staff and attending physicians are mandated to place orders in the system. Access to the system is provided though the many fixed work-stations located in reception units, physicians' charting rooms, medical clinics (GPs and specialists), head nursing units, nurse stations, and in the health science library.

III. RESEARCH METHODOLGY

A case study methodology is used to describe the CPOE system adoption and to evaluate its impact in KSMC. Data is collected through reviewing KSMC documents, observations of physicians at work, own experience at work (being a dentist at KSMC), and through key administration and IT department staff interviews. A survey is conducted to evaluate staff satisfaction and staff acceptance with the CPOE system by using the perceived usefulness, and perceived ease-of-use indices. [8] Perceived usefulness (PU) is defined as the prospective user's subjective probability that using the CPOE system will increase his or her job performance and productivity within an organizational context. Perceived ease of use (PEOU) refers to the degree to which the prospective user expects the target system to be free of effort, which reflects his acceptance of the CPOE system.

Physicians' and dentists' feedback was obtained by a questionnaire. Each participant was asked to fill out a questionnaire indicating his or her agreement or disagreement with each statement, mostly on a 5-point Likert-type scale with the end points being 'strongly disagree', and 'strongly agree'. Responses were received from 38 subjects, giving a response rate of around 76%.

KSMC, from where the sample was selected, had implemented the CPOE for more than a year at the time of survey. Physicians and dentists were randomly selected from a group who were using the CPOE in their practice. Sample demographic information with respect to gender, age, specialty, and experience was also taken for potential purposes in data analysis.

Descriptive statistics collected from the survey showed the majority of the respondents were dentists (about 55.3%), and the respondents' experience varied from 1 to 26 years (mean = 9.57 years, SD = 6.57), reflecting the population from which the sample was drawn.

IV. FINDINGS

- All physicians (resident, specialists, consultants) were trained on the CPOE system before they were mandated to use it.
- CPOE is connected to all related modules within KSMC such as: drug-to-drug interactions, medication error and adverse drug reaction (ADR).
- The adopted CPOE system's main characteristics include a user-friendly interface, good documentation and superior software implementation, and the system offers training and follow-up of customer service.

V. MAJOR RESULTS

The research results (as concluded from the IT department statistics and obtained from the responses to the questions in the interviews with the IT department manager and some of the key administration staff) are:

- The KSMC physicians' satisfaction level with the CPOE implementation is 80 to 90%.
- CPOE adoption resulted in a saving of up to 45% of medication wastage.
- The reduction in medication transcription errors in KSMC pharmacies upon implementing CPOE is more than 90%.

The main CPOE disadvantages are the workflow delays at times of system failure or system crash, and the increased time that it takes for a physician to enter an order.

The main advantages of implementing CPOE in KSMC are:

- Quick alerts on drug-to-drug interactions.
- Elimination of order paperwork.
- Patients receive much quicker care as their drug profiles are always available on-line.

The barriers to the adoption Of CPOE are mainly: inadequate long-term financial commitment, user computer-literacy problems, and lack of patient awareness.

Table 1.0 provides a brief description of the Descriptive Statistics (percentage values) of the staff responses to the questions of the survey questionnaire, related to the perceived usefulness index and the perceived ease-of-use index.

Table 1. Perceived Usefulness and Perceived Ease of Use.

Scale Item	%Strongly Disagree	%Disagree	%Neutral	%Agree	%Strongly Agree	% Agree & strongly Agree
Perceived CPOE Usefulness (Measure of Satisfaction)						
Improves performance	0	0	13.2	65.8	21.1	86.9
Increases productivity	2.6	10.5	15.8	39.5	31.6	71.1
Enhances communication	0	13.2	10.5	55.3	18.4	73.7
Intention for future use	0	0	26.3	57.9	15.8	73.7
Perceived CPOE Ease of Use (Measure of Acceptance)						
Clear & understandable	2.6	7.9		60.5	28.9	89.4
Easy to use	0	0	15.8	57.9	26.3	84.2

VI. CONCLUSIONS

The vendor-built CPOE system, used for direct entry of various clinical orders at KSMC, significantly improved patient safety and work efficiency. In addition, the well designed system, accompanied with early user training, enhanced user acceptance and satisfaction, and achieved rapid adoption by KSMC physicians.

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