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Neonatal Informatics: Computerized Physician Order Entry

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Abstract

Computerized physician order entry (CPOE) is the feature of electronic medical record (EMR) implementation that arguably offers the greatest quality and patient safety benefits. The gains are potentially greater for critically ill neonates, but the effect of CPOE on quality and safety is dependent upon local implementation decisions.

Objectives—After completing this article, readers should be able to:

1. Define the basic aspects of CPOE and clinical decision support (CDS) systems.
2. Describe the potential benefits of implementing CPOE associated with CDS in a neonatal intensive care unit (NICU).

Introduction

Dr Willa Drummond's five-part series in NeoReviews, "Dream of a Paperless NICU" (<http://neoreviews.aappublications.org/cgi/content/abstract/10/10/e480>), described challenges in optimizing hospital computer systems for use in newborn intensive care. (1) The current series of articles reviews the neonatal informatics literature as it pertains to several broad topics in healthcare information technology, examining current successes when they exist and delineating short- and long-term opportunities for enhancements. For each topic, an expert in the field co-authors the review. The focus of this first installment is CPOE with CDS systems, the features of EMR implementation that arguably offer the greatest potential quality and patient safety benefits. (2)(3)(4)

Adverse drug events (ADEs) occur frequently in pediatric inpatients and can contribute to morbidity and mortality. (5)(6)(7)(8) Due to the importance of appropriate weight- and age-based dosing calculations, children have been shown to be at higher risk for ADEs and their consequences. (9)(10) The paucity of evidence for neonatal pharmacotherapeutic interventions and the need for neonate-specific formulations place infants in the NICU at

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further increased risk. (7)(11)(12) Many realized and potential ADEs result from prescriber error and are considered preventable. (5)(7)(8) Accordingly, the gains of CPOE and CDS implementations are potentially greater for critically ill neonates than for other groups of patients, (13) and CPOE has been classified as a Core Objective for meaningful use of EMRs under the Health Information Technology for Economic and Clinical Health Act. (14) (15)(16)

Computerized Physician Order Entry

CPOE systems give licensed prescribers the ability to enter orders for their patients into a computer (Figs. 1 and 2), allowing for electronic transmission of the orders to the appropriate department (eg, pharmacy, radiology, laboratory). (9) Broadly, CDS refers to electronic suggestions or reminders linked with a patient's electronic data and integrated within a clinician's workflow, and provides much of the value in implementing CPOE systems. (17)(18) CDS linked to CPOE systems can notify clinicians of inappropriate dosages (dose range checking), drug allergies, and the potential for adverse effects based on other aspects of a patient's condition, such as concurrent medications or renal impairment. CDS systems can also notify a clinician of high-cost laboratory tests and suggest alternatives, alert them that a redundant diagnostic test was performed recently, or suggest additional orders based on best practice guidelines (eg, a reminder to order parenteral nutrition for a very low birth weight newborn).

Potential benefits of CPOE associated with CDS include decreased medication errors and ADEs, (19)(20) increased quality of care, (2)(9)(21) and more efficient use of resources. (18) Some of these benefits have been demonstrated in the NICU specifically. Cordero and associates, (22) for example, documented the positive impact of implementation of a CPOE system on several aspects of clinical care in a NICU, demonstrating a reduction in medication turnaround time (caffeine loading dose), medication errors (accuracy of gentamicin dose), and radiology turnaround time (following endotracheal intubation or umbilical catheter placement).

Implementation

Although implementation of CPOE with CDS has been shown to decrease medication errors and ADEs and improve other aspects of clinical care, elucidating their effect on morbidity and mortality has proved more challenging. (19)(20) In fact, a 2005 article described an increase in mortality rate associated with the implementation of a commercially available CPOE system in a pediatric intensive care unit (PICU). (23) Both medical informaticists and health policy researchers were quick to respond to this finding and emphasized the importance of implementation issues such as careful workflow redesign to the success of CPOE systems. (24)(25) Another group subsequently showed no increase in mortality rates following CPOE implementations in PICUs, (26) and most recently, Longhurst and associates (27) demonstrated a decrease in hospital-wide mortality rate (including approximately 72 level II and level III NICU beds) following implementation of a locally modified commercial CPOE system at an academic children's hospital. Interestingly, each of these studies (which occurred at three different children's hospitals) used the same commercial CPOE vendor, highlighting that local implementation decisions can determine the safety performance of a CPOE system. The variability in safety performance was described further in a recent study that used a simulation approach to test the medication-related CDS of CPOE systems at 62 hospitals. (28) The authors found the best performing hospitals represented six different CPOE software products, and although vendor choice played a role in safety performance, it accounted for only 27% of observed performance variation.

CPOE and CDS systems can have a positive effect on patient safety and quality of care, and the challenge of implementing these systems successfully while minimizing unintended consequences has been described in the literature. (29) Perhaps the most concerning unintended consequence of implementing a new technology is the introduction of new types of errors, (30) such as entering an order in the wrong patient's electronic chart. The national trend toward implementation of hospital-wide EMR systems (16)(31) demands attention to the lessons learned from previous experiences (32)(33) and those derived from the NICU setting, in particular. (34)

Conclusion

The central role of CPOE and associated CDS systems in successful EMR implementations and the extensive literature published on the subject made it a natural choice for the first topic in this series. Several other areas of clinical informatics warrant special consideration, given the workflows unique to the NICU setting, including decision support tools not linked to CPOE, electronic physician documentation, and electronic sign-out/handoff tools. These topics will be addressed in future reviews.

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Abbreviations

ADE	adverse drug effects
CDS	clinical decision support
CPOE	computerized physician order entry
EMR	electronic medical record
NICU	neonatal intensive care unit
PICU	pediatric intensive care unit

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Figure 1.
Dosing suggestions that appear when an order for ampicillin is selected.

Figure 2.
Order entry screen, where the details related to an order are specified.