


# Adult Standardized Concentration of Cardiovascular Medications Intravenous infusion: A New Initiative in Saudi Arabia

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## ABSTRACT

**Objectives:** To declare the adult standardized concentration of cardiovascular intravenous infusion as a new initiative in the Kingdom of Saudi Arabia. **Methods:** It is a new initiative project drove by national standardized concentration of cardiovascular 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 cardiovascular medications intravenous infusion services defined as vision, mission and goals. The services had various 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 illustrated in the review. The transition to operation project though closing project stage explored in the analysis. **Conclusion:** The adult standardized concentration of cardiovascular intravenous infusion services is a new initiative part of the intravenous admixture program. The standardized concentration of cardiovascular will diminish healthcare professional workload and avoid economic burden on healthcare system; it is highly recommended to implement in the Kingdom of Saudi Arabia.

**Keywords:** Adult, Standardized, Concentration, Cardiovascular, Intravenous, Saudi Arabia.

## INTRODUCTION

Medication errors are the foremost issues in the treatment process that leads to harm to hospitalized patients.<sup>[1-3]</sup> One of the significant medication errors that can occur in the hospital settings and is utilizing numerous intravenous infusion medications. Several studies showed that errors involving intravenous infusion medications have great potential to cause serious harm to hospitalized patients.<sup>[4-6]</sup> Standardizing concentrations of high-risk intravenous medications are being used to reduce medication errors that inevitably leading to a safer delivery system.<sup>[7-13]</sup> Cardiovascular medications characterize one of the important and highly used medications in hospitalized patients.<sup>[11-13]</sup> There are many medication errors have been documented of cardiovascular medications, which have many different concentrations.<sup>[5]</sup> This project purposes to prevent or at least reduce these types of medication errors by implementation and development system responsible for determining specific concentration for cardiovascular medications used in the settings of Kingdom of Saudi Arabia.

## METHODS

It is a new initiative project drove by the national intravenous program.<sup>[14]</sup> The task force team of adults standardized concentration of cardiovascular intravenous infusion medications

formulated and contained of from the author's expertise in the adults parenteral medications. The committee utilized and drove the pharmacy parenteral administration guidelines and from the textbook and international literature adults standardized concentration of cardiovascular intravenous infusion medications written by utilizing the international business model, pharmacy project guidelines project management institution guidelines of a new project.<sup>[15-18]</sup> The adult's standardized concentration of cardiovascular intravenous infusion medications adjusted based on the acceptable concentration, daily dose and the volume of bag as possible. The project is written through project management professionals and contained of several parts, including the initial phase, the planning phase, the execution phase, the monitoring and controlling phase.

## Initial Phase

## Assessment Needs

Multiple hospitals have been used in numerous concentrations of cardiovascular infusion medications. Besides creating economic challenges on healthcare institutions, the use of different concentrations of cardiovascular medications may lead to medication errors that may cause adverse effects to patients and, in the long term, caused deaths. The best way of

reducing and preventing such instances is by standardizing the prevailing concentrations.

## Market Analysis

Most of the parenteral admixture services in the Kingdom of Saudi Arabia had various methods of adult cardiovascular intravenous medication concentrations. The guidelines of preparation comprised of medications, route of administration, the stability of preparation, concentration and medication compatibility. Most the healthcare organizations had the same guidelines with different medications. The adult standardized concentration of cardiovascular intravenous infusion or standardized diluent solution has not existed. The adult standardized concentration of cardiovascular intravenous infusion is an excellent method to reassure the manufacturers to produce the same ready-made, standardized concentration. However, there were some ready-made medications with specific concentration a variable in the market but coveted all adult's cardiovascular medications and the concentration was not proper.

## SWOT Analysis

To attain the goals of the project, a SWOT analysis was carried out. The "strengths" of the project were accompanied by the documentation of pharmacy workload for the prevention of medication errors, the estimated cost of avoidance of medication errors and the estimated cost of correction of medication errors. A limited number of resources accompanied the "weaknesses" in this project adult's standardized concentration of cardiovascular intravenous infusion medications and diluent. The opportunities that were looked into in this project encompassed the implementation of both international and local standards of healthcare organizations. It also needed how to implement the New Saudi Vision 2030 and limiting the errors that cause by using various concentration. The threats of the project included the change of pharmaceutical administration and also an analysis of the standards for accreditation.

## Planning Phase

### Scope of the Project

The project confined the adult's standardized concentration of cardiovascular medications with specific diluent solutions. The concentration drove from typical daily dose and frequency administration. The adults' standardized concentration of cardiovascular intravenous medications encourages pharmaceutical companies to make ready-made antibiotics with resembling concentration and diluent solution.

## Vision, Missions and Goals

The project's vision is to best standardization and limits the drug concentrations at healthcare institutions, particularly for drugs used in cardiovascular treatment. The mission of the project is to standardize the adult's concentrations of intravenous infusion of cardiovascular medications. The project goals included the facilitation of standardization drug concentration, preventing complications from unstandardized drug concentrations, reducing the errors, mortality, the economic challenges on the healthcare system and reduce the workload of the healthcare providers and pharmacy.

## Description of the Project

The following policies were put in place for every pharmacist and other health care individuals:<sup>19,20</sup>

- ✓ The increased pharmacy workload and misuse of documentation through the evaluation of the performance of the pharmacy staff committee should be formulated at healthcare institutions.
- ✓ The increased pharmacy workload and misuse of documentation through the evaluation of the performance of pharmacy staff committee should consist of IV pharmacist and pharmacy technician, adults nursing representative, adult surgical or medical representative and cardiovascular clinical pharmacist.
- ✓ The committee revises the adults standardized concentration of cardiovascular intravenous infusion medications annually (Table 1).
- ✓ The adult's standardized concentration of cardiovascular intravenous infusion medications education and training sessions should be conducted by the committee to all healthcare providers, including physicians and nurses, with pharmacy staff.
- ✓ The adults standardized concentration of cardiovascular intravenous infusion medications distributed to healthcare sectors at the institutions.
- ✓ The physician writes the prescription based on the adults standardized concentration of cardiovascular intravenous infusion medications.
- ✓ If the physician wishes to prescribe outside the adults standardized concentration of cardiovascular intravenous infusion medication guidelines, he should document the justification.
- ✓ The prescription should send to the pharmacy and IV pharmacist and the pharmacy technician will prepare it based on the adult's standardized concentration

of cardiovascular intravenous infusion medications.

- ✓ The pharmacy staff sends the medications to the nursing department and the nurse administers the medications based on the adult's standardized concentration of cardiovascular intravenous infusion medication guidelines.
- ✓ The pharmacy department should measure the clinical outcome of the adult's standardized concentration of cardiovascular intravenous infusion medications.
- ✓ The pharmacy department should measure the economic outcome of the adult's standardized concentration of cardiovascular intravenous infusion medications.
- ✓ The pharmacy department should document any prescription non-adherence to the adult's standardized concentration of cardiovascular intravenous infusion medications.

## Plan Cost Management

The demand budget should be detailed in every current project of adult standardized concentration of cardiovascular intravenous infusion. The cost, including the educational courses, the management team meeting and updated references. Furthermore, the budget should be supervision for the overall period.

## Executing Phase Management Team

The adult standardized concentration of cardiovascular intravenous infusion project should lead by the administration team. The team entailed of adult cardiovascular clinical pharmacists, adult's intravenous admixture pharmacists, pharmacy technicians, cardiology physicians, surgeons, pharmacy total quality management and adult medications safety pharmacist. The team will implement and monitor the project. Set-up the performance indicators, policies and procedures. In addition to updating the adult standardized concentration of cardiovascular intravenous infusion list occasionally. Perform all education and training of the project for pharmacists and healthcare providers and related issues.

## Education and Training

Various educational and training sessions about the adult standardized concentration of cardiovascular intravenous infusion should be conducted for pharmacy staff, including pharmacists, pharmacy technicians and healthcare providers, including physicians and nurses, should receive education and training before starting the project. Another candidate for

Table 1: Suggested Adults standardized cardiovascular medications. [24-33]

No	Generic Name	Initial Strength	Diluents	Reconstitution Volume	Final Concentration IVPB	Final Preparation with Standard Concentration	Maximum Conc.	Final Preparation with Maximum Concentration	Stability of Solution RT	Ref	Rate of Administration IVPB
1	Abciximab	2mg / ml	D5W NS	5 ml	40mcg/ml	10mg/ 250ml D5W 10mg/ 250ml NS	40mcg/ml	10mg/ 250ml D5W 10mg/ 250ml NS	12 hrs	12hrs	10mcg/ mint for 12-24 hr
2	Alteplase 50 mg	1 mg/ml	SWFI 50 ml	SWFI 50 ml	0.5 mg/ml	50 mg/100 ml	1mg/ml	50 mg/50ml	8 hrs	8 hrs	30 mint- 3 hrs
3	Aminocaproic Acid	250mg/ ml	D5W NS	NA	10mg/ ml	1gm/50ml D5W 1gm/50ml NS 5gm / 250ml D5W 5gm / 250ml NS	20mg/ ml	1gm/50ml D5W 1gm/50ml NS 5gm / 250ml D5W 5gm / 250ml NS	7 days	7 days	4-5 gm over 60 mint then 1gm/hr for 8 hrs
4	Amiodarone	50 mg/ml	D5W	NA	1.8mg/ml	450mg/ 250ml D5W 900mg/ 500ml D5W	6mg/ ml	450mg/ 100ml D5W 900mg/ 250ml D5W	24 hrs (glass or polyolefin container)	NA	15 mg/min for first 10 min (150mg), then 1 mg/min for next 6 hrs (360mg), then 0.5mg/min over remaining 18 hrs (540mg)
5	Atenolol 5mg/10ml	0.5mg/ml	NA	NA	Mix in 50 ml NS or D5W	5mg/25 ml NS 5mg/25 ml D5W	0.5mg/ml	5mg/50 ml NS 5mg/50 ml D5W	Use immediately	24 hrs	30 mint
6	Calcium Chloride 10% 1 gm/10ml	100 mg/ml 1.4 mEq/ml	D5W NS	NA	5 mg/ ml	1g/ 100ml D5W 1g/ 100ml NS	20 mg/ ml	1g/ 50ml D5W 1g/ 50ml NS	24 hrs	NA	1 hr Or 45-90mg/kg over 1 hr (0.3-0.6 mmol/kg over 1 hr)
7	Calcium Gluconate 10%	100 mg/ml 0.465 mEq/ml	D5W NS	NA	10mg/ ml	1g/ 50ml D5W 1g/ 50ml NS	50mg/ ml	2g/ 50ml D5W 2g/ 50ml NS	24 hrs	NA	Not exceed 200mg/ mint (2ml/mint)
8	Digoxin 500 mcg/2ml	250mcg/ ml	D5W NS	NA	5mcg/ ml	0.25mg/ 25ml D5W 0.25gm/ 25ml NS	250mcg/ml	0.5mg/ 25ml D5W 0.5gm/ 25ml NS	24 hrs	NA	10-20 mint
9	Dipyridamole 10mg/2ml	5mg/ml	D5W NS	NA	1mg/ml	40mg/50ml NS 40mg/50ml D5W	2.5mg/ml	40mg/25ml NS 40mg/25ml D5W	NA	NA	over 4 mint
10	Esmolol 100mg/10ml	10mg/ ml	D5W NS	NA	10mg/ ml Continuous infusion	1gm/ 100ml D5W 1gm/ 100ml NS	20mg/ ml	1gm/ 50ml D5W 1gm/ 50ml NS 2gm/ 100ml D5W 2gm/ 100ml NS	24 hrs	24 hrs	≤ 200mcg/ kg/ min Continuous infusion

Table 1: Suggested Adults standardized cardiovascular medications. [24-33]

		10mg/ml	NS	NA	1mg/ml	40mg/ 25ml NS 40mg/ 25ml D5W 80mg/ 50ml NS 80mg/ 50ml D5W	10mg/ml	80mg/ 25ml NS 80mg/ 25ml D5W	24hrs	NA	≤4mg/mint
11	Furosemide 10mg/ml 250mg/25ml										
12	Hydralazine 20mg	20mg/ ml	NS	1 ml SWFI	0.04mg/ ml	40mg/ 500ml NS	0.2mg/ ml	40mg/ 250ml NS	24 hrs	NA	0.05mg – 0.2mg/ mint
13	Isoproterenol 200mcg/ml	0.2mg/ ml	D5W NS	NA	0.002mg/ ml	1mg/ 250ml D5W 1mg/ 250ml NS 2mg/ 250ml D5W 2mg/ 250ml NS	0.02mg/ ml	1mg/ 100ml D5W 1mg/ 100ml NS 2mg/ 100ml D5W 2mg/ 100ml NS	24 hrs	24 hrs	2-20 mcg/mint
14	Labetalol 5mg/ml	5mg/ ml	D5W NS	NA	1mg/ ml	100mg/ 100ml NS 100mg/ 100ml D5W	3.75mg/ ml	100mg/ 50ml NS 100mg/ 50ml D5W	3 days	3 days	0.5-2mg/mint Continuous Infusion titrate according to blood pressure
15	Mexiletine 250mg/10ml	25mg/ml	NS D5W	NA (1)	0.5 mg/ml	500mg/ 500ml NS 500mg/ 500ml D5W	1mg/ml	250mg/ 500ml NS 250mg/ 500ml D5W	8 hrs	NA	Initial infusion rate of admixture is 4 mL/min over the first hour followed by infusion of the next 250 mL at 2 mL/min over the next two hours.
17	Metoprolol tartrate 5mg/5ml	1mg/ml	D5W NS	NA	0.1mg/ml	5mg/50ml D5W 5mg/50ml NS	0.4mg/ml	10mg/50ml D5W 10mg/50ml NS	NA	NA	30-60 mint
16	Nitroglycerin	5mg/ ml	D5W	NA	0.2mg/ ml	50mg/ 250ml D5W Withdraw 50 ml D5W from a 250 ml glass bottle D5W and replace volume with 50 mg (50 ml) of Nitroglycerin	0.4mg/ ml	100mg/ 250ml D5W Withdraw 100 ml D5W from a 250 ml glass bottle D5W and replace volume with 100 mg (100 ml) of Nitroglycerin	48 hrs	7 days	5-20 mcg/mint titrate according to blood pressure
17	Phenylephrine	10mg/ ml	NS	NA	0.02mg/ ml	10mg/ 500ml NS	0.2mg/ ml	50mg/ 500ml NS	14 days	NA	0.1-10 mcg/kg/mint
18	Streptokinase	50000U/ ml 150000U/ 300000U/ ml	NS	5 ml NS	15000U/ ml	1.5Million U/ 100ml NS	30000U/ ml	1.5million U/ 50ml NS	24 hrs	24 hrs	30-60 mint
19	Sodium Nitroprusside	50 mg/ml	D5W	NA	0.2 mg/ml	50mg/250 ml D5W	0.4 mg/ml	100mg/250 ml D5W	24 hrs	24 hrs	0.3-0.5 mcg/kg/mint
20	Vasopressin	20 U/ml (400mcg/ ml)	D5W NS	10ml D5W	0.1U/ml	50U/ 500ml D5W 50U/ 500ml NS	1U/ ml	100U/ 100ml D5W 100U/ 100ml NS	18 hrs	24 hrs	0.01-0.03 units/mint

**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

The pharmacist should the review the appropriate concentration of final preparations according the strength of the medications, prescribing dose, and their local healthcare institution policy



the adult standardized concentration of cardiovascular intravenous infusion education courses, the management team and proper orientation for new pharmacy or healthcare staff join the healthcare institutions.

## Project Total Quality Management

There are multiple tools practice during total quantity management with new project adult's standardized concentration of cardiovascular medications during the implementation stage and reflect the outcomes. The balance scored cards was among them.<sup>[21]</sup> The elements monitor involved of four-part including the finance, the customer, internal process, education and innovation. The assessment of healthcare and pharmacy services of adult's standardized concentration of cardiovascular medications was an example of an internal process type. The clinical impact of adult's standardized concentration of cardiovascular medications, which adequately reflect the education, competency of pharmacists and pharmacy technicians, was an example of the education type. The financial type had another example of measuring the avoidance cost of the adult's standardized concentration of cardiovascular system medications. The last type of quality management was the customer types through measures the patient's satisfaction with healthcare providers, including pharmacy staff of adults standardized concentration of cardiovascular 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.<sup>[22,23]</sup> The project might be exposed to risks such as personnel, budget, technical and quality risks. The project suffered sufficiently from personal risks with not trained pharmacist or pharmacy technician or nor sufficient pharmacy staff. The budget risk is not just enough education and training courses to all healthcare providers' related issues. It might expose to the same. There is another of technical risk may be exposed without the electronic recourses of friendly used computer system in pharmacy practice. The project may be exposed to quality risks with non-implemented medications safety elements or non-trained personnel.

## Closing of the Project

The standardized concentration of adult's cardiovascular medications at all healthcare organizations of governmental and private sectors is required to prevent drug-related misadventures and might lead to morbidity

and mortality. Moreover, to prevent additional redundant cost burden on healthcare institutions, including the hospitals and primary healthcare centers services in the Kingdom of Saudi Arabia. The project should continue during the preparation of parenteral cardiovascular medications at each pharmacy unit and related committees. The standardized adult's concentration of cardiovascular medications education and training should be implemented periodically. Adult's cardiovascular medications concentration should be updated and more expand the number of medications in the future. The annual celebration of all IV admixture pharmacy staff, including the pharmacist and pharmacy technician, is highly suggested in the Kingdom of Saudi Arabia.

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## CONFLICT OF INTEREST

None.

## FUNDING

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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; **SWOT:** Strengths, Weaknesses, Opportunities and Threats; **IV:** Intravenous; **BSC:** Balance Scored Cards; **IAC:** intravenous admixture committee.

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