

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

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ABSTRACT

Objectives: To establish the pediatrics and neonates standardized concentration of central nervous system 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 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:** The pediatrics and neonates standardized concentration of central nervous system 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 confident 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 central nervous system intravenous infusion services is new initiative as part of the intravenous admixture program. The pediatrics and neonates standardized concentration of central nervous system intravenous infusion properly reduce medication errors and improve patient safety culture system; it is highly recommended to implement in the Kingdom of Saudi Arabia.

Keywords: Pediatrics, Neonates, Standardized, Concentration, Central Nervous System, Intravenous, Services, Saudi Arabia.

INTRODUCTION

The national intravenous admixture program originated during the implementation of the pharmacy strategic plan 2012-2015.^[1,2] It contained of multiple aspects, for an instant, guiltiness of aseptic technics, adult parenteral medications manual, design of intravenous admixture based on bed capacity, pediatrics parental medications manual and neonatal parental medications manual.^[1] All parenteral preparation guidelines had medications, stability after preparation and different concentration with various diluent solutions. In those manuals, the authors propose starting steps of standardized concentration of medications, including central nervous system medications. Several investigations showed that the unique concentration would prevent drug-related errors and decrease health care providers and pharmacist staff workload.^[3-7] The American Society of Health-System Pharmacists with other healthcare organizations underway and fortified to implement the standardized concentrations for safety.^[8,9] However, there are no local or Middle East studies to declare the pediatrics and neonates standardized concentration of central nervous system intravenous infusion.^[10-16] The aim of this project is to explore the pediatrics and neonates standardized concentration of Central

Nervous System (CNS) intravenous infusion as new initiatives in the Kingdom of Saudi Arabia.

Project Management Professional Method of the Project

It is a new initiative project drove from the national IV admixture and chemotherapy program.^[1] The task force team of standardized intravenous pediatrics and neonates central nervous system medication concentration formulated and contained the author's expert in the parenteral medications. The committee utilized and drove the pharmacy parenteral administration guidelines, from the textbook and international literature of the intravenous pediatrics and neonates central nervous system medication concentration written by utilizing the international business model, pharmacy project guidelines and project management institution guidelines of a new project.^[17-20] 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 comprised of several parts, including the initial phase, the planning phase, the execution phase, the monitoring and controlling phase.

Initiative Phase

Assessment Needs

The majority of the intravenous admixture services prepare multiple medications with various concentrations and different diluent solutions daily. The nurses administer multiple medications with various concentration and solution daily. There was a high workload of pharmacy staff through parenteral admixture services and received by patients through nursing care. The large workload of various concentrations and the different solutions may lead to preparation or administration errors. In progress, the standardized concentration and solution were required to prevent mistakes by reducing the workload of pharmacy and other healthcare professionals. Also, there was an opportunity to inspire the manufactures to produce the same time the standardized concentration and ready-made solutions

SWOT Analysis

There are common and popular analysis tools by name the SWOT Analysis stands for strengths, weaknesses and opportunities and threats points. The strengths points of the project are medication mistake prevention, reducing the healthcare professionals and pharmacy staff workload, while the weak points are a limited number of diluent solutions and medication concentration. In addition, the opportunity points are the presence of quality patient safety programs and the process of the local and international accreditation. Moreover, the threat points are the non-availability of a healthcare leader and the non-implementation of the pharmacy strategic plan.

Market Analysis

Multiple medications came as ampoules solution or powers for reconstitution. Some pharmaceutical companies yield the medications ready-made a solution or diluted with the solution ready for administration. The ready-made of medications was the same as the strength of medications regardless of the concentration suitable or not for administration through a central venous or peripheral line. Moreover, the pharmaceutical care services had guidelines for the preparation of intravenous medications with different concentrations and diluted solutions. Several above factors may surge workload and subsequent, leading to medication errors. The standardized concentration of parenteral medications properly reduces the workload and implement the safety of the medication in practice.

Planning Phase

Scope of the Project

The project covers the pediatrics and neonates standardized concentration of central nervous system intravenous infusion based on the common dosing and frequency administration including a suitable diluent solution.

Vision, Missions, Goals

The vision of the project to reach best with high-quality pediatrics and neonates standardized concentration of central nervous system intravenous infusion, while the message is to provide the high quality stable intravenous standardized concentration of central nervous system medications with suitable dosing and frequency administration. The goals of this project is to standardized the concentration of intravenous central nervous system medications, to prevent medication errors related to concentration, to decrease the workload of pharmacy and medical staff, to prevent intravenous central nervous system medications wastage and economic burden on the healthcare system.

Project Description

The following policies were put in place for every pharmacist and other health care individuals:^[21,22]

- ✓ The pediatrics and neonates standardized concentration of central nervous system intravenous infusion committee should be formulated at healthcare organizations.
- ✓ The pediatrics and neonates standardized concentration of central nervous system intravenous infusion committee should consist of pediatrics IV pharmacist and pharmacy technician, pediatrics physician and nurse representative, neonatal physician and nurse representative.
- ✓ The committee revises the pediatrics and neonates standardized concentration of central nervous system intravenous infusion and updates at least every year.
- ✓ The pediatrics and neonates standardized concentration of central nervous system 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 central nervous system intravenous infusion distributed to healthcare sectors at the institutions (Table 1).
- ✓ The physician writes the prescription based on the pediatrics and neonates

standardized concentration of central nervous system intravenous infusion.

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

Plan Cost Management

The fiscal budget must be set in each new project. The cost enclosed the education courses, the administration team meeting and updated references. The budget must be observed from time to time.

Executing Phase

Management Team

One of the tools of the professional's management project skills were the leading project by the team. The team contained of several essential members, including neurology pediatrics clinical pharmacist, parenteral medications preparation pharmacist, pharmacy technician, pharmacy total quality management, pediatrics medications safety pharmacist and pediatrics neuroscience physician. The team should implement and follow the project. The team had to have education and training for medical and pharmacy staff on the project and updating of medications concentration regularly based on evidence-based literature.

Table 1: Suggested Pediatrics and Neonates Standardized Concentration of Central Nervous System Intravenous Infusion. [24-36]

No.	Generic medications	Initial Strength	Diluents	Reconstitution Volume	Final Concentration IVPB	Final Preparation with Maximum Concentration	Maximum Conc.	Final Preparation with Standard Concentration	Stability of mixed Solution RT Ref	Rate of Administration IVPB
1	Atracurium 50mg/5ml	10mg/ml Iv push	D5W NS	NA	0.2 mg/ml Continuous infusion	25mg/50ml NS 25mg/50ml D5W 5mg/25ml NS 5mg/25ml D5W	0.5 mg/ml	25mg/50ml NS 25mg/50ml D5W 10mg/25ml NS 10mg/25ml D5W	24 hrs 24hrs	2-15 mcg/kg/mint
2	Diazepam 10mg/2ml	5mg/ml	NS D5W	NA	0.25 mg/ml	50mg/50ml D5W 50mg/50ml NS	5mg/ml	50mg/25ml D5W 50mg/25ml NS	NA	60 mint
3	Fentanyl	100mcg/ml	NS D5W	NA	10mcg/ml	0.5mg/25ml D5W 0.5mg/ 25ml NS 100 mcg/5 mL D5W 100 mcg/5 mL NS	50mcg/ml	1mg/25ml D5W 1mg/ 25ml NS 250 mcg/5 m D5W 250 mcg/5 mL NS	30 days	1-3 mcg/kg/hr
4	Hydrocortisone Sodium Succinate	100mg/ 2ml 500mg/ 4ml	D5W NS	2 ml SWFI 4ml SWFI	0.5mg/ ml	50mg/ 25ml D5W 50mg/ 25ml NS 10mg/ 10ml D5W 10mg/ 10ml NS	5mg/ ml	100mg/ 25ml D5W 100mg/ 25ml NS 10mg/ 2ml D5W 10mg/ 2ml NS	0.1 - 1 mg/ ml 24 hrs 2-10 mg/ml 4 hrs	30 min
5	Lorazepam	4mg/ml 2mg/ml	D5W NS	NA	0.04mg/ml	2mg/25ml NS 2mg/25ml D5W 2mg/10ml NS 2mg/10ml D5W	2mg/ml	4mg/25ml NS 4mg/25ml D5W 4mg/10ml NS 4mg/10ml D5W	24 hrs	0.2 mg/mL Continuous infusion
6	Mannitol	100mg/ml 200mg/ml	D5W	NA	100mg/ml	50g/ 500ml D5W 25g/ 250ml D5W	200mg/ml	100g/ 500ml D5W 50g/ 250ml D5W	24 hrs	30-60 mint
7	Methylprednisolone Sodium succinate	40 mg dose → 40mg/ml 500mg dose → 62.5mg/ml	D5W NS	40mg dose 1-8 ml SWFI	2 mg/ml Or in 50-250 ml	120mg/ 50ml D5W 120mg/ 50ml NS 40mg/ 20ml D5W 40mg/ 20ml NS	5mg/ ml	250mg/ 50ml D5W 250mg/ 50ml NS 20mg/ 10ml D5W 20mg/ 10ml NS	48 hrs	30-60 min Dose >15 mg/kg or ≤1g → over 1 hrs

Table 1: Suggested Pediatrics and Neonates Standardized Concentration of Central Nervous System Intravenous Infusion. [26-36]

8	Midazolam	1mg/ ml 5mg/ ml	D5W NS	NA	0.5mg/ ml	50mg/ 100ml D5W 50mg/ 100ml NS 5mg/ 10ml D5W 5mg/ 10ml NS	1mg/ ml	50mg/ 50ml D5W 50mg/ 50ml NS 5mg/ 5ml D5W 5mg/ 5ml NS	24 hrs	NA	0.5-5 mcg/kg/ min
9	Morphine	D5W NS	5ml	Undiluted	0.05mg/ ml	10mg/ 25ml D5W 10mg/ 25ml NS 5mg/ 20ml D5W 5mg/ 20ml NS	1mg/ ml	10mg/ 10ml D5W 10mg/ 10ml NS 5mg/ 10ml D5W 5mg/ 10ml NS	7 days	7 days	infusion
10	Naloxone	0.4mg/ ml	D5W NS	NA	0.004mg/ ml	2mg/ 250ml D5W 2mg/ 250ml NS 0.2mg/ 50ml D5W 0.2mg/ 50ml NS	0.016 mg/ ml	4mg/ 250ml D5W 4mg/ 250ml NS 0.4mg/ 50ml D5W 0.4mg/ 50ml	Use fresh	24 hrs	infusion
11	Octerotide	0.5mg/ ml	D5W NS	NA	0.005mg/ ml	0.25mg/ 50ml D5W 0.25mg/ 50ml NS 0.04mg/ 8ml D5W 0.04mg/ 8ml NS	0.005 mg/ ml	0.25mg/ 50ml D5W 0.25mg/ 50ml NS 0.04mg/ 8ml D5W 0.04mg/ 8ml NS	24 hrs	24 hrs	30 min
12	Phenytoin	50mg/ ml	NS	NA	2mg/ ml	250mg/ 25ml NS 50mg/ 20ml NS	10mg/ ml	500/ 25ml NS 50mg/ 10ml NS	2 hrs	NA	25mg/ min 0.5-1 mg/kg/min

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

Education and Training

For any new project, there are several pediatrics and neonates standardized concentration of central nervous system intravenous infusion educational sessions and training courses should be conducted for pharmacy staff, including pharmacists and pharmacy technicians. Other courses should be carried to healthcare providers, including physicians and nurses. Moreover, the management team members should obtain the educational courses about the project and any newly joint pharmacy or healthcare provider's staff should the orientation sessions with the involvement of the new project.

Monitoring and Controlling Phase Project

Total Quality Management

Several methods used to measure the total quality management of the new project. The Balance Score Card one the famous new system in practice.^[23] The BSC contained four types of measurement tools. There are many tools used for total quantity management including customer, finance, internal process, education and innovation. The international process part might use the assessment of healthcare services of pediatrics and neonatal standardized concentration of central nervous system medications. The second type related to the education and competency of healthcare professionals, including pharmacy staff, which involved the clinical outcome of pediatrics and neonatal standardized concentration of central nervous system medications. The third type, which measures the financial-related issues, for instance, the type had another example of measuring the economic impact of the pediatrics and neonates standardized concentration of central nervous system intravenous infusion. The other type was the customer types with measuring the patient's satisfaction, healthcare providers and pharmacy staff of pediatrics and neonatal standardized concentration of central nervous system medications satisfaction in the Kingdom of Saudi Arabia.

Risk Management

The budget risks, scope risks, schedule risks, personal risks, technical risks and quality risks are types of risk management.^[24,25] The majority of risks exposed to the current project were personnel, budget, technical and quality risks. The project might suffer from personal risks that are including a shortage of pharmacists and pharmacy technicians or trained them. The budget types are another example of common risks that involve not enough budget for education and training for pharmacy and healthcare professionals

or electronic update references. Also, the technical risk might be exposed, which involves a non-friendly used computer system within computerized physician order entry (CPOE) or non-available altering services inside the electronic prescribing. The quality risks are another risk that might be exposed to the new project including related non-standardized medications safety procedures and not sufficient quality management pharmacy staff.

Closing of the Project

The pediatrics and neonates standardized concentration of central nervous system intravenous infusion at all healthcare governmental and private organizations sectors is a request to prevent drug-related problems that might lead to admission to critical care or death prevent an unnecessary economic burden on healthcare services in the Kingdom of Saudi Arabia. The project should endure intravenous parenteral medications in each pharmacy's services with the involvement of related committees. The pediatrics and neonatal CNS medication with standardized concentration Education and training should be done periodically. Update CNS medications concentration with more expanded of new parental CNS medications for adults is demand in the future. The pharmacy staff in the IV admixture services should make annual celebration for them is highly recommended in the Kingdom of Saudi Arabia.

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CONFLICT OF INTEREST

None.

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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; **ISMP:** Institution

of Safe Medication Practice; **SWOT:** Strengths, Weaknesses, Opportunities and Threats; **CNS:** Central Nervous System; **IV:** Intravenous; **BSC:** Balance Scored Cards; **IAC:** intravenous admixture committee.

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