


# Emergency Medications Order for Neonates and Pediatrics: A Standardized Concentration System in Saudi Arabia

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## ABSTRACT

The national pediatric pharmacy program was founded in 2014. It is a part of the pharmacy strategic plan. This program has implemented several projects including preparation and administration of intravenous medication to neonates and pediatric patients. The complementary new initiatives program is the neonates and pediatrics standardized concentration of emergency medications with an emphasis on medications used to treat critically ill patients and in emergency department. This new project has physician order form with selected dilutions, concentrations and route of administration. The form may be converted to a computerized order form. The new initiatives of the project may be implemented through project management tools. The project prevents drug-related problem and decrease economic burden on healthcare system for neonates and pediatrics hospitals in the Kingdom of Saudi Arabia.

**Keywords:** Emergency, Medications, Neonates, Pediatrics, Standardized, Concentration, Saudi Arabia.

## INTRODUCTION

The general administration of pharmaceutical care established the national medication safety program at the Ministry of Health (MOH) hospitals in 2013.<sup>[1]</sup> The program consisted of several strategic elements including the standardized concentration of emergency medications with an emphasis on neonates and pediatrics. The Institute of Safe Medication Practice in the United States of America (USA) considers the emergency medications as high alert medications and several precautions should be taken to prevent medication errors especially with neonates and pediatric populations.<sup>[2-5]</sup> The local accreditation body of Saudi *Central Board for Accreditation of Healthcare Institutions* (CBAHI) published essential safety requirements for high alert medications.<sup>[6]</sup> The standardized concentration of medications is a crucial element of Institute of Safe Medication Practice (ISMP) self-assessment of hospitals' medication safety. Various studies conducted in Saudi Arabia of a national assessment of medications safety during Hajj period.<sup>[7-12]</sup> Previous reports have shown least score of medication safety assessment studies were for the demand of the standardized contraction for medication and administration.<sup>[9,10]</sup> The new initiative program of medications safety and total management in the pharmacy practice was conducted at three major hospitals in Riyadh city, Saudi Arabia. This was conducted to prevent drug-related problems and improve clinical outcome of patient during drug therapy.<sup>[13-14]</sup> The author is not familiar with any initiative projects in Saudi Arabia, Gulf, or in the Middle Eastern countries describing the standardized concentration of emergency medications for neonates and pediatrics.

## Neonates and Pediatrics Emergency Medications Standardized Concentration in Saudi Arabia

The standardized formulation of emergency medications included cardiopulmonary resuscitation requirements for neonates and pediatrics. The formulation was derived from the current literature and guidelines for neonates and pediatric population with an average of 70 kg body weight. The medication consisted of dopamine, dobutamine, epinephrine, norepinephrine and so on. The physician order form consisted of several parts including demographic data of the patients, medications names, the standardized and maximum concentration, the type of crystallized fluid, the route of administration through a central or peripheral vein, the dosing range requirements as explored in physician order entry form (Figure 1).

## SWOT Analysis

In this study, we performed strengths, weaknesses, opportunities and threats (SWOT) analysis to analyze the benefits and risks to the project. The strength of the neonates and pediatrics physician order forms including all information of common medications used in emergency situations, dosing of medications, fixed standardized concentration of emergency medications, the method of medications administration and prevention of mistakes in writing emergency medications orders are available for neonates and pediatrics. The weaknesses are including dosing drips used outside another's resources and it cannot apply to renal or hepatic failure. The opportunity that is including it is a straightforward form to convert them into computerized and physician order entry and it can calculate

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statistical information of all emergency medications. The threat points include the physician or pharmacist have not used the standardized concentration.

## Implementations Steps of Emergency Medications for Neonates and Pediatrics

The pharmacy department organizes consultation with the expert pharmacist especially for the intravenous admixture and expert clinical pharmacists in critical care involving in the committee. The committee should extensively review the draft and then approve the standardized concentration form of neonates and pediatrics emergency medications form. The head of the committee will contact the surgical and medical department of neonates and pediatric patients for final revisions of the draft and its approval. The head of pharmacy services will submit the final draft of the formulation to Pharmacy and Therapeutic Committee for review and approval. The head of the committee will collaborate with the computer department in order to prepare the electronic order forms. The pharmacy education coordinator coordinates with all the departments including nursing, surgical and medical department in order to educate and train the medical and pharmacy staff about the formulation. The quality management department will set up the Key Performance Indicators (KPIs) in order to measure the impact of the project. All teams related to the department of pharmacy including emergency medications preparation and clinical pharmacist will obtain the KPI of the project retrospectively in the past 3–6 months. Then, the collected data were prospectively analyzed in the following months. The head of the committee will contact the nursing and medical development to start project stepwise of one medical department as the pilot trial. The pharmacist will review the pilot trial and correct the form according to the feedback shared by the pharmacy consultation committee. The team will share the document with all the personnel of the medical department and surgical department who will review and change the medication accordingly. The head

of the committee will share it with all the staff members of the hospital including adult's critical care, who will review it and adjust the formulation accordingly. The coordinator of the quality management will measure the impact of the project by comparing the KPIs before and after starting the project. The head of the committee will analyze the results and review them. The head of the pharmacy will submit the final report to Pharmacy and Therapeutic committee for final touch and comments. The consultation team will review the final comments and update it accordingly. The project will continue until next year

## CONCLUSION

The neonates and pediatrics standardized concentration of emergency medications is a new program which is applied first time at the MOH hospitals in Saudi Arabia, Gulf and Middle Eastern countries. It prevents emergency-related adverse events and improve neonates and pediatrics clinical outcomes.

## ACKNOWLEDGEMENT

None.

## CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

## ABBREVIATIONS

**KSA:** Kingdom of Saudi Arabia; **MOH:** Ministry of Health; **USA:** United States of America; **CBAHI:** Saudi Central Board for Accreditation of Healthcare Institutions; **ISMP:** Institute of Safe Medication Practice; **SWOT:** Strengths, Weaknesses, Opportunities and Threats; **KPIs:** Key Performance Indicators.

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KINGDOM OF SAUDI ARABIA



Hospital: \_\_\_\_\_ مستشفى: \_\_\_\_\_  
 Region: \_\_\_\_\_ المنطقة/المحافظة: \_\_\_\_\_  
 Dept./Unit: \_\_\_\_\_ القسم/الوحدة: \_\_\_\_\_

## Figure 1

MRN: \_\_\_\_\_  
 رقم الملف: \_\_\_\_\_  
 Name: \_\_\_\_\_ الاسم: \_\_\_\_\_  
 Nationality: \_\_\_\_\_ الجنسية: \_\_\_\_\_  
 Age: \_\_\_\_\_ العمر: \_\_\_\_\_  
 Gender:  Male  Female  
 الجنس: \_\_\_\_\_

## Emergency Medications for Neonates and Pediatrics (1) (2)(3)(4)

Diagnosis	Allergy	Weight	Starting Date		
Medications	Standard Formula	Concentration	Rate	Disp.	Rate
<b>Peripheral line</b>					
Heparin	25000 Units / 250 ml D5W	100 units/ml			<b>10 ml/hr</b>
Heparin	10000 Units / 100 ml D5W	100 units/ml			<b>10 ml/hr</b>
Heparin	5000 Units / 50 ml D5W <b>Syringe Pump</b>	100 units/ml			<b>10 ml/hr</b>
Insulin	100 units / 100 ml NS	1 units / ml			<b>0.5-1 ml/hr</b>
					<b>Neonate hyperglycemia:</b> CI: initial rate: 0.05 units/kg/hr <u>Usual range:</u> 0.01 to 0.2 units/kg/hr <b>Hyperkalemia:</b> CI: initial bolus: 0.05 units/kg followed by CI: 0.1 unit/kg/hr
Insulin	50 units / 50 ml NS <b>Syringe Pump</b>	1 units / ml			<b>0.5-1 ml/hr</b>
					<b>Pediatric DKA:</b> 0.05 to 0.1 units/kg/hr <b>HHS:</b> CI: 0.025 to 0.05 units/kg/hr
Furosamide	100 mg / 100 ml D5W	1 mg / ml			<b>Neonate:</b> 0.2mg/kg/hour Max: 0.4 mg/kg/hour
Furosamide	50 mg / 50 ml D5W <b>Syringe Pump</b>	1 mg / ml			<b>Pediatrics:</b> 0.05 mg/kg/hour Titrate dosage to clinical effect
Midazolam	50 mg / 100 ml D5W	0.5 mg / ml			<b>Neonate Sedation, mechanically ventilated:</b> 0.5 mcg/kg/min to 1mcg/kg/min

	Midazolam	5 mg / 10 ml D5W <b>Syringe Pump</b>	1 mg / ml			60–120 mcg/kg/hr	<b>Pediatric, Sedation, mechanically ventilated:</b> 1 to 2 mcg/kg/min Range: 0.4 to 6 mcg/kg/min <b>Status epilepticus:</b> CI: 0.83 to 33.3 mcg/kg/min
	Fentanyl	100 mcg / 10 ml <b>Syringe Pump</b>	10 mcg/ml			<b>Neonate:</b> 0.5- 5 mcg/kg/hour  <b>Pediatrics:</b> 1- 5mcg/kg/hour	
	Sodium Nitroprusside	50 mg / 250 ml <b>PROTECT FROM LIGHT</b>	200 mcg/ml			( 0.5--10 ) mcg /kg/min	
	Sodium Nitroprusside	10mg/50ml D5W <b>Syringe Pump</b>	200 mcg / ml			( 0.5--10 ) mcg /kg/min	
	Nitroglycerin	50mg/250ml D5W	200 mcg / ml			1-5 mcg / min	<b>Neonate</b> = 1-3mcg/kg/min Max= 5 mcg/kg/min <b>Children</b> = 1-5mcg/kg/min Max= 10 mcg/kg/min
	Nitroglycerin	10mg/50ml D5W <b>Syringe Pump</b>	200 mcg / ml			1-5 mcg / min	
	Vasopressin	80 units / 100 ml NS GIT Preparation	0.8 units / ml			0.1-1.5 units / min	
	Vasopressin	40 units / 50 ml NS GIT Preparation <b>Syringe Pump</b>	0.8 units / ml			0.1-1.5 units / min	
	Vasopressin	20 units / 100 ml NS Cardiac Preparation	0.2 units / ml			0.01-0.06 units / min	<b>Neonate shock:</b> 0.01 to 0.6 units/kg/hour  <b>Infants, children and adolescents shock:</b> 0.01 to 0.48 units/kg/hour  <b>GI hemorrhage children adolescents:</b> CI: 2 to 5 miliunits/kg/min Max: 10 miliunits/kg/min
	Vasopressin	10 units / 50 ml NS Cardiac Preparation <b>Syringe Pump</b>	0.2 units / ml			0.01-0.06 units / min	
	Aminophylline	500mg/500ml DW5	1mg/ml			( 0.1--1.2 ) mg/kg/hr	<b>Infants 6 to 52 wks:</b> Dose (mg/kg/hour) = [(0.008 X age in weeks) + 0.21] divided by 0.79
	Aminophylline	500mg/250ml DW5	2mg/ml			( 0.1--1.2 ) mg/kg/hr	
	Aminophylline	500mg/100ml DW5	5mg/ml			( 0.1--1.2 ) mg/kg/hr	
	Aminophylline	250mg/50ml DW5 <b>Syringe Pump</b>	5mg/ml			( 0.1--1.2 ) mg/kg/hr	

Bretylium	2000mg/500ml D5W	4 mg/ml			(0.014--0.028 ) mg/kg/min		
Bretylium	2000mg/250ml D5W	8 mg/ml			(0.014--0.028 ) mg/kg/min		
Bretylium	800mg/100ml D5W	4 mg/ml			(0.014--0.028 ) mg/kg/min		
Bretylium	400mg/50ml D5W <b>Syringe Pump</b>	4 mg/ml			(0.014--0.028 ) mg/kg/min		
Norepinephrine	4000mcg / 500 ml D5W	8 mcg / ml			Initial: ( 0.1---0.3 ) mg/ kg /min Maintenance: ( 0.01---0.06 ) mcg / kg / min	<b>Neonate septic shock, refractory</b> Initial: 0.05 to 0.1mcg/kg/min Usual range: 0.1 to 2 mcg/kg/min <b>Pediatric Hypotension/shock (off-label use):</b> 0.05 to 0.1 mcg/kg/min Max: 2 mcg/kg/min	
Norepinephrine	4000mcg / 250 ml D5W	16 mcg / ml			Initial: ( 0.1---0.3 ) mg/ kg /min Maintenance: ( 0.01---0.06 ) mcg / kg / min		
Norepinephrine	4000mcg / 100 ml D5W	40 mcg / ml			Initial: ( 0.1---0.3 ) mg/ kg /min Maintenance: ( 0.01---0.06 ) mcg / kg / min		
Norepinephrine	2000mcg / 50 ml D5W <b>Syringe Pump</b>	40 mcg / ml			Initial: ( 0.1---0.3 ) mg/ kg /min Maintenance: ( 0.01---0.06 ) mcg / kg / min		
Epinephrine 1:10,000	4000mcg / 500 ml D5W	8 mcg / ml			(0.01---0.5) mcg/kg/min	<b>Neonate hypotension; dopamine resistant shock:</b> 0.05 to 0.3 mcg/kg/min Usual range: 0.05 to 0.5 mcg/kg/min Max: 2.6 mcg/kg/min <b>Pediatric hypotension/shock:</b> 0.1 to 1 mcg/kg/min	
Epinephrine 1:10,000	4000mcg / 250 ml D5W	16 mcg / ml			(0.01---0.5) mcg/kg/min		
Epinephrine 1:10,000	2000mcg / 100 ml D5W	20 mcg / ml			(0.01---0.5) mcg/kg/min		
Epinephrine	1000mcg / 50 ml D5W <b>Syringe Pump</b>	20 mcg / ml			(0.01---0.5) mcg/kg/min		
Isoproterenol	2500 mcg / 250 ml D5W	10 mcg/ml			( 2--20 ) mcg / min	<b>Neonate bradycardia:</b> 0.05 to 1 mcg/kg/min <b>Pediatric bradycardia:</b> 0.05 to 0.5 mcg/kg/min Doses as high as 2 mcg/kg/min may be needed	
Isoproterenol	1000 mcg / 100 ml D5W	10 mcg/ml			( 2--20 ) mcg / min		
Isoproterenol	500 mcg / 50 ml D5W <b>Syringe Pump</b>	10 mcg/ml			( 2--20 ) mcg / min		
Dobutamine 250 mg/20 mL ampoules	250mg/250ml D5W	1 mg/ml			Neonates and Child (2--20) mcg/kg/min		
Dobutamine	250mg/100ml D5W	2.5 mg/ml			Neonates and Child (2--20) mcg/kg/min		
Dobutamine	500mg/100ml D5W	5 mg/ml			Neonates and Child (2--20) mcg/kg/min		

	Dobutamine	250mg/50ml D5W <b>Syringe Pump</b>	5 mg/ml			Neonates and Child (2--20) mcg/kg/min	
	Dopamine	400mg/250ml DW5	1.6 mg/ml			(1—20) mcg/kg/min	
	Dopamine	160mg/100ml DW5	1.6 mg/ml			(1—20) mcg/kg/min	
	Dopamine	80mg/50ml DW5 <b>Syringe Pump</b>	1.6 mg/ml			(1—20) mcg/kg/min	
	Dopamine	800mg/250ml DW5	3.2 mg/ml			(1—20) mcg/kg/min	
	Dopamine	320mg/100ml DW5	3.2 mg/ml			(1—20) mcg/kg/min	
	Dopamine	160mg/50ml DW5 <b>Syringe Pump</b>	3.2 mg/ml			(1—20) mcg/kg/min	
	Lidocaine	2000 mg/500ml D5W	4000 mcg/ml			( 1--4 ) mg / min	<b>Neonate and pediatric with ventricular arrhythmias, shock-refractory VF or pulseless VT</b>  LD: 1mg/kg/dose  Continuous IV infusion: 20 to 50 mcg/kg/min Don't exceed 20mcg/kg/min in patient with shock, hepatic disease, cardiac arrest of CHF
	Lidocaine	2000 mg/250ml D5W	8000 mcg/ml			( 1--4 ) mg / min	
	Lidocaine	800 mg/100ml D5W	8000 mcg/ml			( 1--4 ) mg / min	
	Lidocaine	400 mg/50ml D5W <b>Syringe Pump</b>	8000 mcg/ml			( 1--4 ) mg / min	
	Procainamide	1000 mg / 250 ml D5W	4000 mcg / ml			( 1-6) mg/ min	<b>Neonate supraventricular tachycardia:</b> LD: 7 to 10mg/kg over 60 min followed By <u>continuous infusion</u> of 20 to 80 mcg/kg/min  <b>Infants, children and adolescents:</b> LD: 10 to 15mg/kg over 30 to 60min Maintenance: Continuous infusion: 20 to 80 mcg/kg/min Max daily dose: 2000mg/24h
	Procainamide	400 mg / 100 ml D5W	4000 mcg / ml			( 1-6) mg/ min	
	Procainamide	200 mg / 50 ml D5W <b>Syringe Pump</b>	4000 mcg / ml			( 1-6) mg/ min	

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<b>Physician sig.:</b>			<b>Pharmacist sig.:</b>		
<b>Nurse sig.:</b>			<b>Pharmacist sig.:</b>		