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Medication errors in neonatal care: A systematic review of types of errors and effectiveness of preventive strategies

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Abstract *Background:* Neonates are particularly vulnerable to medication errors and may be at further risk of harm because of, immature renal and hepatic clearance of drugs, the use of very small doses, and the widespread use of off-label and unlicensed drugs.
Objective: To review the literature on the frequency and types of medication errors in Neonatal Intensive Care Units (NICUs) and the effectiveness of preventive strategies.
Methods: We conducted a systematic review of the published literature from 2000 through 2013 for studies that examined the prevalence of medication errors and interventions used to reduce the incidence in NICUs.
Results: 13 studies were identified describing medication errors, 13 about type of errors and 16 regarding interventions to improve medication safety.
Conclusions: Medication errors are an avoidable cause of iatrogenic events in neonatal care settings. Evidence-based interventions implemented in collaboration with pharmacists, appear to be an effective way of reducing medication errors.

Introduction

Medication use is associated with risk of errors and adverse effects. The publication of several studies

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on patient safety in the 1990's changed the perception of the needs of preventing medication potential adverse effects by implementation of systems to ensure patient safety (Leape et al., 1991, 1995; Bates et al., 1993, 1997; Konh et al., 2000).

Medication therapy in the neonatal population is complex as in addition to the common steps of drug use where risks can occur (prescribing, transcribing, dispensing, preparation and administration), we must add other factors, such as lack of research on drug pharmacokinetics and pharmacodynamics in terms of weight and gestational age, and complexity of treatments with numerous calculations and dilutions.

Drugs are subject to licensing procedures to ensure their safety, effectiveness, and quality. Many drugs used to treat children in hospital are either not licensed (unlicensed), or are prescribed outside the terms of the product license (off-label). Unlicensed drugs are those that are specifically contraindicated in children or not tested in paediatrics (no information appears in the summary of product characteristics) or those that result from modifications of licensed drugs (such us crushing a tablet to prepare a syrup). Off label refer to drugs licensed for childrens' use but prescribed in different conditions to their approval sheet (differences in indication, dosage, administration route or patient age).

Up to 90% of drugs used in neonates are unlicensed or off-label (McIntyre et al., 2000) because of this fact, many children in hospital are exposed to drugs without the guarantees the regulatory process should ensure.

In order to improving the process of drug management, some systems like computerized physician order entry (CPOE) or barcode management (BCMA) have been implemented. CPOE systems are powerful tools for managing and structuring data. When they are applied directly to the care process, they have the potential to change prescribing practices substantially. This is especially true for order entry; the computer can review every entry as it is entered, and can immediately present alerts and recommendations directly to the physician. The computer can display important supporting information at the time it is needed. Medication doses and frequencies can be presented in menus containing only appropriate choices. Guidelines for drugs use can be displayed and checks can be performed to look for conflicts with allergies or other drugs. BCMA included machine-readable barcodes on patients and medications via informatics' system and verify right patient, dosage, form, time, and route. These two systems reduce medication error rate in prescription and administration processes respectively.

There are few studies on drug errors on the neonatal population. We conducted a systematic review of the literature to synthesize data from studies on medication errors that occur in NICUs. We also reviewed work that measured interventions aimed at reducing medication errors in neonatal units.

Methods

We conducted a systematic review of the published literature from 2000 through 2013 for observational studies that examined the prevalence of medication errors and interventions to reduce the incidence in neonatal units.

Search strategy

The literature search (Fig. 1) was conducted between February and December 2014. Databases searched included Drug information full text, Ovid MEDLINE, Embase, EBM Reviews and Cochrane database of systematic reviews using Ovid online electronic resources. Language limitations were Spanish and English.

Following a preliminary review of terms in the literature, and of the MeSH database definitions of terms, key search terms were selected by the researchers. To maximize sensitivity an extensive set of keywords and subject headings (MeSH) were used. The following search terms were selected: Neonates; Infant, Newborn; Intensive Care, Neonatal; Intensive Care Units, Neonatal; NICU; Intensive care; Medical errors; Medication errors; Patient safety; Incident; Adverse event; Near miss; Error reporting; Anonymous reporting; Non-anonymous reporting; Voluntary reporting; Health care quality. Combining descriptors seven searches were developed (Fig.1).

Study selection

Search articles were reviewed to eliminate duplicates. Titles and abstracts were examined independently by two authors (SE and CA) using inclusion and exclusion criteria.

Inclusion criteria were: original studies or systematic reviews that measured medication errors in NICU and original studies or systematic reviews that measured interventions to reduce medication errors in NICUs.

Exclusion criteria were: Case studies or case reports, studies about errors in parenteral nutrition preparation, editorial articles or narrative