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We thought we would be perfect: medication errors before and after the initiation of Computerized Physician Order Entry

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ABSTRACT

Background: Because the Institute of Medicine demanded health care improvement, electronic medical records have been implemented with the hopes of eliminating iatrogenic injury caused by avoidable mistakes. Electronic orders and electronic medical records survived its initial slow adoption and have since had a myriad of identifiable flaws as it becomes incorporated nationally.

Materials and methods: This retrospective study at a university teaching hospital analyzed all medication order errors (OEs) for the 26 wk of paper-order entries before computer physician order entry (CPOE) and 26 weeks after CPOE was initiated. All OEs were included and documented by month as well as severity using standard taxonomy.

Results: Results indicated that CPOE yielded a significant increase in overall medication OE with five of six severity categories remaining the same or increasing in OE. Severity categories A and E saw a significant increase once CPOE began ($P < 0.01$). Pre-CPOE OEs were 1741, whereas Post-CPOE OEs were 2226, showing an increase in overall medication errors ($P < 0.01$). After CPOE began, the cumulative successive errors recorded were 112, 290, 267, 307, 412, 399, and 439 with an R^2 value of 0.849 and a P value of 0.003 in the analysis of variance to test regression relation.

Conclusions: As CPOE adapts for its real-world applications, it may eventually prove useful in reducing errors; however, perfection and error free order entry will not be achieved unless objective data analysis guides its evolution.

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1. Introduction

It has been a decade and a half since the Institute of Medicine (IOM) demanded health care improvement, and the era of electronic medical records (EMRs) was inaugurated. The IOM's *To Err is Human* defined the abundance of medication order errors (OEs) and paper charting errors that compromise patient safety while exaggerating health care costs [1–4]. It concluded that these errors could be prevented by the introduction of EMRs [4,5]. EMR was instituted to streamline, simplify, and unify patient care throughout the country, which is something paper charting could not contend with [1,6]. Computer physician order

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entry (CPOE) was specifically designed to ensure all orders would be efficient, legible, complete, and void of drug interactions [1–4,7]. However, a learning curve must be anticipated as users become familiar with computerized orders entry.

EMR implementation, like any large-scale system that is designed in a theoretical vacuum will be subject to unanticipated forces on implementation. Just as the outcomes of the IOM's recommendations of changing residents' work hours to a regulated, monitored environment was met with flaws initially, EMR was also met with less than ideal results [2,8,9]. A continual evolution of interface between computer platform and health care provider is needed to assist in the modeling of an ideal system. In this high-tech electronic world, a computerized medication ordering system should show immediate benefits by preventing "never events" and reducing the 1.5 million errors entered annually [9,10]. The problems of illegible handwriting, misplaced charts, and carelessness that were assumed to be responsible for 7000 deaths per year with paper charting have been replaced with a new set of errors during CPOE implementation [4,9,11,12]. Since going live, CPOE has shown a new collection of errors that are still being identified as researchers investigate the new electronic system and how it interacts with health care providers in the hospital setting [13,14].

Some obstructions have been identified such as an observed increased time for medication delivery because of confusing software, slow Internet connection, or the lack of available computers for nurses [9]. Barriers for physicians include an abundance of medication dosages offered, look-alike medications presented on the software, and cumbersome screen views. CPOE has also lead to depersonalization between the nurse and physician as interaction has been replaced with computer availability [13].

The objective of this study was to determine, by summation, the quantitative medication OEs for the 6 months before and after CPOE went live at our university teaching hospital. Our hypothesis was that the total number of OEs would be reduced by CPOE as it eliminated illegible orders, lost charts, and other innumerable errors of omission that occurred with paper charting. Additional aims of the study were to trend the medication OEs by severity categories with the additional hypothesis that orders across all severity categories would be reduced after the introduction of CPOE.

2. Materials and methods

2.1. Setting and study population

This study was conducted at a large urban adult and pediatric hospital in central New Jersey between October 1, 2012 and October 31, 2013. Subjects in all age groups from all medical, surgical, obstetrics and gynecology, pediatric, emergency medicine, and radiology services were included in the study.

2.2. Study design and medication OE definitions

We performed a retrospective study, comparing all medication OEs for the 26 wk of paper-order entry before the implementation of CPOE (October 1, 2012–April 14, 2013) and 26 wk after CPOE was initiated (April 15, 2013–October 31, 2013).

In our study, all OEs were identified and categorized according to where they occurred in the medication use process [15]. The US Pharmacopeia identified five stages in the medication use process to reduce errors. These stages include prescribing, documenting and/or transcribing, dispensing, administering, and monitoring (Table 1) [16].

All OEs were included and documented by month as well as assigned a severity category of A through F. The severity scale categories of A through F were defined by using the National Coordinating Council for Medication Error Reporting and Prevention Taxonomy (Table 2) [17].

2.3. Reporting and identification of medication errors

In our study, the identification and reporting of OE was accomplished through four main ways. This involved multiple members of the health care team including but not limited to physicians, nurses, clinical pharmacists, and technicians. All paper charting and CPOE OEs over the study period were captured by the hospital staff and recorded in detail by the pharmacy staff. Physician orders that were written and scanned to pharmacy or orders that were electronically entered were all captured ensuring no order was missed even if the orders were not executed.

First, pharmacists identified potential OE while monitoring patient medication profiles. Patient medication profiles contain a record of all the medications prescribed to the

Table 1 – Showing the breakdown of the medication use process errors according to the US Pharmacopeia.

Stage of medication use process	Medication errors included
Prescribing	• Prescriptions with incomplete orders, illegible orders, contraindicated medications, duplicate therapy, wrong dose, wrong rate/frequency, wrong duration, wrong route, wrong time, wrong patient
Documenting/ transcribing	• Incomplete transcriptions of prescriptions, illegible transcriptions, wrong interpretation of prescriptions, completion of wrong dosage forms
	• Transcriptions with wrong dose, wrong frequency/rate, wrong route, wrong patient, wrong drug
Dispensing	• Dispensing resulting in delay in receiving from pharmacy, wrong drug, wrong dose, wrong route, wrong expiration, wrong frequency/rate
Administering	• Wrong patient, wrong drug, wrong route, wrong rate/frequency, wrong time
Monitoring	• Failure to monitor patients for correct dose, correct drug, correct route of administration, side effects of drug, contraindications

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