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# Medication Errors in Neonatal Care Units

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**Abstract** **Background:** Medication errors are common in the neonatal intensive care units. **Aim**: this current study aimed to describe the medication errors seen in the NICU, types, rates and prevention. **Method:** This current study was a prospective study of medication errors in two NICUs (Abu El rish El Monira NICU and Sayed Galal NICU). The study consisted of three phases; pre intervention phase, interevention phase and post intervention phase. Residents and nurses were interviewed to further investigate the weak points in the drug use process and possible causes of errors .This was followed by a data show presentation for the NICU staff to show the most common errors seen in the pre intervention phase, Intervention phase and post intervention phase to explore ideas for elimination of these medication errors at the NICU. **Results**: In the pre intervention phase: From total of 700 prescribing orders evaluated, 522 prescribing error were detected in the two NICUs (74.5%). The administration errors detected in the two NICUs were 488 (69.7%). **Conclusions**: Medication errors are common in NICUs. Fortunately, actual harm to an infant is rare. Continuous monitoring, frequent training and educational courses and presence of clinical pharmacist in the NICU will contribute to eliminate the medication errors in NICUs.

**Keywords** Medication errors, Prescription, Administration, Intervention

## 1. Introduction

Almost every healthcare professional has at some time made a mistake resulting in injury or possible injury to a patient. In clinical practice, however, the magnitude of this problem has long been underestimated, despite several large studies confirming the occurrence of medical error with possible patient harm [1].

Medication errors occur more commonly in intensive care units (ICUs) because patients in an ICU receive a larger number of medications. Critically ill patients also call for high-intensity care and may be at high risk of iatrogenic harm since they are severely ill [2].

'Neonates are very vulnerable for dosing and dispensing errors because neonates have a rapidly changing body surface area and weight; a rapidly developing system of drug absorption, metabolism and excretion; an inability to communicate with the provider; and off-label or unlicensed drug usage. Most of the drugs used in neonates are available in dosages and units ready for dispensing in children or adults [3].

The Institute Of Medicine (IOM) recommended that all healthcare settings should establish comprehensive patient safety programs executed by trained personnel within a culture of safety, and emphasized that reporting systems are one of the key strategies for learning from errors and for monitoring progress in the prevention of their recurrence [4].

Drugs are defined as "a substance intended for use in the diagnosis, cure, mitigation, treatment or prevention of disease; a substance (other than food) intended to affect the structure or any function of the body; and a substance intended for use as a component of a medicine but not a device or a component, part or accessory of a device" [5].

Medication error is defined as "Any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer" [4]. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing; order communication; product labeling, packaging, and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use [6].

## 2. Aim of the Work

To study medication errors of ordering, dispensing and administering medication in neonates admitted in the neonatal intensive care units (NICU) in two university hospitals, Abu El rish El Monira NICU and Sayed Galal NICU and to Outline important measures to prevent medication errors.

## 3. Subjects and Methods

The present study is a prospective study of medication errors at different stages of the drug use process: prescribing,

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preparation, and administration stages in two university hospitals; Sayed Galal & Abu El rish EL Monira.

In each hospital; the study was divided into three phases:

- **Phase one (pre-intervention phase):** Was a prospective study of medication errors at the different stages of the drug use process. A pilot study was conducted for 2 weeks prior to the commencement of the main study. This was to test the practicability and feasibility of the methodology, and to make any modification on the data collection form as needed. In addition, the pilot study was needed for the researcher to be familiar with the place and NICU staff.

  Errors at the prescribing stage were detected by chart review method, while administration errors were detected by the direct observation method.
- **Phase two (intervention phase):** Involved further investigation of the weak points in the drug use process and possible causes of errors, followed by a brain storming session for the NICU staff to inform them about the errors found and the possible solution. Finally multiple medication errors reducing measures were implemented and designed.
- **Phase three (post- intervention phase):** Was a prospective study of medication errors after implementation of medication errors reducing measures**.**

# 4. Determination of the Prescribing Errors

Medication order sheet and relevant data in the medical record were screened by the researcher for determination of prescribing errors.

For each patient, the following data were collected and recorded in special collection form: Patient's name, age (or date of birth), weight, diagnosis and all drug orders as written by the resident.

A prescribing error was defined as "an error that occurs at the stage of prescribing and order writing "[7] this included:

- Wrong dose: deviation of ≥ 10% of the recommended dose in neonatal references [8].
- Wrong frequency: Using the appropriate total daily dose, but divided in more or less doses than recommended by the manufacturer or reference books [8] and [9].
- Wrong concentration for administration of intravenous drugs: instructing the nurse to dilute the dose in a way that results in a final concentration different than that recommended by the manufacturer or reference books [9].
- Wrong or missed rate of administration of intravenous drug: prescribing an intravenous drug without specifying the duration over which it is to be administered [9].
- Wrong or missed instruction for proper drug administration by the nurse: this includes writing the wrong diluents, failure to appropriately space in times of administration of interacting drugs, failure to give information for the administration of drugs that should be given at specific times in relation to meals [9].

# 5. Direct Observation Method for the Detection of Medication Administration Errors

A drug administration error was defined as "any deviation in the preparation or administration of a drug from the physician order, or the manufacturer's instructions "[10].

Administration errors were classified into:

- Timing error: giving a drug dose more than one hour before or after its scheduled administration time [7].
- Omission: a dose of a drug that was not given by the time of the end of the nurse shift [7].
- Wrong storage: The use of a drug product that is not stored according to the package inserts [7].
- Wrong administration technique: Inappropriate procedure or improper technique in the administration of a drug [7].
- Wrong preparation.

**A. The physician questionnaire:**

**Table (1).** Physician questionnaire; area of investigation and indicators

| Area for investigation | Indicator |
|---|---|
| The resident's workload | Working care hours ,enough time for optimal patient care |
| Training and professional development with regard to medication use and ordering | Guidelines for prescribing writing, orientation programs, quality improvement programs |
| Prescribing and order writing practice | Selection of medication based on evidence; consideration of concentration ,drug interactions, mode of IV drug administration, concentration for administration for IV drugs, incompatibilities; double check practice and instructions for nurses |
| Source and dissemination of drug information | Source of information regarding different aspects of drug order, satisfaction with the available references, and guiding nurses for drug preparation |
| Resident's opinion about medication errors | How common, pharmacist role |

### B. Nurse questionnaire

**Table (2).** Nurse questionnaire; area of investigation and indicators

| Area for investigation | Indicators |
|---|---|
| The nurse's workload | Number of shifts and number of babies she is responsible for, management procedures |
| Training and professional development with regard to medication use and administration | Formal training upon employment, formal performance assessment or feedback |
| Drug administration and preparation practice | Written guidelines or sheets for preparation ,administration and storage of drugs ,time spent on drug related tasks , practical difficulties, documentation practice, and double check of the order |
| The nurse's opinion about the physician's preparation writing | Legibility, completeness and clarity of the instructions |
| Nurse's opinion about medication errors | How common, pharmacist role |

## 6. Results

### 1. Abu EL rish EL Monira NICU:

**A. Prescribing errors:** All orders recorded: 350 pre and 350 post intervention

**Table (3).** The prescribing errors rates & P value of each error in Abu El rish NICU

| Type of error | Number of each error (/350 orders) | | Percentages % | | P value |
|---|---|---|---|---|---|
| | Pre intervention | Post intervention | Pre intervention | Post intervention | |
| **1-Wrong dose** | 21 | 9 | 6% | 2.6% | 0.025** |
| **2-Wrong frequency** | 92 | 34 | 26.3% | 9.7% | 0.00** |
| **3-Wrong concentration the drug** | 70 | 36 | 20% | 10.3% | 0.00** |
| **4-Wrong rate of administration** | 45 | 22 | 12.9% | 6.3% | 0.003** |
| **5-Wrong or missed instructions for proper use of drug by the nurse** | 12 | 9 | 3.4% | 2.6% | 0.5* |
| **The total** | 240 | 110 | 68.6% | 31.5% | |

**(**referring to significant and *referring to non significant p value)**

### B. Direct observation method for the detection of medication administration errors:

**Table (4).** The medication administration errors rates in the pre and post intervention phases at Abu El rish NICU

| Type of error | Number of errors ( / 350 ) | | Percentages % | | P value |
|---|---|---|---|---|---|
| | Pre intervention | Post intervention | Pre intervention | Post intervention | |
| **1-Timing errors** | 56 | 50 | 16% | 14.3% | 0.527* |
| **2-Omission** | 13 | 9 | 3.7% | 2.6% | 0.386* |
| **3-Wrong storage** | 25 | 10 | 7.1% | 2.9% | 0.009** |
| **4-Wrong administration technique** | 156 | 89 | 44.6% | 25.4% | 0.000** |
| **5-Wrong preparation** | 19 | 8 | 5.4% | 2.3% | 0.031** |
| **The total** | 269 | 166 | 76.8% | 47.5% | |

**(**referring to significant and *referring to non significant p value).**

### 2. Sayed Galal NICU

**A. Prescribing errors:** Prescription errors: All orders recorded; 350 pre and 350 post intervention

**Table (5).** Numbers and rates of the prescribing errors at Sayed Galal NICU in the pre and post intervention phases

| Type of error | Number of each error (/350 orders) | | Percentages % | | P value |
|---|---|---|---|---|---|
| | Pre intervention | Post intervention | Pre intervention | Post intervention | |
| **1-Wrong dose** | 45 | 33 | 12.9% | 9.4% | 0.149* |
| **2-Wrong frequency** | 64 | 28 | 18.3% | 8% | 0.00** |
| **3-Wrong concentration of the drug** | 110 | 70 | 31.4% | 20% | 0.001** |
| **4-Wrong rate of administration** | 53 | 34 | 15.1% | 9.7% | 0.029** |
| **5-Wrong or missed instruction for the proper use of drug by the nurse** | 10 | 7 | 2.9% | 2% | 0.461* |
| **The total** | 282 | 172 | 67.7% | 49.1% | |

**(**referring to significant and*referring to non significant p value)**

### B. Direct observation method for the detection of medication administration errors:

**Table (6).** Number and rates of medication administration errors at Sayed Galal NICU in the pre and post intervention phases

| Type of error | Number of errors (/350) | | Percentages % | | P value |
|---|---|---|---|---|---|
| | Pre intervention | Post intervention | Pre intervention | Post intervention | |
| **1-timing errors** | 44 | 34 | 12.6% | 9.7% | 0.230* |
| **2- omission** | 12 | 9 | 3.4% | 2.6% | 0.506* |
| **3-wrong storage** | 27 | 15 | 7.7% | 4.3% | 0.056* |
| **4-wrong administration technique** | 121 | 79 | 34.6% | 22.6% | 0.000** |
| **5-wrong preparation** | 15 | 10 | 4.3% | 2.9% | 0.309* |
| **The total** | 219 | 147 | 62.6% | 42.1% | |

## 7. Discussion

Medication errors occur regularly in NICUs. Fortunately, actual harm to an infant is rare. Prescribing error rate represented 68.6% in Abu El rish (table 3) and 67.7% in Sayed Galal (table 5). In a recent similar study at Ain Shams university hospital but the difference is that it was in the PICU department not in the NICU, the baseline prescribing error rate was (78.1%) [11].

The rates in the present study was higher than rates detected by other studies, 16.6% (12) and 42% (8). There criterion for dosing errors was a deviation by more than 25% of the recommended dose not the 10% deviation used in our study. The most common prescribing error seen in Abu El rish NICU was wrong frequency (26.3%) while in Sayed Galal NICU the most common error was wrong concentration (20%) (table 3&5).

There was a consensus among physician to consider wrong rates of administration of drugs given as intermittent infusion as a prescribing error. The same was with missed instructions about the time of drug administration with respect to meals and wrong diluents for drugs given as intermittent infusion. [11].

Considering the poor drug knowledge among nurses and the absence of a clinical pharmacist in the studied NICU; the physician is considered the main nurses' source for information regarding proper administration of drug. Therefore, wrong instructions for nurses will lead eventually to administration errors that may be significant [11].

Wrong instructions for nurses regarding the diluents used for the preparation of IV drugs can also be significant. The use of a wrong diluents may cause a reduction in the solubility of the drug powder being reconstituted that can lead to powder particulates being administered to the patient. Also, it can lead to a reduction of the stability and activity of the drug and possible drug precipitation [10].

In many countries, there are system checks in hospitals that allow for monitoring of prescriptions and as much as 70% of prescribing errors may be intercepted by pharmacists and nurses [13].

This situation in most of the hospitals in Egypt is totally different. Pharmacists are not involved actively in the medication use process. They don't attend physician rounds, revise medication records, recheck dose calculations, nor do they provide any drug information or educational services. Such factors might have contributed to the high error rate [11].

Medication knowledge deficiency has long been known as a major contributor to prescribing errors [14].

Workload is the amount of time spent performing certain predefined tasks. In the question assessing physicians workload, physicians were asked: "do you work in crisis mode; trying to do too much too quickly? 100% of the physician at Abu El rish NICU and Sayed Galal NICU were strongly agreed. 100% also questioned think that the unit does not have enough staff to handle the work load and 100%

agreed that staff in the 2 NICUs work longer hours than is best for patient care.

In the current study (table 4 & 6), medication administration error rates in the pre intervention phase represented 76.8% in Abu El rish and 62.6% in Sayed Galal). These rates were lower than that of Badary study (78.3% pre intervention) [11] While they were higher than those found by, Lope (31%) (Raja Lope et al., 2009) [15], Bretsche (40%) [16].

Badary suggested that a major contributing factor to the high error rate might be the study setting itself. Unlike setting in other studies; there was no pharmacy involving in or supervision over the preparation of drugs. Nurses were used to do all medication- related tasks, so most of the observed doses required multiple step preparation and administration by nurses.

The most important factor that contribute to administration errors generally and wrong administration errors and timing errors especially was the shortage of nurse numbers in relation to number of cases which could be (1 to 3 or 1 to 4 sometimes) leading to overwork of each nurse and delay in drug administration and the absence of a pharmacist that can train health providers both physicians and nurses.

The mean number of shifts taken by each nurse in Abu El rish NICU was 16.4 and each nurse was responsible for 3.4 kids. The increase number of shifts and the increase in workload per shift could contribute to the high rate of errors in Abu El rish NICU.

The poor training and staff development may be one of the contributing factors of administration errors. Nurses generally learn how to perform drug related tasks from each other without formal training.

There were lack of lectures, and lack written guidelines about medication administration or preparation. Nurses also were unaware of administration errors.

Reducing workloads, sufficient nurse staffing and continuous training and education are essential in reducing medication errors.

## 8. Conclusions and Recommendations

We all make errors from time to time. There are many sources of medication errors and different ways of avoiding them. However, we must start by being aware that error is possible and take steps to minimize the risks. Medication errors occur regularly in NICUs. Fortunately, actual harm to an infant is rare.

From this study we recommend the following:

Provide an adequate number of nursing and involving pharmacist activities in the hospital system, continuous education and training courses for the NICU staff, presence of clinical pharmacist in the NICU, computerize systems to check dose and dosage schedules, stay current and knowledgeable concerning changes in medications and treatment of neonatal conditions and the nurses have to discuss medication orders with prescriber whenever possible, record and verify patient identity, weight and allergies.

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