Pediatrics Standardized Concentration of Cardiovascular Intravenous Infusion Medications: A New Initiative in Saudi Arabia

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ABSTRACT
Objectives: To explore the pediatrics and neonates standardized concentration of cardiovascular intravenous infusion as new initiatives in the Kingdom of Saudi Arabia.
Methods: It is a new initiative project drove by national standardized concentration of cardiovascular intravenous infusion services. The projects formulated from the international business model, pharmacy project guidelines and project management institution guidelines of a new project. The initiative project is written through project management professionals and consisted of several parts, including the initial phase, the planning phase, the execution phase, the monitoring and controlling phase.
Results: Results indicates that the pediatrics and neonates standardized concentration of cardiovascular intravenous infusion services with a defined vision, mission and goals. The services had multiple benefits including clinical and economic on patients, the continuous of the project assured by risk management model description and the monitoring and controlling of the services as explored in the review. The transition to operation project though closing project stage confirmed in the analysis.
Conclusion: The pediatrics and neonates standardized concentration of cardiovascular intravenous infusion services is a new initiative as part of the intravenous admixture program. The pediatrics and neonates standardized concentration of cardiovascular might diminution the workload of healthcare, pharmacy staff and avoid additional unnecessary economic burden on healthcare system; it is highly recommended to implement in the Kingdom of Saudi Arabia.
Keywords: Pediatrics, Neonates, Standardized, Concentration, Cardiovascular, Intravenous, Services, Saudi Arabia.

INTRODUCTION
Medication errors consider noteworthy problems in healthcare organizations, locally and internationally. The medication errors may rarely occur with adults or pediatrics and neonatal populations. The medication errors in neonates or pediatrics more dangerous than adults lead to a high mortality rate. Multiple elements exaggerated the mistakes incident, including the high workload on healthcare providers or pharmacy staff and non-existed medications preparation guidelines, non-implemented medications safety culture, or program. The common mistake came from parental medications and high alert medications, and Institute for Safe Medication Practices (ISMP) release some recommendations to standardized the neonates medication concentration with emphasis on cardiovascular drugs- to avoid the mistakes. The guidelines of pediatrics or neonatal parental medications released during 2012-2015 as the activities of the national medications safety program. However, the guidelines of preparations of neonatal or pediatrics medications did not include the standardized concentration of medications with an emphasis on cardiovascular drugs. Various researches published to show the outcome of the standardized concentration of medications. However, the local or Gulf and the Middle East studies about pediatrics and neonates standardized concentration of cardiovascular intravenous infusion not existed. The goal of the review project is to declare the pediatrics and neonates standardized concentration of cardiovascular intravenous infusion as new initiatives in the Kingdom of Saudi Arabia.

Method of the Project
It is a new initiative project drove from the national IV admixture and chemotherapy program. The task force team of pediatrics and neonates standardized Concentration of Cardiovascular Intravenous Infusion Medications and contained from author’s expert in the parenteral medications. The committee utilized and drove the pharmacy parenteral administration guidelines, from the textbook and international literature pediatrics and neonates standardized Concentration of Cardiovascular Intravenous Infusion Medications written by utilizing the international business model, pharmacy project guidelines and project management institution guidelines of a new project. The standardized concentration familiar based on the acceptable concentration, daily dose and the volume of bag as possible. The project is written through project...
management professionals and consisted of several parts, including the initial phase, the planning phase, the execution phase, the monitoring and controlling phase.

**Initiative Phase**

**Assessment Needs**

The pharmacy staff makes multiple intravenous medications with different concentrations and different diluent solutions daily. The adults or pediatrics and neonates have various doses for multiple indications. On the other hand, handled the healthcare care providers, including the physician, prescribe different intravenous medications with various doses and concentration. Moreover, the nurse's staff control different medications with various concentrations or solutions to different patients. If the above factors involved with daily performance, it will surge the workload for all types of healthcare professionals and subsequent medication mistakes during pressing medications or dispense and administer the medicines. The pediatrics and neonates standardized concentration of cardiovascular intravenous infusion with the limited and specific numbers with unique solutions will diminution the workload and medication mistakes at all stages of medication distribution processes.

**SWOT Analysis**

There are several tools and methods of the total most quality management used for the new project and the SWOT method was one of the conventional methods. It stands for strength, weakness, opportunities and threats pints. The most strengths points of the project are reduced workload for healthcare and pharmacist and pharmacy technician and reduction of medication errors. The weak points are a limited number of diluent solutions and standardized concentration. The opportunities points are continuing updates of international and local accreditation standards, implementation of total quality management policy. The threat points are higher healthcare care providers, increased fatigue, and if the pharmacy strategic plan not implemented.

**Project Description**

The following policies were put in place for every pharmacist and other healthcare individuals.[25][26]

- The pediatrics and neonates standardized concentration of cardiovascular intravenous infusion committee should be formulated at healthcare organizations.
- The pediatrics and neonates standardized concentration of cardiovascular intravenous infusion committee should contain of pediatrics IV pharmacist and pediatrics physician and nurse representative, neonatal physician and nurse representative.
- The committee reviews the pediatrics and neonates standardized concentration of cardiovascular intravenous infusion and updates at least annually (Table 1).
- The pediatrics and neonates standardized concentration of cardiovascular intravenous infusion education and training sessions should be conducted by the committee to all healthcare providers, including physicians and nurses, with pharmacy staff.
- The pediatrics and neonates standardized concentration of cardiovascular intravenous infusion distributed to healthcare sectors at the institutions.

**Planning Phase**

**Scope of the Project**

The project covered pediatrics and neonatal standardized cardiovascular medications based on the suitable dosing, frequency administration with high stability and the preparation with commonly used the diluent solution in practice.

**Vision, Missions, Goals**

The vision of the project is to reach best with high-quality pediatrics or neonatal intravenous standardized cardiovascular medications, while the message to provide appropriate neonatal or patients parenteral standardized cardiovascular with a long half-life. The aim of the project is to standardize the intravenous concentration of cardiovascular medications, to prevent mistakes related to concentrations of cardiovascular medicine, to encourage the pharmaceutical companies to manufacture of the same concentration and to prevent the additional cost of cardiovascular medications wastage.

**Plan Cost Management**

The financial budget must be determined for each new project. Also, the charge of a management team meeting, the charge of educational courses and the charge of updated references are requirements of budget. Therefore, every period, the budget should be observed.

**Executing Phase**

**Management Team**

The projected demands for team management to take care of the implementation. The team contained of several members, including cardiology pediatrics clinical pharmacist, cardiology neonatal clinical pharmacist, cardiology pediatrics, neonatal physician, pediatrics nurse, neonatal nurse, pharmacist, pharmacy technician of parental preparation and pharmacy quality management. The team should follow and measure the outcomes of the project.
<table>
<thead>
<tr>
<th>No.</th>
<th>Generic Name</th>
<th>Initial Strength</th>
<th>Diluents</th>
<th>Reconstitution Volume</th>
<th>Final Concentration IVPB</th>
<th>Final Preparation with Standard Concentration</th>
<th>Maximum Conc.</th>
<th>Final Preparation with Maximum Concentration</th>
<th>Stability of Solution</th>
<th>Solution</th>
<th>Ref</th>
<th>Rate of Administration IVPB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Amiodarone</td>
<td>50 mg/ml</td>
<td>D5W</td>
<td>NA</td>
<td>1.8 mg/ml</td>
<td>450 mg/250 ml D5W 75 mg/50 ml D5W 10 mg/5 ml D5W</td>
<td>3 mg/ml</td>
<td>300 mg/100 ml D5W 75 mg/25 ml D5W 10 mg/2.5 ml D5W</td>
<td>24 hrs (glass or polyethylene container)</td>
<td>NA</td>
<td>60 mint</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Calcium Chloride 10%</td>
<td>100 mg/ml</td>
<td>D5W</td>
<td>NA</td>
<td>5 mg/ml</td>
<td>250/25 ml D5W 250/25 ml NS</td>
<td>20 mg/ml</td>
<td>500/25 ml D5W 500/25 ml NS</td>
<td>24 hrs</td>
<td>NA</td>
<td>45-90 mg/kg/hr (0.3-0.6 mmol/kg/hr)</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Calcium Gluconate 10%</td>
<td>100 mg/ml</td>
<td>D5W</td>
<td>NA</td>
<td>10 mg/ml</td>
<td>250/25 ml D5W 250/25 ml NS</td>
<td>50 mg/ml</td>
<td>500/25 ml D5W 500/25 ml NS</td>
<td>24 hrs</td>
<td>NA</td>
<td>Not exceed 200 mg/min (2 ml/min)</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Digoxin 100 mcg/2ml</td>
<td>250 mcg/ml</td>
<td>D5W</td>
<td>NA</td>
<td>0.25 mcg/ml</td>
<td>250 mcg/ml 0.25 mg/25 ml D5W 0.25 mg/25 ml NS 0.025 mg/10 ml D5W 0.025 mg/10 ml NS</td>
<td>250 mcg/ml</td>
<td>0.5 mg/25 ml D5W 0.5 mg/25 ml NS 0.025 mg/5 ml D5W 0.025 mg/5 ml NS</td>
<td>24 hrs</td>
<td>NA</td>
<td></td>
<td>10-20 min</td>
</tr>
<tr>
<td>5.</td>
<td>Dipyridamole 10 mg/ml</td>
<td>5 mg/ml</td>
<td>D5W</td>
<td>NA</td>
<td>1 mg/ml</td>
<td>10 mg/25 ml NS 10 mg/25 ml D5W</td>
<td>2.5 mg/ml</td>
<td>10 mg/25 ml NS 10 mg/25 ml D5W</td>
<td>NA</td>
<td>NA</td>
<td>over 4 min</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Esmolol 100 mg/10 ml</td>
<td>10 mg/ml</td>
<td>D5W</td>
<td>NA</td>
<td>10 mg/ml Continuous infusion</td>
<td>500 mg/50 ml D5W 500 mg/50 ml NS 200 mg/20 ml D5W 200 mg/20 ml NS</td>
<td>20 mg/ml</td>
<td>500 mg/25 ml D5W 500 mg/25 ml NS 200 mg/10 ml D5W 200 mg/10 ml NS</td>
<td>24 hrs</td>
<td>24 hrs</td>
<td>≤ 200 mcg/kg/min Continuous infusion</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Furosemide 10 mg/ml</td>
<td>10 mg/ml</td>
<td>NS</td>
<td>D5W</td>
<td>1 mg/ml</td>
<td>20 mg/25 ml NS 20 mg/25 ml D5W 40 mg/25 ml NS 40 mg/25 ml D5W 5 mg/5 ml NS 5 mg/5 ml D5W</td>
<td>10 mg/ml</td>
<td>20 mg/10 ml NS 20 mg/10 ml D5W 40 mg/10 ml NS 40 mg/10 ml D5W 10 mg/2.5 ml NS 10 mg/2.5 ml NS</td>
<td>24 hrs</td>
<td>NA</td>
<td>≤ 4 mg/min</td>
<td></td>
</tr>
</tbody>
</table>
Education and Training

The project desires several education courses should be conducted for pharmacist and pharmacy technician. Besides, orientation education courses for healthcare providers, including physicians and nurses. The management team should receive education and training sessions about the project. Any new pharmacy staff or physician or nurse should receive orientation courses about the project.

Monitoring and Controlling Phase

Project Total Quality Management

The conventional method used for quality management during the implementation of the project pediatrics and neonatal standardized concentration of cardiovascular medications was the Balanced Scored Card. It entailed four types including the customer, finance, internal process, education and innovation.

The internal processes type contained the assessment of healthcare services of patients and neonatal standardized concentration of cardiovascular medications. On the other hand, the education and innovation types had an example of the measures of clinical outcome of pediatrics and neonatal standardized concentration of cardiovascular medications explored the education and competency of pharmacy staff. Moreover, another financial element had an example of the measurement of the cost-saving impact of pediatrics and neonatal standardized concentration of cardiovascular medications. The fourth type intricate the customer types that measure the patient's satisfaction or healthcare providers and pharmacy staff toward pediatrics and neonatal standardized concentration of cardiovascular medications in the Kingdom of Saudi Arabia.

Risk Management

Many kinds of risks are involved including budget risks, scope risks, schedule risks, personal risks, technical risks and quality risks. The most kinds of risks exposed to the new project were personnel, budget, technical and quality risks. The project may be suffered from personal risks, which no trained pharmacy staff or a shortage of them. The budget types are common risks which comprised not sufficient budget for education and training for pharmacist and pharmacy technician or healthcare providers and updated resources. Moreover, the technical risk properly exposed that includes a non-friendly used computer system within electronic prescribing or not available altering system. One the other hand, the quality risks are another risk that might be suffered from the

### Table 1: Suggested Pediatrics and Neonates Standardized Concentration of Cardiovascular Intravenous Infusion Medications

<table>
<thead>
<tr>
<th>Medication</th>
<th>Concentration</th>
<th>Dose</th>
<th>Administration</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydralazine</td>
<td>0.05mg – 0.2mg/ml</td>
<td>20mg</td>
<td>100ml NS</td>
<td>24 hrs</td>
</tr>
<tr>
<td>Labetalol</td>
<td>5mg/ml</td>
<td>25mg</td>
<td>250ml NS</td>
<td>7 days</td>
</tr>
<tr>
<td>Nitroglycerin</td>
<td>0.1mg/ml</td>
<td>5mg</td>
<td>50ml D5W</td>
<td>14 days</td>
</tr>
<tr>
<td>Sodium Nitroprusside</td>
<td>10mg/ml</td>
<td>50mg</td>
<td>250ml D5W</td>
<td>24 hrs</td>
</tr>
</tbody>
</table>

**Abbreviations:** IVBP: Intravenous Piggyback, NA: Not Applicable/ Not available, NS: Normal Saline, Ref: Refrigerate, RT: Room Temperature, SWFI: Sterile Water For Injection, Hrs : hours, Mint: Minutes

Note: The healthcare professionals should adjust the concentration and the dose requirement according to the patient condition and their local healthcare institution policy.
project, which related to none implemented the elements of the medications safety system and not enough quality management pharmacy in the health institutions.

Closing of the Project

The cardiovascular pediatrics and neonatal medications with standardized concentration at hospitals and primary healthcare centers of governmental and private sectors are highly proposed to prevent medications related mistakes with morbidity or mortality errors and to prevent redundant additional cost on the healthcare system in the Kingdom of Saudi Arabia. The project should continue at parenteral medications in each pharmacy department and related committees. The cardiovascular medications of pediatrics and neonatal education and training for standardized concentration should be performed periodically. The pediatrics and neonatal cardiovascular medications with standardized concentration should be updated and expand the number of medications in the future. The pediatrics and neonatal cardiovascular medications pharmacist and pharmacy technician should conduct the annual celebrate, highly recommended in Saudi Arabia.

ACKNOWLEDGEMENT

None.

CONFLICT OF INTEREST

None.

FUNDING

None.

CONSENT FOR PUBLICATIONS

Informed consent was obtained from all the participants.

ETHICAL APPROVAL

This research exempted from research and ethical committee or an institutional review board (IRB) approval.


ABBREVIATIONS

MOH: Ministry of Health; KSA: Kingdom of Saudi Arabia; ISMP: Institution of Safe Medication Practice; SWOT: Strengths, Weaknesses, Opportunities and Threats; IV: Intravenous; BSC: Balance Scored Cards; IAC: intravenous admixture committee.

REFERENCES

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