*Opinion*

# Clinical pharmacist in competition with medication errors in the neonatal intensive care unit

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A medication error is any preventable event that may cause or lead to inappropriate use of drugs or patient harm if it is not under the control of the health care professional. Despite the fact that healthcare professionals take the responsibility very seriously, it has been estimated that 250 000 Americans die annually due to medication errors [1]. Although, estimates show that one in ten patients worldwide is affected by medication errors while receiving hospital care, the harm can be caused by a range of incidents or adverse events [2]. The exact incidence of medication errors in the neonatal intensive care unit (NICU) is unknown. In neonates especially premature infants, the immaturity of developing body systems affects the absorption, distribution, metabolism and excretion of drugs and therefore an exponential risk for medication errors is present [3]. The risk of medication errors in children are much greater than adults [4]. Neonates are at a high risk for medication errors because of incorrect calculation of doses individually that should be based on age, weight and surface area as well as inadequate information. In addition, lack of suitable dosage forms and concentrations and need for complex calculations or dilutions by medical staff including nurses, physicians and pharmacists [5]. Medication errors can occur at several steps in patient care, from ordering the medication to the time when the patient is administered the drug [6]. To the best of our knowledge, there is no uniform definition and protocol of a medication errors in Libyan hospitals. Therefore, from my experience in NICU at Tripoli University Hospital (TUH), a view point and the role of a clinical pharmacist towards medication errors seems to be an issue of concern. To clarify this point, some examples of medication errors in NICU at TUH are shown in **Table 1** and the expected risk that may occur with corrections of such errors are also given.

Most drugs prescribed in NICU at TUH are often used in an off label and unlicensed fashion. As a result, no standard for doses exist. Moreover, NICU drug dispensing is complex in which errors may occur by use of stock drug concentrations intended primarily for use in adults. In order to minimize medication errors, one should avoid verbal orders except in emergencies, avoid abbreviations, work as a team with pharmacist and nurse, use special caution with high-risk medications, report errors, provide references in ordering, dispensing and administration locations, encourage rounding to the whole numbers when possible, appropriately use decimal points, have pharmacists prepare all IV admixtures and oral liquid preparations, double check prior to dispensing, do not administer oral liquids with IV syringes and label all medications placed on and off sterile field (including: drug name, concentration & strength, date and initials of person preparing). From **Table 1**, several types of medication errors appear to be extremely harm to the patient. This include choice and frequency of medications, individually dosing calculations, drug-drug interaction and use of unsuitable solution or dilution.

**Table 1:** Medication errors at NICU in Tripoli University Hospital

| Type of errors | Case of error | Action | Adjustment |
|---|---|---|---|
| **Medication dose** | 1. Single dose divided by frequency: If 3 mg/kg every 8 hours and the body weight is 2 kg. Incorrectly 2 mg every 8 hours is given | Ineffectiveness | It should be 6 mg every 8 hours |
| | 2. Single dose NOT divided by frequency: If a 6 mg/kg/day every 8 hours and the body weight is 2 kg. Incorrectly 12 mg every 8 hours is given | Overdose | It should be 4 mg every 8 hours |
| **Frequency of drug** | In dosing of Vancomycin, no distinguish between preterm, term and infant dose | Ineffectiveness or overdose | Vancomycin i.v. dose in neonates is 15 mg/kg, so it should be given every 24 hours for preterm (< 29 weeks), every 12 hours for preterm (29 - 35 weeks) and 8 hours for infant (> 35 weeks) |
| | Fluconazole i.v. dosing to treat invasive candida infection. No distinguish between neonatal doses according to age | Ineffectiveness or overdose | 6-12 mg/kg should be given every 72 hours for neonate (up to 13 days), 6-12 mg/kg every 48 hours for neonates (up to 14-28 days) and 6-12 mg/kg every 24 hours for infants (> 28 days) |
| **Calculating drip rate (infusion speed)** | Fast dosing of i.v. Vancomycin | Red man syndrome | Vancomycin should be given over at least one hour by infusion pump |
| | i.v. dosing of calcium gluconate too quickly | Extra-vasation of $Ca^{+2}$ solution resulting s.c. $Ca^{+2}$ deposition with sloughing of skin and bradycardia | Calcium gluconate should be given too slowly and diluted |
| **Drug interaction** | Prescribe Gentamycin with Atracrium | Gentamycin increases Atracrium effect (risk of apnea) | Use alternative drug |
| | Prescribe Meropenem with Valproic acid | Meropenem decreases Valproic acid by increase renal clearance of Valproic acid (risk of seizure) | Use alternative drug |
| | Prescribe Furosemide with Gentamycin | Increase toxicity of the other by pharmacodynamic interaction (risk of ototoxicity and nephrotoxicity) | Use alternative drug |
| | Prescribe Rocuronium with Colistimate | Rocuronium increase Colistimate effect by pharmacodynamic interaction (risk of respiratory arrest) | Use alternative drug |
| **Use of unsuitable solution for drug dilution** | Dilute Amphotericin by use of normal saline | Amphotericin not compatible to normal saline | Use dextrose 5% or 10% as solvent |
| **Errors in preparation non-commercial I.V. fluid** | When prepare dextrose 7.5%, 12.5%, 14% more or less grams of dextrose is used | Risk of hypoglycemia or hyperglycemia | Need to be prepared by pharmacist |
| **Administration of incompatible drugs in 3-way cannula** | Administration of sodium bicarbonate, dopamine and doputamine in 3-way cannula | May result precipitation in cannula and ineffective | Sodium bicarbonate incompatible dopamine and dopamine |

While medication errors affect a wide variety of patients, certain patients and populations are significantly at a greater risk [7]. Health professionals at TUH include physicians, nurses and pharmacists held responsibility and must do their best to target this issue. Among others, pharmacist obviously is the most professional to deal with medications due to his more knowledge and education. Clinical pharmacist should be participating in daily patient care round in NICU in order to discuss medication order with prescriber and document any

change in the patient's state. Clinical pharmacist should also inform and teach nurses who prepare medication orders, accurately, for providing an appropriate pharmaceutical care to neonatal patient. Besides his role in double check on pharmaceutical calculation, monitor drug therapy and to evaluate appropriateness of use, dose, dosage form, regimen, route and drug interactions and/or reporting adverse drug reaction and medications errors.

The role of clinical pharmacist in the NICU at any hospital definitely would avoid occurrence of medication errors. The opinion expressed herewith emphasizes on the necessity of clinical pharmacist in NICU at hospitals. In case there is no clinical pharmacist in the hospital, it is often a good idea to engage an objective third-party organization to track and analyze medication errors. This is, not only due to their likely expertise, but also because their outside perspective may allow the hospital to know and avoid medications errors. All of these tactics will help hospitals collect accurate data and then triage to address the most dangerous errors for the quickest improvement in patient safety.

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