Emergency Medications Order for Adults: Standardized Concentration System in Saudi Arabia

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INTRODUCTION

The national medication safety program at the Ministry of Health, Kingdom of Saudi Arabia, was founded in 2013.[1] This program has a strategic plan for several years and follows the national and international accreditation organization, for instance, Saudi Central Board for Accreditation of Healthcare Institutions (CBAHI) and Joint Commission.[2,3] In addition, the program is collaborated with the Institute for Safe Medication Practices (ISMP)-the organization for medication safety in the United States of America (USA). The ISMP has several assessments related to the medications safety in the hospitals and in ambulatory care setting. [4,5] The American Society of Health-System Pharmacist (ASHP) launched standardized concentration before several years. [6] Recently, the first national survey of medication safety through ISMP assessment was conducted during the Hajj period in Saudi Arabia. [7,8] The principal defect point of the critical elements of the ISMP assessment was the standardized concentration of medications during administration through drug devices.[9,10] The new initiative of adults emergency medications with standardized concentration and administration to improve medication safety culture and prevent medication error-related issues at three hospitals in Riyadh city, Saudi Arabia. To the best of our knowledge, there are no publications in Saudi Arabia, Gulf, or in Middle Eastern countries describing the standardized concentration of emergency medications for adults.

Adults Emergency Medications Standardized Concentration in Saudi Arabia

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

SWOT Analysis

The Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis method was used in this project. The strengths of the physician order forms for adults includes all information regarding common medications used in emergency situations, dosing of medications, fixed standardized concentration of emergency medications, the method of administration and prevented mistakes in writing emergency medications orders for adults are available. The weaknesses include dosing drips used outside another’s resources and it cannot apply to diseases such as renal or hepatic failure. The opportunities include a straightforward form to convert the physician order form into a computerized and physician order entry; it can perform statistical calculations on all emergency care medications. The threat points include the physician or the pharmacist not using the standardized concentration.

Implementations Steps of Emergency Medications Standardized Concentration for Adults

The pharmacy department organizes consultation with the committee of expert pharmacists especially from those experts on intravenous admixture and clinical pharmacists in critical care in the pharmacy department. The commit-
The pharmacy education coordinator arranges with all departments including nursing, surgical and medical department to prepare electronic order forms. The pharmacy quality management will set up the Key Performance Indicators (KPIs) to measure the impact of the project. All pharmacy-related teams including emergency medications preparation and clinical pharmacist will collect the KPIs of the project retrospectively over 3-6 months. Another collection of the data prospectively after implementations. The head of the committee will contact the nursing and medical department to start with one medical department as the pilot trial. The pharmacist will review the pilot trial and correct the form according to the pharmacy consultation committee. The team will expand to all medical department and surgical department. Review and alter the shape accordingly through committee. The head of the committee will expand to all hospital department including adult’s critical care, review and adjust the formulation accordingly. The pharmacy quality management coordinator measures the impact of the project by comparing the KPI before starting the project. The head of the committee will analyze the results and review with the consultation committee. The head of the pharmacy will submit the final report to the pharmacy and therapeutic committee for final comments. The consultation team reviews the final comments on the project, update it accordingly and continue the project with next year.

CONCLUSION
The standardized concentration of emergency medications for adults is an essential demand to prevent attributable errors and improve patient outcomes in addition to the regulatory requirements of high-alert medications at the Ministry of Health hospitals in the Kingdom of Saudi Arabia.

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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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### Adults Emergency Medications (1)(2)(3)(4)(5)

| Medications       | Standard Formula | Concentration | Rate       | Disp. Rate       |
|-------------------|------------------|---------------|------------|------------------|
| **Peripheral line Administration** |                  |               |            |                  |
| **Starting Date:** |                  |               |            |                  |

| # | Medications       | Standard Formula | Concentration | Rate       | Disp. Rate       |
|---|-------------------|------------------|---------------|------------|------------------|
| 1 | Aminophylline     | 500mg/500ml D5W  | 1mg/ml        |            |                  |
| 2 | Aminophylline     | 500mg/250ml D5W  | 2mg/ml        | (0.1-1.2)  | mg/kg/hr         |
| 3 | Aminophylline     | 500mg/100ml D5W  | 5mg/ml        | (0.1-1.2)  | mg/kg/hr         |
| 4 | Aminophylline     | 250mg/50ml D5W   | 5mg/ml        | (0.1-1.2)  | mg/kg/hr         |
| 5 | Fentanyl          | 500 mcg / 50 ml  | 10 mcg/ml     | 0.5-10     | mcg/kg/hr        |
| 6 | Fentanyl          | 100 mcg / 10 ml  | 10 mcg/ml     | 0.5-10     | mcg/kg/hr        |
| 7 | Furosemide        | 100 mg / 100 ml D5W | 1 mg / ml    | 10-40      | mg/hr            |
| 8 | Furosemide        | 50 mg / 50 ml D5W | 1 mg / ml    | 10-40      | mg/hr            |
| 9 | Heparin           | 25000 Units / 250 ml D5W | 100 units/ml | 10         | ml/hr            |
| 10| Heparin           | 10000 Units / 100 ml D5W | 100 units/ml | 10         | ml/hr            |
| 11| Heparin           | 5000 Units / 50 ml D5W Syringe Pump | 100 units/ml | 10         | ml/hr            |
| 12| Insulin           | 100 units / 100 ml NS | 1 units / ml | 0.5-1      | ml/hr            |
| 13| Insulin           | 50 units / 50 ml NS Syringe Pump | 1 units / ml | 0.5-1      | ml/hr            |
| 15| Midazolam         | 5 mg / 10 ml D5W Syringe Pump | 0.5 mg / ml | 10-100     | mcg/kg/hr        |

**Anesthesia:**

CI: 0.25 to 1 mcg/kg/min

**Sedation in mechanically-ventilated patients:**

Maintenance infusion: 0.3 to 1.7 mcg/kg/min

**Status epilepticus:**

CI: 0.83 to 33.2 mcg/kg/min
|   | Drug               | Dose                  | Concentration | Rate          | Additional Details                                      |
|---|--------------------|-----------------------|---------------|---------------|---------------------------------------------------------|
| 17| Nitroglycerin      | 10mg/50ml D5W         | 5 mg/ml       | 5 mg / min    | Syringe Pump                                           |
| 18| Oxytocin           | 30 units / 500 ml NS  | 60 miliunits / ml | 60 to 120 nU / hour (1-2ml/hour EVERY 30 to 60 minute) |
| 19| Oxytocin           | 30 units / 500 ml D5W | 60 miliunits / ml | 60 to 120 nU / hour (1-2ml/hour EVERY 30 to 60 minute) |
| 20| Sodium Nitroprusside | 50 mg / 250 ml       | 200 mcg / ml  | (0.25--10) mcg / kg/min                  |
| 21| Sodium Nitroprusside | 10mg/50ml D5W        | 200 mcg / ml  | (0.25--10) mcg / kg/min                  |
| 22| Vasopressin        | 80 units / 100 ml NS  | 0.8 units / ml | 0.1-1.5 units / min                        |
| 23| Vasopressin        | 40 units / 50 ml NS   | 0.8 units / ml | 0.1-1.5 units / min                        |
| 24| Vasopressin        | 20 units / 100 ml NS  | 0.2 units / ml | 0.01-0.06 units / min                      |
| 25| Vasopressin        | 10 units / 50 ml NS   | 0.2 units / ml | 0.01-0.06 units / min                      |

**Central line Administration**

|   | Drug               | Dose                  | Concentration | Rate          | Additional Details                                      |
|---|--------------------|-----------------------|---------------|---------------|---------------------------------------------------------|
| 1 | Bretylium          | 2000mg/500ml D5W     | 4 mg/ml       | (0.014--0.028) mg/kg/min |
| 2 | Bretylium          | 2000mg/250ml D5W     | 8 mg/ml       | (0.014--0.028) mg/kg/min |
| 3 | Bretylium          | 800mg/100ml D5W      | 4 mg/ml       | (0.014--0.028) mg/kg/min |
| 4 | Bretylium          | 400mg/50ml D5W       | 4 mg/ml       | (0.014--0.028) mg/kg/min |
| 5 | Bretylium          | 2000mg/500ml D5W     | 4 mg/ml       | (0.014--0.028) mg/kg/min |
| 6 | Dobutamine         | 1000mg/500ml D5W     | 2 mg/ml       | (2.5--40) mcg/kg/min |
| 7 | Dobutamine         | 1000mg/250ml D5W     | 4 mg/ml       | (2.5--40) mcg/kg/min |
| 8 | Dobutamine         | 500mg/100ml D5W      | 5 mg/ml       | (2.5--40) mcg/kg/min |
| 9 | Dobutamine         | 250mg/50ml D5W       | 5 mg/ml       | (2.5--40) mcg/kg/min |
| 10| Dobutamine         | 800mg/500ml DW5      | 1.6 mg/ml     | (1—50) mcg/kg/min                                   |
| 11| Dobutamine         | 800mg/250ml DW5      | 3.2 mg/ml     | (1—50) mcg/kg/min                                   |
| 12| Dobutamine         | 320mg/100ml DW5      | 3.2 mg/ml     | (1—50) mcg/kg/min                                   |
| 13| Dobutamine         | 160mg/50ml DW5       | 3.2 mg/ml     | (1—50) mcg/kg/min                                   |
| 14| Dobutamine         | 4000mcg / 500 ml D5W | 8 mcg / ml    | (0.01---0.5) mcg/kg/min                              |
| 15| Epinephrine 1:10,000 | 4000mcg / 500 ml D5W | 8 mcg / ml    | (0.01---0.5) mcg/kg/min                              |
|   | Medication       | Concentration Details | Dosing Information |
|---|------------------|-----------------------|--------------------|
| 14| Epinephrine 1:10,000 | 4000mcg / 250 ml D5W | 16 mcg / ml        |
| 15| Epinephrine 1:10,000 | 2000mcg / 100 ml D5W | 20 mcg / ml        |
| 16| Epinephrine 1:10,000 | 1000mcg / 50 ml D5W  | 20 mcg / ml        |
|   |                  | Syringe Pump          |                    |
| 16| Isoproterenol    | 1000 mcg / 250 ml D5W| 4 mcg/ml           |
| 17| Isoproterenol    | 400 mcg / 100 ml D5W | 4 mcg/ml           |
| 18| Isoproterenol    | 200 mcg / 50 ml D5W  | 4 mcg/ml           |
| 19| Lidocaine        | 2000 mg/500ml D5W    | 4000 mcg/ml        |
| 20| Lidocaine        | 2000 mg/250ml D5W    | 8000 mcg/ml        |
| 21| Lidocaine        | 800 mg/100ml D5W     | 8000 mcg/ml        |
| 22| Lidocaine        | 400 mg/50ml D5W      | 8000 mcg/ml        |
|   |                  | Syringe Pump          |                    |
| 23| Norepinephrine   | 4000mcg / 500 ml D5W | 8 mcg / ml         |
| 24| Norepinephrine   | 4000mcg / 250 ml D5W | 16 mcg / ml        |
| 25| Norepinephrine   | 4000mcg / 100 ml D5W | 40 mcg / ml        |
| 26| Norepinephrine   | 2000mcg / 50 ml D5W  | 40 mcg / ml        |
|   |                  | Syringe Pump          |                    |
| 27| Procainamide     | 1000 mg / 250 ml D5W | 4000 mcg / ml      |
| 28| Procainamide     | 400 mg / 100 ml D5W  | 4000 mcg / ml      |
| 29| Procainamide     | 200 mg / 50 ml D5W   | 4000 mcg / ml      |

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