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Computerized physician order entry in the cardiac intensive care unit: Effects on prescription errors and workflow conditions☆,☆☆

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ABSTRACT

Purposes: To evaluate the effects of a computerized physician order entry (CPOE) system in the cardiac intensive care unit by detecting prescription errors (PEs) and also to assess the impact on working conditions.
Methods: A longitudinal, prospective, before-after study was conducted during the periods before and after the implementation of the CPOE system. Clinical pharmacists were responsible for the registration, description and classification of PEs, and their causes and severity, according to an international taxonomy. Professionals were also surveyed for their opinion, concerns, and level of satisfaction.
Results: A total of 470 treatment orders containing 5729 prescriptions were evaluated. The CPOE resulted in a marked reduction in the number of PEs: error rate was 44.8% (819 errors among 1829 prescriptions) with handwritten orders and 0.8% (16 among 2094 prescriptions) at the final electronic phase ($P < .001$). Lapses were the main cause of error in both prescription methods. Most errors did not reach the patients. Errors related with the computerized system were scarce. Most users were satisfied with many aspects of this technology, although a higher workload was reported.
Conclusions: Computerized physician order entry in the cardiac intensive care unit proved to be a safe and effective strategy in reducing PEs and was globally well received by professionals.

1. Introduction

Computerized physician order entry (CPOE) can contribute to hospitalized patients safety by reducing common medication errors, mainly in the prescription phase [1,2]. Organizations that monitor the quality of health care recommend the implementation of electronic prescription (EP) in this setting [3].

Patients admitted to the intensive care unit (ICU) are particularly vulnerable to prescription errors (PEs) because of the presence of multiple risk factors [4]. However, the use of CPOE in ICUs is still limited for several reasons: the complexity and variability of the patient's clinical status, which requires frequent changes in treatment orders; the possibility of committing new medication errors by misuse of computer media; and the workflow disruptions [5,6].

Although there have been several publications regarding its use in the pediatric intensive care setting [7], only few authors have specifically evaluated the effects of CPOE among adult patients admitted to the ICU [8–10]. While analyzing these studies, it could be observed that disparity in results was probably caused by the incorporation of the different clinical decision support systems (CDSS), the degree of local adaptation in computer programs, and the development of the implementation schedule. Moreover, the evidence of its impact on clinical outcomes is limited. Thus, the usefulness of CPOE in the critical care environment remains controversial.

Despite the current recommendations [11], we have not found any evidence regarding their effectiveness in nonsurgical acute cardiac patients or the official data on the degree of implementation in cardiac ICUs. These units usually assist patients with very specific cardiac pathologies. They are characterized by the high degree on standardization and formalization of their treatments. It could lead to the feeling that CPOE may not be necessary caused by a lack of PEs. Therefore, this environment appears as a challenge to explore the CPOE utilities.

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We aimed to evaluate the effects of a CPOE system, by detecting PEs, their frequency, and their type and severity, including unintended technology-related errors. We also wanted to assess the impact of EP on the working conditions and on the level of satisfaction of the personnel involved in its use.

2. Materials and methods

2.1. Setting

La Paz Hospital, a tertiary care university center in Madrid, Spain, has been provided with an EP system (Farmatools Dominion; Global Dominion Access SA, Bilbao, Spain), which has been implemented in medical and surgical units since 2009. Acute cardiac care is carried out in a 9-bedded ICU, whose medical staff is composed of 2 senior cardiologists and 3 residents. There is an average of 800 annual admissions in this unit. It is the first experience of implementation of this CPOE system in the intensive care setting at our hospital.

2.2. CPOE implementation

FarmaTools Dominion was connected with the hospital information network and equipped with a moderate level of CDSS, such as information on drugs, predefined dose, maximum dosage, and need for dose adjustment. Alerts about duplicities, potential interactions, and allergies are also available. Over the years in our hospital, this system has been refined through user feedback.

Before the CPOE implementation in the cardiac ICU, a total of 25 therapeutic protocols were incorporated into the electronic prescribing system according to the most prevalent clinical situations (ie, noncomplicated acute coronary syndrome, congestive heart failure, therapeutic hypothermia for patients resuscitated from out-of-hospital cardiac arrest, malignant arrhythmias, cardiogenic shock, etc). The staff followed a training program on the management of the computer system for 8 hours. Besides, nurses had also the opportunity to gain knowledge regarding drug dispensing sheets. There were no further interventions once the CPOE was activated.

2.3. Study design

A longitudinal, prospective, before-after study was conducted to analyze treatment orders made during the periods before and after the implementation of the CPOE in the cardiac ICU. It was developed from June to December 2012 and had 3 prespecified sampling stages of 21 consecutive days each. The first stage corresponded to a conventional manual prescription (MP) before CPOE implementation (control group). The second and third stages took place just before the completion of 1 month (EP1) and 3 months (EP2), respectively, since CPOE was started (experimental groups, Fig. 1).

Only the morning shift prescriptions were included because most health practitioners who attended the training program usually work in the morning shift. Similarly, the morning shift has the largest amount of drug prescriptions. In the 9-bedded unit, it was estimated that the number of treatment orders to study each day would be from 6 to 8, with an average of 10 to 15 drugs per patient. Study protocol was approved by the ethics committee of the institution. The informed consent was considered unnecessary.

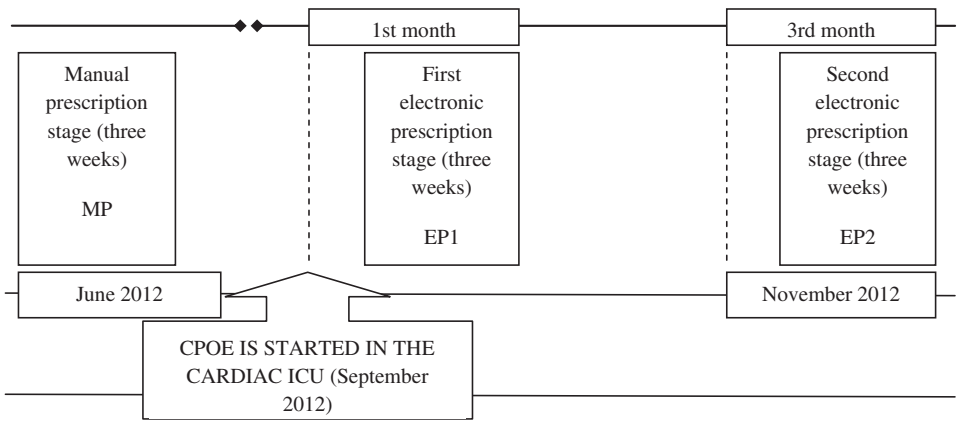
2.4. Outcomes

The main end point measure was the number of PEs identified when using EP vs MP method. Characteristics of the error, types, possible causes, and severity were explored as secondary variables following the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) taxonomy [12]. Throughout the 3 study periods, ICU-independent pharmacists analyzed the treatment orders in the course of their daily work. They did not participate in morning rounds and were not involved in drug prescription. The pharmacists were not blinded regarding the prescription method given the difficulty to mask the manual and electronic orders.

The pharmacists were in charge of registering, describing, and classifying errors as illegible, wrong, or omitted data. The specific types of error explored were as follows: drug name, pharmaceutical form, dosing (figures and units of measure), administration route, dosage interval (frequency of administration), known drug allergy, and important drug-drug interactions. In addition, prescribed drugs, effect of CDSS on error reduction, errors with the date or patient identification, and prescribed nursing care were checked.

On the other hand, those errors that would not have occurred if the clinician had prescribed manually were considered as CPOE-related errors. In this category, the following were included: improper selection from dropdown menu, errors in scheduled treatments, double prescriptions, and discrepancies in the free-text field. They were carefully checked for in the EP stages.

The degree of severity of errors was assigned by the pharmacists after reviewing patient clinical records according to NCC MERP taxonomy [12]. If needed, the pharmacist contacted the medical or



MP indicates manual prescription; EP, electronic prescri ption; CPOE , computerized prescription order entry; ICU, intensive care unit.

Fig. 1. Sampling stages and timing of implementation of CPOE.

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