Adult Standardized Concentration of Central Nervous System Medications Intravenous Infusion: A New Initiative in Saudi Arabia

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ABSTRACT

Objectives: To declare the adult standardized concentration of central nervous system medications intravenous infusion as new initiatives in the Kingdom of Saudi Arabia.

Methods: It is a new initiative project drove by national standardized concentration of central nervous system medications 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: The adult standardized concentration of central nervous system medications intravenous infusion services defined as a vision, mission and goals. The services had various profits including clinical and economic on patients, the continuous of the project assured by risk management model description. In addition, the monitoring and controlling of the services and the transition to operation project through closing project stage explored in the analysis as illustrated in the review.

Conclusion: The adult standardized concentration of central nervous system medications intravenous infusion services is a new initiative part of the intravenous admixture program. The standardized concentration of central nervous system medications maybe leads to reduction of medication errors and improve patient safety culture at healthcare organization; it is highly suggested to implement in the Kingdom of Saudi Arabia.

Keywords: Adult, Standardized, Concentration, Central nervous system medications, Intravenous, Saudi Arabia.

INTRODUCTION

The medication errors are one major concern complications in worldwide and locally. The medications may hurt the medications lead to the incidence of mobility and mortality. The economic burden of medication errors on the healthcare system was very high. The pharmacist had a noteworthy role in medications errors prevention and recognized the medications safety program. The medication error prevention had exceptional clinical or economic outcomes in the patient's care. Several elements related to patients, drug, equipment, education, competency and total quality medications were the angle of assessment of medications safety culture and prevented the errors before it occurs. Institute of Safety Medications Practice (ISMP) worked very hard in this matter and release several indicators to prevent mistakes at the hospital or primary healthcare centers and community pharmacies. ISMP published several guidelines of medication safety assessment as general in the hospitals or with emphasis on specialty, for instance, oncology medications. Several local investigations should the outcome of self-assessment of medication safety at the hospital or primary healthcare centers. Lowest part was standardized medications or standardized medications equipment for administration.

Various studies released about the standardized concentration of medications with an emphasis on central nervous system medications. The authors best of their knowledge were not familiar with local investigations or Gulf areas and Middle East countries about this concept. The current review aims to explore the adult’s standardized concentration of central nervous system medications as a new initiative project 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 standardized intravenous adults central nervous system medication concentration formulated and contained from author's expert in the parenterl medications. The committee utilized and drove the pharmacy parenteral administration guidelines and from the textbook and international literature standardized concentration of intravenous central nervous system medication written by utilizing the international business model, pharmacy project guidelines and project management institution guidelines of a new project. The standardized concentration adjusted based on the acceptable concentration, daily dose and the volume of bag as possible. The project is written...
through project management professionals and entail of several parts, including the initial phase, the planning phase, the execution phase, the monitoring and controlling phase.

**Initiative Phase**

**Assessment Needs**

Every intravenous admixture service had guidelines for parenteral medications. The guidelines consisted of medications, route of administration, the rage of concentration, stability and compatibilities. The pharmacy staff prepares various medications with multiple concentrations and different diluent solutions. Also, the healthcare providers, including physicians and nurses, are dealing with a different method of administration with various concentrations and multiple solutions. The workload of healthcare professionals can be increased through prescribing or dispensing and administration of medications. The various factors of the workforce may affect the safety culture and lead to medication errors if the integrated concentration with the solution will diminution the workload and prevent medication mistakes.

**SWOT Analysis**

SWOT analysis is a simple but useful framework for analyzing your organization’s strengths, weaknesses, opportunities and threats. The strengths points of the project are medication safety prevention elements, reductions of pharmacy and healthcare provider, while the weak points are limited medication concentration and few numbers of diluent solution. The opportunities points are quality elements accreditation and patient safety program implementation. Threats are anything that could cause damage to your organization, venture, or product. e.g. If the pharmacy strategic plan does not occur and if the administration banner was not available.

**Market Analysis**

Each intravenous admixture service had a specific method of parenteral medications. The manual of preparation contained of medications, route of administration, the stability of preparation, regular with maximum concentration and medication compatibility. Most of the governmental or private organizations had the same guideline with different medications. There is no standardized concentration for medications or standardized diluent solution. It is an exceptional method for standardized concentration to encourage pharmaceutical companies to manufacture the same ready-made, standardized concentration, although some ready-made medications with specific concentration considered as a variable in the market.

**Planning Phase**

**Scope of the Project**

The project covers an adult’s standardized concentration of intravenous central nervous system medications including common, maximum concentration based on the dosage, frequency administration and the diluent solution for CNS medications.

**Vision, Missions, Goals**

The vision of the project is to reach the best adult’s standardized concentration of intravenous CNS medications, while the message to deliver the appropriate adults’ fixed standardized concentration of intravenous CNS medications with an appropriate solution. The goals of the project is to fix the adults’ standardized concentration of intravenous CNS medications, to prevent any errors related to drug concentration, to decrease workload for healthcare providers and to avoid the supplementary cost of medication waste.

**Project Description**

The following policies were put in place for every pharmacist and other health care individuals:

- The adult standardized concentration of central nervous system medications intravenous infusion committee should be formulated at healthcare organizations.
- The adult standardized concentration of central nervous system medications intravenous infusion committee should consist of IV pharmacist, pharmacy technician, adults nursing representative, adult surgical or medical representative, pediatrics physician, nurse representative, neonatal physician and nurse representative.
- The committee revises the adult standardized concentration of central nervous system medications intravenous infusion and updates at least annually (Table 1).
- The adult standardized concentration of central nervous system medications intravenous infusion education and training sessions should be conducted by the committee to all healthcare providers, including physicians and nurses, with pharmacy staff.
- The adult standardized concentration of central nervous system medications intravenous infusion distributed to healthcare sectors at the institutions (Table 1).

- The physician writes the prescription based on the adult standardized concentration of central nervous system medications intravenous infusion. If the physician wishes to prescribe outside the standardized concentration of medication guidelines, he should document the justification.
- The prescription should send to the pharmacy, IV pharmacist and pharmacy technician will prepare it based on the adult standardized concentration of central nervous system medications intravenous infusion.
- The pharmacy department should measure the clinical outcome of the adult standardized concentration of central nervous system medications intravenous infusion.
- The pharmacy department should measure the economic outcome of the adult standardized concentration of central nervous system medications intravenous infusion.
- The pharmacy department should document any prescription non-adherence to the adult standardized concentration of central nervous system medications intravenous infusion.

**Plan Cost Management**

Every new project, the management team must set up the financial budget, which includes the price of educational courses, the price of the management team meeting and the price of updated references. The budget must be supervision over a period of time.

**Executing Phase**

**Management Team**

The project management professionals consisted of several steps. One of the essential steps was executing phase, which had a team lead the project from the beginning until becoming one of the operating systems at healthcare institutions. The team entailed of several members, including adult neurology clinical pharmacist, medical neurology physician, pharmacist and pharmacy technician experts in the parental preparation, pharmacy quality management and medications safety officer representing. The team should implement and follow up on the project with regular updating of medications list with their concentration. Also, the team should educate and train the
<table>
<thead>
<tr>
<th>No.</th>
<th>Generic Name</th>
<th>Initial Strength</th>
<th>Diluents</th>
<th>Reconstitution Volume</th>
<th>Final Concentration IVBP</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>RT Ref</th>
<th>Rate of Administration IVBP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chlorpromazine</td>
<td>25mg/ ml</td>
<td>NS</td>
<td>NA</td>
<td>0.25mg/ ml</td>
<td>25mg/ 500ml NS</td>
<td>0.5mg/ ml</td>
<td>50mg/ 500ml NS</td>
<td>Use fresh</td>
<td>NA</td>
<td>1mg/min</td>
</tr>
<tr>
<td>2</td>
<td>Clonazepam</td>
<td>1mg/1ml</td>
<td>NS</td>
<td>NA</td>
<td>3mg/250ml</td>
<td>6mg/500ml NS</td>
<td>1mg/85ml</td>
<td>6mg/250ml NS</td>
<td>24hr</td>
<td>NA</td>
<td>8 hrs</td>
</tr>
<tr>
<td>3</td>
<td>Dantrolene</td>
<td>0.33mg/ ml</td>
<td>SWFI</td>
<td>60 ml</td>
<td>0.33mg/ ml</td>
<td>20mg/ 60ml SWFI</td>
<td>0.33mg/ ml</td>
<td>20mg/ 60ml SWFI</td>
<td>6hrs</td>
<td>NA</td>
<td>60 min</td>
</tr>
<tr>
<td>4</td>
<td>Dexamethasone</td>
<td>4mg/ml</td>
<td>NS</td>
<td>NA</td>
<td>&gt;8mg/50ml</td>
<td>8mg/25ml D5W</td>
<td>4mg/ml</td>
<td>16mg/25ml D5W</td>
<td>24 hrs</td>
<td>2 days</td>
<td>30 min</td>
</tr>
<tr>
<td>5</td>
<td>Sodium phosphate</td>
<td>5mg/ml</td>
<td>NS</td>
<td>NA</td>
<td>0.25 mg/ml</td>
<td>50mg/50ml D5W</td>
<td>5mg/ml</td>
<td>50mg/25ml D5W</td>
<td>NA</td>
<td>NA</td>
<td>60 min</td>
</tr>
<tr>
<td>6</td>
<td>Diazepam</td>
<td>50mg/ ml</td>
<td>DSW</td>
<td>NA</td>
<td>1mg/ ml</td>
<td>50mg/50ml D5W</td>
<td>2mg/ ml</td>
<td>100mg/ 50ml D5W</td>
<td>24 hrs</td>
<td>NA</td>
<td>25 mg/min</td>
</tr>
<tr>
<td>7</td>
<td>Diphenhydramine</td>
<td>0.2mg/ ml</td>
<td>DSW</td>
<td>NA</td>
<td>2mcg/ml</td>
<td>0.2mg/100ml NS</td>
<td>2mcg/ml</td>
<td>0.2mg/100ml NS</td>
<td>24 hrs</td>
<td>NA</td>
<td>15–20 min</td>
</tr>
<tr>
<td>8</td>
<td>Glycopyrrolate</td>
<td>5mg/ml</td>
<td>NS</td>
<td>NA</td>
<td>1mg/ ml</td>
<td>25mg/ 25ml D5W</td>
<td>1mg/ ml</td>
<td>25mg/ 25ml D5W</td>
<td>NA</td>
<td>7 day</td>
<td>30 min</td>
</tr>
<tr>
<td>9</td>
<td>Haloperidol</td>
<td>100mg/ 2ml, 500mg/ 4ml</td>
<td>DSW</td>
<td>2ml SWFI, 4ml SWFI</td>
<td>1mg/ ml</td>
<td>100mg/ 25ml D5W</td>
<td>60mg/ ml</td>
<td>200mg/ 25ml D5W</td>
<td>0.1 - 1 mg/ml, 24 hrs</td>
<td>2-10 mg/ml</td>
<td>24 hrs, 30 min</td>
</tr>
<tr>
<td></td>
<td>Sodium Succinate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1: Suggested Adults standardized central nervous system medications.

<table>
<thead>
<tr>
<th>Medication</th>
<th>Concentration</th>
<th>Duration</th>
<th>Infusion</th>
<th>Use</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lorazepam</td>
<td>0.2 mg/mL</td>
<td>Continuous infusion</td>
<td>30-60 mins</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24 hrs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.08 mg/mL</td>
<td>2 mg/ml</td>
<td></td>
<td>48 hrs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.04 mg/mL</td>
<td>1 mg/ml</td>
<td></td>
<td>48 hrs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.02 mg/mL</td>
<td>0.5 mg/ml</td>
<td></td>
<td>24 hrs</td>
<td></td>
</tr>
<tr>
<td>Mannitol</td>
<td>2 mg/mL</td>
<td>Resolution</td>
<td>6 hrs</td>
<td>Use</td>
<td>fresh</td>
</tr>
<tr>
<td>Sodium Succinate</td>
<td>4 mg/250ml D5W</td>
<td>2 mg/250ml DSW</td>
<td>48 hrs</td>
<td>24 hrs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 mg/500ml NS</td>
<td>0.4 mg/ml</td>
<td>500mg/100ml NS</td>
<td>Use</td>
<td>fresh</td>
</tr>
<tr>
<td></td>
<td>2 mg/250ml NS</td>
<td>0.016 mg/ml</td>
<td>2mg/250ml NS</td>
<td>Use</td>
<td>fresh</td>
</tr>
<tr>
<td></td>
<td>0.004 mg/ml</td>
<td>0.01 mg/ml</td>
<td>2mg/250ml NS</td>
<td>Use</td>
<td>fresh</td>
</tr>
<tr>
<td>Naloxone</td>
<td>0.4 mg/ml</td>
<td>40 mg dose</td>
<td>40mg/ml</td>
<td>40mg/ml</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>62.5 mg/ml</td>
<td>500mg/250ml</td>
<td>40mg/ml</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>125 mg/ml</td>
<td>500mg/250ml</td>
<td>40mg/ml</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>250 mg/ml</td>
<td>500mg/250ml</td>
<td>40mg/ml</td>
<td></td>
</tr>
</tbody>
</table>


Note: The healthcare professionals should adjust the concentration and the dose requirement according to the patient's condition and measure the clinical and economic outcome of the project.

Education and Training

Each new project needs special education and training about the adult standardized concentration of central nervous system medications intravenous infusion for concern people. This project desires education and training for pharmacy staff, including pharmacists and pharmacy technicians. The healthcare providers, including physicians and nurses, need another special education and training. Besides, the team management needs orientation education about the project. The orientation needs for any new staff healthcare providers joined the healthcare organization.

Monitoring and Controlling Phase

Project Total Quality Management

There are many tools used for total quantity management with new project adults standardized concentration of central nervous system medications during the implementation stage and reflect the impact and the balance scored cards was among them. The elements monitor consisted of four-part including the customer, finance, internal process, education and innovation. The assessment of healthcare services of adult's standardized concentration of central nervous system medications was an example of an internal process type. The clinical outcome of adult's standardized concentration of central nervous system medications, which might reflect the education and competency of pharmacy staff as an example of the education type. The financial type had another example of measuring the cost avoidance of the adult's standardized concentration of central nervous system medications. The fourth type was the customer types with measuring the patient's satisfaction with healthcare providers, including pharmacists and pharmacy technicians of adult's standardized concentration of central nervous system medications satisfaction in the Kingdom of Saudi Arabia.

Risk Management

There are several considered risks including budget risks, scope risks, schedule risks, personal risks, technical risks and quality risks. The project mostly exposed to risks such as personnel, budget, technical and quality risks. The project properly suffered from personal risks with not trained pharmacists or pharmacy technicians or not sufficient pharmacy staff. The budget risk during not enough education and training courses to all healthcare providers’ related issues. It might
expose to the budget, not enough for education and training of healthcare providers. There is another of technical risk maybe exposed; the technical without the electronic recourses of friendly use computer system in pharmacy practice. The project maybe is exposed to quality risks with not implemented medications safety elements or non-trained personnel.

Closing of the Project

The adult standardized concentration of central nervous system medications intravenous infusion at all healthcare organizations of governmental and private sectors are required to prevent drug-related misadventures lead to morbidity and mortality and prevent an unnecessary economic burden on hospitals and primary healthcare centers services in the Kingdom of Saudi Arabia. The project should continue at the preparation of parental medications at each pharmacy unit and related committees. The standardized adult's concentration education and training should be implemented periodically. Adults CNS medications concentration should update and furthermore expand of medications is suggested in the future. The annual celebration of all IV admixture pharmacy staff with pharmacist and pharmacy technician is highly optional in the Kingdom of 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. https://www.hhs.gov/ohrp/regulations-and-policy/decision-charts-2018/index.html

ABBREVIATIONS
MOH: Ministry of Health; KSA: Kingdom of Saudi Arabia; ASHP: American Society of Health-System Pharmacists; SWOT: Strengths, Weaknesses, Opportunities and Threats; CNS: Central Nervous System; IV: Intravenous; BSC: Balance Scored Cards; IAC: intravenous admixture committee.

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REFERENCES