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OPINION

A protocol of drug and infusion fluid: Preparation, administration, compatibility, and stability in neonatal intensive unit care

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Newborn or neonate denotes to an infant in the first few days after birth. They are not small children when it comes to medicinal use and formulation development. Neonates include term, post-term and preterm babies. The neonatal period for preterm newborn infants is defined as the day of birth through to the expected date of delivery plus 27 days [1]. The majority of drugs used in sick newborns receiving intensive care are unlicensed and off-label, exposing infants to a greater risk of adverse drug reactions (ADRs). This study is extremely important due to the presence of a variety of drug information sources if used together lead to medication errors. From this point of view, this approach is suggested to eliminate or minimize these varieties. Where the most important challenges in the neonatal intensive care unit (NICU) are proper and correct calculations and administration. Drug-related events in a hospital setting are the highest cause of recorded errors such as in the USA and UK [2]. However, there is a wide range of potential sources of drug errors including documentation, calculation, preparation, and administration [3]. Now, babies commonly receive off-label drugs, at dosages extrapolated from children or adults. Besides the lack of labelling, inappropriate formulations, polypharmacy, immature organ function and multiple illnesses further raise the risk for ADRs in neonates [2].

Determining the right dose for drugs used to treat neonates is critically important. Neonates have significant differences in physiology affecting drug absorption, distribution, metabolism and elimination that makes extrapolating dosages from adults and older children usually inappropriate [4]. Many neonatal patients in a critical care setting receive between 15 and 20 infusion (iv) medications daily. The majority of these are unlicensed or used off-label. Lack of knowledge around the physicochemical incompatibilities of infusion drugs in NICU and PICU settings often necessitates the use of a dedicated IV catheter in neonates and infants who have limited IV access [5-7]. Drug incompatibilities are often an underestimated aspect of clinical practice and are concerning in the neonatal population where a lower capability to compensate for ADRs may lead to higher morbidity and death [2, 6, 7]. This concern is exacerbated in neonates by the frequent requirements for poly-pharmacy, multiple infusions delivered through a single catheter due to limited vascular access, low infusion rate exposing drugs to longer interaction and the possibility of incomplete dissolution or precipitation of drugs due to low volumes of drug solutions. Realistically, limited venous access can result in little choice but to co-administer drugs [1]. Therefore, this study aims to recommend and use local guidelines

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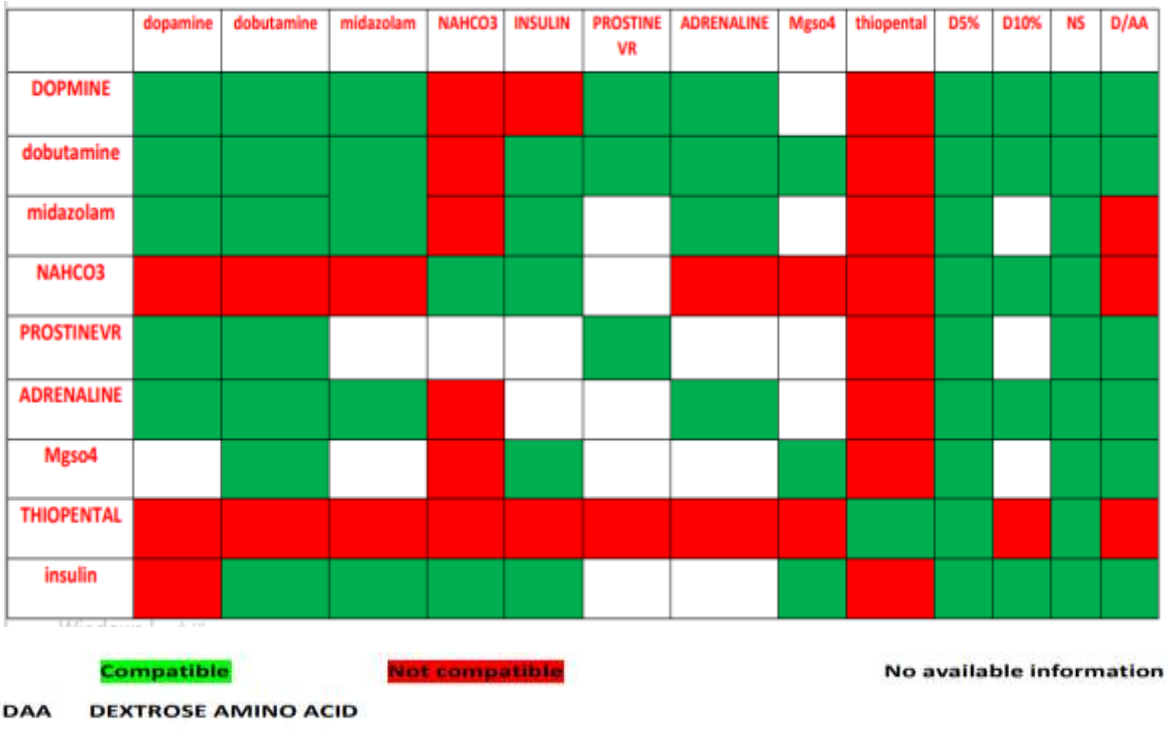
that will decrease and minimize medication use errors and make the use of medication easier in NICU while improving the quality of a baby's life by using proper preparations and cautious drug intake.

	Maintenance	Deficit
Kcl 15% 1 mmol = 0.50 cc	M = 1 - 2 mmol per kg Rate = 150 cc/kg/day, 1 mmol = 0.5 cc/kg/day, bottle = 500 cc 0.5 x 500 / 150 = 1.6 cc kcl added to fluid bottle	Kcl daily requirement = M (maintenance) + D (deficit) D = (4 - K reading) x wt x 0.6 / 2 = volume by cc Kcl 15% volume added to bottle = (M + D) x 500 Fluid daily requirement (rate x 24)
Kcl 10% 1 mmol = 0.74 cc	M = 1 - 2 mmol per kg Rate = 150 cc/kg/day, 1 mmol = 0.74 cc/kg/day, bottle = 500 cc 0.74 x 500 / 150 = 2.4 cc kcl added to fluid bottle	Kcl daily requirement = M (maintenance) + D (deficit) D = (4 - K reading) x wt x 0.6 x 0.74 = volume cc KCL 10% volume added to bottle = (M + D) x 500 Fluid daily requirement (rate x 24)
Kcl 7.5% 1 mmol = 1.00 cc	M = 1 - 2 mmol per kg Rate = 150 cc/kg/day, 1 mmol = 1 cc/kg/day, bottle = 500 cc 1 x 500 / 150 = 3.3 cc Kcl added to fluid bottle	Kcl daily requirement = M (maintenance) + D (deficit) D = (4 - K reading) x wt x 0.6 = volume by cc Kcl 7.5% volume added to bottle = (M + D) x 500 Fluid daily requirement (rate x 24)

The presence of different doses and precautions for calcium, Ca gluconate 10%, 1 mmol per kg =4.4 cc/kg/day, 2 mmol per kg =8.8 cc/kg/day. Ca chloride 10%, 1 mmol/kg/day =1.5 cc/kg/day, 2 mmol/kg/day =3.0 cc/kg/day. *SLOW I.V WITHIN 30 MIN.*

Table 1: Infusion drugs and infusion fluid compatibility commonly used in neonatal ICU



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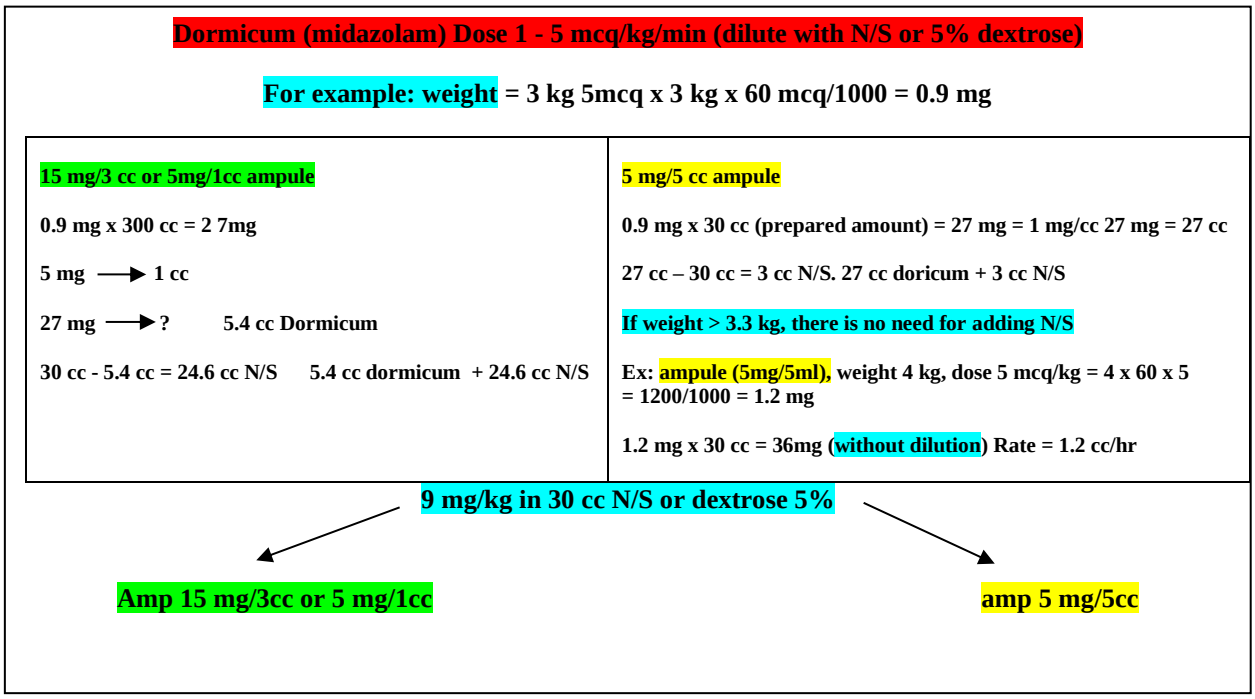
Some drugs like vancomycin had acute side effects (red man syndrome). So, it should be given by the correct infusion rate. Vancomycin 500 mg: Add 10 ml of water to the drug vial, then calculate the dose by ml as follows: Dose in the file multiplied by 10 and divided by 500. The calculated dose by ml was completed by normal saline according to the body weight of the baby as in **Table 1**.

Total volume	Weight (kg)	Rate
06 cc	(1.7 to 2.0 kg)	06 cc /hr
08 cc	(2.1 to 2.5 kg)	08 cc /hr
09 cc	(2.6 to 3.0 kg)	09 cc /hr
11 cc	(3.1 to 3.5 kg)	11 cc /hr
13 cc	(3.6 to 4.0 kg)	13 cc /hr
14 cc	(4.1 to 4.5 kg)	14 cc /hr
16 cc	(4.6 to 5.0 kg)	16 cc /hr

Finally, it is not the end, in this approach the calculations of IV infusion drugs are available in the following **Figure** 1.



Conclusion: The present study suggests protocol (procedure) for drugs and infusion fluids used in the neonatal ICU of Algala Maternity Hospital, Tripoli, Libya. These plans are taken to facilitate the daily hard work and to make it easier as well as more accurate. However, an absence of these materials will lead to confusion, misunderstanding and misuse of drugs with failure of all the treatment processes or protocols. Thus, a recommendation is provided to make sure that there should be a plan like this for drugs used in neonates in each unit of pediatric hospitals in Libya.

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Conflict of interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.
Data availability statements: The raw data that support the findings of this article are available from the corresponding author upon reasonable request.
Ethical issues: Including plagiarism, informed consent, data fabrication or falsification and double publication or submission were completely observed by the authors.
Author declaration: The authors confirm that all relevant ethical guidelines have been followed and any necessary IRB and/or ethics committee approvals have been obtained.

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