HIGH ALERT MEDICATION

POLICY ON MANAGEMENT OF HIGH ALERT MEDICATIONS

PHARMACY DEPARTMENT,

HOSPITAL ENCHE' BESAR HAJJAH KHALSOM, KLUANG

Acknowledgement

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1 Some medications have a very narrow margin of safety and can cause severe patient harm when implicated in an adverse drug event and hence require heightened vigilance. The consequences of an error associated with use of these medications can result in significant patient injury and special precautions must be employed with their overall management. These medications are identified as High Alert Medications.

2.0 DEFINITION

High Alert Medications are medications that bear a heightened risk of causing significant patient harm when these medications are used in error.

3.0 POLICY

- High-alert medications will be prescribed, dispensed and administered using practices that are deemed safe by Hospital Enche' Besar Hajjah Khalsom, Kluang.
- Prescribing of high–alert medications shall be in concordance with the general prescribing policy as stated in Departmental Policy.

4.0 Hospital Enche' Besar Hajjah Khalsom's high alert medications as listed in this policy are based on "Guideline On Safe Use of High Alert Medications (HAMs) 2nd Edition, Pharmaceutical Services Division, Ministry of Health Malaysia Nov 2020" and "surat pindaan Guideline On Safe Use of High Alert Medications (HAMs) 2nd Edition".

High Alert Medication List

No	Category	Medications	Safety Mechanism in Place	Related Standard/ Resource
1	Adrenergic agonists, IV	Adrenaline Acid (Epinephrine) Tartrate 1mg/ml Injection	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's emergency trolley and floor stock. - Use cautionary label	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Noradrenaline (Norepinephrine) 4mg/4ml Injection	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's emergency trolley and floor stock. - Use cautionary label	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Phenylepherine 10mg/ml Injection	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock.	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Ephedrine 30mg/ml Injection	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock.	- High Alert Medication Administration List, HEBHK - Medication Double Check

2	Adrenergic antagonists, IV	Propranolol 1mg/ml Injection	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock.	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Labetalol 25mg/5ml Injection	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock.	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Esmolol 10mg Injection	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock.	- High Alert Medication Administration List, HEBHK - Medication Double Check
3	Anaesthetic Agents (General, Inhaled, IV)	Ketamine 500mg/10ml Injection	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock. - Designated place in Pharmacy. - Designated place in the wards	- High Alert Medication Administration List, HEBHK - Medication Double Check - DD Act and Regulations

		Propofol 200mg/20ml Injection	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock.	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Etomidate 20mg/10ml Inj	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock.	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Desflurane Liquid	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock.	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Sevoflurane Luquid	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock	- High Alert Medication Administration List, HEBHK - Medication Double Check
4	Antiarrythmic IV	Amiodarone 150mg/3ml Injection	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in	- High Alert Medication Administration List, HEBHK - Medication Double Check

			ward's emergency trolley and floor stock.	
		Digoxin 0.5mg/2ml Injection	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's emergency trolley and floor stock.	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Lignocaine 100mg/5ml Injection	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's emergency trolley and floor stock. - Labelled for IV use for every storage shelves.	- High Alert Medication Administration List, HEBHK - Medication Double Check
5	Antithrombotic agents	Warfarin Sodium 1mg/2mg/3mg/ 5mg tablet	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock. - Use auxiliary label or cautionary label	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Heparinol 5000IU/ml	- Yellow colour medication bin and high alert label for storage shelves in pharmacy.	- High Alert Medication Administration List, HEBHK

			- High alert label for storage shelves in ward's floor stock. - Use auxiliary label or cautionary label	- Medication Double Check
		Heparinised Saline 5000IU/ml	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock.	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Enoxaparin 40mg, 60mg	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock. - Use auxiliary label or cautionary label	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Fondaparinux 2.5mg/0.5ml, 7.5mg/0.6ml	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock. - Use auxiliary label or cautionary label	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Tenecteplase 10,000 unit (50mg) Injection	- Yellow colour medication bin and high alert label for storage shelves in pharmacy.	- High Alert Medication Administration List, HEBHK

			- High alert label for storage shelves in ward's floor stock.	- Medication Double Check
		Streptokinase 1, 500, 000 IU Injection	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock. - To be refrigerated	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Urokinase 250,000 IU Inj	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock. - To be refrigerated	- High Alert Medication Administration List, HEBHK - Medication Double Check
6	Antivenom	Hemato Polyvalent Snake Antivenom	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock.	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Neuro Polyvalent Snake Antivenom	- Yellow colour medication bin and high alert label for storage shelves in pharmacy.	- High Alert Medication Administration List, HEBHK

			- High alert label for storage shelves in ward's floor stock.	- Medication Double Check
7	Chemotherapeutic agents, parenteral and oral	*** All preparations that are clearly labelled as **CYTOTOXIC** agents.*	- Must be prescribed on standardized chemotherapy order form. - Delineated procedures for pharmacy processing and dispensing; double verification; dose checking against protocol or drug information references. - Designation place in Pharmacy.	- Pharmacy Departmental Policy Procedures for Cytotoxic Drug Reconstitution - Medication Double Check
8.	Dialysis solutions, peritoneal and hemodialysis	*** All kind of dialisis solutions, peritoneal and hemodialysis*	- High alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock.	- High Alert Medication Administration List, HEBHK - Medication Double Check
9	Epidural or Intrathecal Medications	Bupivacaine Injection *Bupivacaine 0.5% Heavy Inj, *Bupivacaine 0.5% Inj, *Bupivacaine 0.5% with Adrenaline 1:200,000 Inj	- High alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock.	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Ropivacaine Injection *Ropivacaine 2mg/ml * Ropivacaine 7.5mg/ml	- High alert label for storage shelves in pharmacy.	- High Alert Medication Administration List, HEBHK

			- High alert label for storage shelves in ward's floor stock.	- Medication Double Check
		Levobupivacaine 5mg/ml Injection	- High alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock.	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Bupi/Fentanyl	- High alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock.	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Ropi/Fentanyl	- High alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock	- High Alert Medication Administration List, HEBHK - Medication Double Check
10	Glyceryl Trinitrate 50mg/10ml injection		- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's emergency trolley and floor stock.	- High Alert Medication Administration List, HEBHK - Medication Double Check
12	Inotropic medications, IV	Dobutamine 250mg/20ml Injection	- Yellow colour medication bin and high alert label for	- High Alert Medication

			storage shelves in pharmacy. - High alert label for storage shelves in ward's emergency trolley and floor stock.	Administration List, HEBHK - Medication Double Check
		Dopamine 200mg/5ml Injection	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's emergency trolley and floor stock.	- High Alert Medication Administration List, HEBHK - Medication Double Check
13	Insulin, subcutaneous and IV	***All kinds of **INSULIN***	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's emergency trolley and floor stock. - To be refrigerated - Use cautionary label to differentiate the types of insulin	- High Alert Medication Administration List, HEBHK - Medication Double Check
14	Magnesium sulfate 2.49 g in 5ml injection		- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in	- High Alert Medication Administration List, HEBHK - Medication Double Check

			ward's emergency trolley and floor stock.	
15	Moderate and minimal sedation agents, oral, for children	Chloral Hydrate Mixture	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - To be refrigerated - Label the medication "FOR ORAL USE ONLY"	- High Alert Medication Administration List, HEBHK - Medication Double Check
16	Moderate sedation agents, IV	Midazolam Injection (5mg/ml, 15mg/3ml)	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock - Designated place in Pharmacy. - Designated place in the wards	- High Alert Medication Administration List, HEBHK - Medication Double Check - DD Act and Regulations
		Dexmedetomidine HCl 100mcg/ml Injection	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock.	- High Alert Medication Administration List, HEBHK - Medication Double Check
17	Neuromuscular blocking agents, IV	Atracurium Besylate 25mg/2.5ml Injection	- Yellow colour medication bin and high alert label for	- High Alert Medication

			storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock. - To be refrigerated	Administration List, HEBHK - Medication Double Check
		Rocuronium Bromide 10mglml Injection	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock. - To be refrigerated	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Suxamethonium Chloride 50mg/ml Injection	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock. - To be refrigerated	- High Alert Medication Administration List, HEBHK - Medication Double Check
18	Opiates and Narcotic	***All drugs clearly labelled as **Dangerous Drug (DD)*** • IV • oral (including liquid concentrates, immediate- and sustained-release formulations) • transdermal	- Designated place in Pharmacy. - Designated place in the wards.	- High Alert Medication Administration List, HEBHK - DD Act and Regulations - Medication Double Check

19	Inj Oxytocin 10u/ml		- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock. - To be refrigerated	- High Alert Medication Administration List, HEBHK - Medication Double Check
20.	Immunosuppressant agents	** All kind of immunosuppressant agent (e.g. azathioprine, cyclosporine, tacrolimus)	- Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock. -	- High Alert Medication Administration List, HEBHK - Medication Double Check -
20	Parenteral Nutrition preparations	***All preparations clearly labelled as **TPN***	- To be supplied based on prescriptions for commercially prepared solutions. - Prescribed on standardized - TPN order form for compounding. - Routine double-check by pharmacists of TPN order entry into compounding system.	- Department of Pharmacy Policy and Procedure for Total Parenteral Nutrition - Medication Double Check

			- Routine double check by pharmacists of manually added electrolytes. - Nursing comparison of TPN label against original order.	
21	Potassium salt injections	Potassium chloride 1g/10ml Injection	- Yellow colour medication bin and high alert label for storage shelves in pharmacy - Use cautionary label - High alert label for each ampoule. - Designated place and bin and high alert label for storage shelves in ward's floor stock.	- High Alert Medication Administration List, HEBHK - Medication Double Check
		Potassium dihydrogen phosphate 1.361g/10ml Injections	- To be supplied based only on prescription. - Yellow colour medication bin and high alert label for storage shelves in pharmacy. - High alert label for each ampoule.	- High Alert Medication Administration List, HEBHK - Medication Double Check
22	Sodium chloride solution (greater than 0.9%	Sodium chloride 20% (10ml)	- To be supplied based only on prescription. - High alert label for storage shelves.	- High Alert Medication Administration List, HEBHK

			- Designated place in Pharmacy. - High alert label for each ampoule.	- Medication Double Check
		Sodium chloride 3% (500 ml)	- High alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock. - Designated place in Pharmacy. - High alert label for each ampoule.	- High Alert Medication Administration List, HEBHK - Medication Double Check
23	Dextrose, Hypertonic, 20% or greater	Dextrose 20% (500ml), Dextrose 50% (10ml), Dextrose 50% (500ml)	- High alert label for storage shelves in pharmacy. - High alert label for storage shelves in ward's floor stock. - Designated place in Pharmacy. - High alert label for each ampoule. [Dextrose 20% (500ml) & Dextrose 50% (500ml)]	- High Alert Medication Administration List, HEBHK - Medication Double Check

5.0 High Alert - Specific Medications

Based on the medication error reports submitted to the Medication Error Reporting System (MERS) in 2019, a list of potential high alert medications has been identified as high-risk medications that could cause harmful incidents. Special precautions and error prevention strategies as recommend will serve as useful initiatives for system improvement to avoid harmful injury with identified high alert medications.

No.	Medication name	Common type of errors	Common risk factors	Recommendation of improvement strategies
1.	**Potassium chloride (KCl) injection**	• Incorrect drug • Drug preparation error	• Potassium Chloride injection and Dextrose 50% were stored next to each other in the medication shelf • Incorrect preparation of medication	a) Develop a clear guideline/standard operating procedure/protocol for the use of KCl injection and ensure that it is readily available and accessible in all patient care units. b) Ensure complete prescribing information for KCl injection which specify the total dose, route, volume of dilution, rate of infusion etc. e.g. 0.5 gram in 50ml NS over 1 hour. c) Perform independent countercheck before preparation, dispensing and administration-at least two healthcare personnel should check the correct product, dose, dilution, labelling, route and rate as per safety protocol. d) Add cautionary label. **CAUTION** CONCENTRATED KCl FATAL IF INJECTED UNDILUTED HIGH CONCENTRATED ELECTROLYTE DILUTE BEFORE IV ADMINISTRATION e) Choose a designated area/container for storage.
2.	**Lignocaine HCl (Lidocaine HCl) Injection**	• Incorrect drug • Incorrect route of administration	• Confusion of different strength/ multiple formulation • Confusion of different route of administration	a) Keep an up-to-date list of all available lignocaine HCl formulation • generic name • trade name • available strengths b) Different brand of products has different reconstitution/dilution and administration instructions.

(e.g. IV vs IM) • Confusion of different	• Ensure appropriate medication preparation, dilution, dosage and rate of administration of the

			indication • Confusion of medication preparation	medication. the labels/package insert c) Read before preparing the reconstitution/dilution. d) All practitioners responsible for administering medications should be an trained on administrations d resuscitation procedures. e) Perform independent countercheck • dosing • infusion pump programming • concentration • dilution f) Add auxiliary label when appropriate • To improve readability of labels e.g. if the preparation is not for IV use, **NOT FOR IV USE** If the preparation is for IM use only, **FOR IM USE ONLY**
3.	**Insulin**	• Incorrect dose • Incorrect type of insulin/ brand	• Look alike sound alike medication (i.e. mixtard vs insulatard, Insugen N vs Insugen R) • Availability of multiple brands of insulin	a) Keep an up-to-date list of all available insulin and the injection device in the facility. b) Limit the variability of insulin in the facility. c) Perform an independent countercheck before dispensing and administering insulin. d) Spell out the word "units" instead of "U". e) Add cautionary label to differentiate the type of insulin.
		• Incorrect injecting device (brand variation) given to patient	• Use of the abbreviation "U" for units mistaken with "0" • Storage of insulin medications next to each other	
4.	**Enoxaparin and Fondaparinux**	• Incorrect dose • Incorrect frequency • Prescribe/ supply fondaparinux instead of enoxaparin	• Confusion with dosing regimen • Dosage prescribed is not based on patient's weight • Inaccurate renal dose adjustment	a) Develop a clear guideline/standard operating procedure/protocol for the use of these medications and ensure that they

			• Look alike packaging (40mg vs 60mg) • Look alike medication (enoxaparin vs fondaparinux)	are readily available and accessible in all patient care units. b) Keep an up-to-date list of all available strengths of these medications in the facility. c) Standardize concentration/strength of available anticoagulants. d) Standardize the baseline information, such as weight in kilograms and renal function, neededduringtheorderingof anticoagulants. e) Use Tall-man lettering and store look alike medications separately. f) The medication, dose and route of administration should be independently counterchecked by another healthcare personnel before administration. g) Emphasize on patient counseling/ education. h) Be diligent in anticoagulants calculations. i) Using auxiliary labels or cautionary label.
5.	**Warfarin**	• Incorrect dose/ frequency/ duration • Incorrect labelling dose	• Complexity of dosing regimen and monitoring • Look alike medication/ packaging • Availability of multiple strength	
6.	**Heparin**	• Incorrect dose/ frequency • Confusion in drug preparation	• Complexity of dosing regimen and monitoring • Look alike medication • Availability of multiple strength • Unclear, imprecise concentration and total volume information on container label	
7.	**Chloral hydrate mixture**	• Incorrect dose • Incorrect route of administration	• Prescribe/ administer incorrect dose due to inaccurate body weight or incorrect calculation • Supply incorrect strength • Administer intravenously instead of orally	a) Clearly label the medication: **"FOR ORAL USE ONLY"** b) Use of oral syringe may help to reduce incorrect route of administration of an oral medication into a vein. c) The medication, dose and route of administration should be independently counterchecked by another healthcare personnel before administration. d) Should only be given by healthcare personnel, not by patient/caregiver unless under special supervision.
8.	**Noradrenaline**	• Incorrect	• Inexperienced	

		infusion rate • Incorrect dose • Incorrect drug	personnel • Inadequate knowledge on noradrenaline/ adrenaline calculation • Inaccurate dose prescribed (e.g. 0.2mcg/hour instead of 0.2mcg/kg/min) • Look alike sound alike medication (i.e. Noradrenaline vs Adrenaline)	a) All personnel shall be trained prior to handling noradrenaline/adrenaline injection. b) Prescribers must have proficient knowledge on the dose and potential side effects. c) Specify the dose, route and rate of infusion on the prescription. d) The correct medication, dose, route and rate of infusion should be independently counterchecked by another healthcare personnel prior to administration. e) Using auxiliary labels or cautionary label.
9.	**Adrenaline**	• Incorrect dose • Incorrect drug		

6.0 Labeling of High Alert Medications (for specified medications only)

6.1 Medical store - High alert label for storage shelves

6.2 Outpatient pharmacy - High alert label for storage shelves and bin

6.3 Inpatient pharmacy - High alert label for storage shelves, bin and each vial/ampoules (for listed medications)

6.4 Ward/Clinic/Unit – High alert label for storage container and each vial/ampoule (for listed medications)

7.0 Prescribing

Prescribing of High Alert Medications shall be in concordance with general prescribing policy

- Use standardized forms for written orders of cytotoxic medications and parenteral nutrition.
- Do not use abbreviation and acronym.
- Specify clearly the dose, route and rate of infusion for high alert medication prescribed.
- Prescribe oral liquid medications with the dose specified in milligrams.
- Use leading zero (e.g. 0.5mg instead of .5mg).
- Do not use trailing zero (e.g. 5.0 mg can be mistaken as 50 mg).
- Use generic names instead of the medication's brand name.
- Always take note of body weight and body surface area for specific medications (e.g. chemotherapy and paediatric patients).
- Verbal communication of medication order on high alert medication are **NOT RECOMMENDED** except in emergency or urgent situations only.
- When verbal order must be taken, the personnel receiving the order must verbally repeat the order back to the prescriber for verification.
- Verbal orders should be immediately documented in the patient's medical record, reviewed, and countersigned by the prescriber in accordance with organizational policy.

8.0 Preparation

1. Establish a counterchecking system for all preparations involving high alert medication.
2. The calculations involving:
   - cytotoxic medications and parenteral nutrition shall be independently counterchecked by another personnel.
   - extemporaneous preparations shall be independently counterchecked by another personnel.
3. All diluted medications must be labeled with the name and strength immediately upon dilution.

   Example of label:

DRUG:

CONCENTRATION: mg in mL NS/D5/	
DATE:	**TIME:**
PATIENT'S NAME:	
R/N:	
PREPARED BY:	**CHECKED BY:**

9.0 Administration

1. The following particulars shall be independently counterchecked against the prescription or medication chart at the bedside by two appropriate persons before administration:
   - Patient's identification - patient's name and RN
   - Name, dose and strength of medications
   - Route and rate (pump setting and line placements when necessary)
   - Expiry date
   - Line attachments
2. Label the distal ends of all access lines to distinguish IV from epidural lines.
3. Ensure no distraction during the administration of medications to patients by implementing special measures (Example: wearing special vest).
4. Return all unused or remaining specially formulated preparations to pharmacy when no longer required.
5. Administration on High Alert Medication should be carried out by trained staff nurse/ medical assistant and counterchecked by a different appropriate person.

REFERENCES:

1) Guideline On Safe Use of High Alert Medications (HAMs) 2nd Edition, Pharmaceutical Services Division, 2020
2) Guideline On Safe Use of High Alert Medications, Pharmaceutical Services Division, 2011
3) High Alert Medication, Department of Pharmacy of Hospital Selayang; 2008
4) High Alert Medication, Department of Pharmacy of Hospital Sultan Ismail; 2012

High Alert Medication Administration List
Hospital Enche' Besar Hajjah Khalsom, Kluang

No	Medication	Diluent	Dilution (Adult)	Usual Infusion Rate	Reference
1.	Adrenaline Acid (Epinephrine) Tartrate 1mg/ml injection	D5% NS	Single strength: 3mg in 50ml NS or D5% Double strength: 6mg in 50ml NS or D5% 0.5-1 mg given by SC or IM	2mcg/min (2mL/hr) and adjust rate according to clinical response Usual infusion rate: 1-4mcg/min	Dilution Guide for High Alert Medication, KKM, 2011 Dilution Protocol Hosp Tuanku Ampuan Najihah, Kuala Pilah 2017
2.	Amiodarone 150mg/3ml	D5%	Loading dose: 300mg in 100cc D5% over 1 hour Maintenance dose: 900mg in 500cc D5% over 23 hours Maintenance dose (For fluid restricted): 900mg in 150cc D5% over 23 hours	Initially, 150-300mg given by iv infusion over 1 hour, dilute into 50mL or 100mL. Initial infusion rate should not exceed 30mg/min. Never used as bolus	Dilution Guide for High Alert Medication, KKM, 2011 Dilution Protocol Hosp Tuanku Ampuan Najihah, Kuala Pilah 2017
3.	Atracurium Besylate 25mg/2.5ml	No dilution required. If to be diluted, use NS, D5%	For intubation, use undiluted. If IV infusion needed, can be diluted: 20mg (2ml) in 98ml diluents, with concentration 0.2mg/ml.	After an initial IV bolus 300-600mcg/kg. Subsequent doses of 80-200mcg/kg may be given as necessary. IV infusion 300-600mcg/kg/h to maintain neuromuscular block	Micromedex Product Insert Dilution Guide for High Alert Medication, KKM, 2011

No	Medication	Diluent	Dilution (Adult)	Usual Infusion Rate	Reference
4.	Dexmedetomidine HCl 100mcg/ml (Precedex)	NS	Dilute 2ml with 48ml NS for a total of 50ml. *[Final concentration: 4mcg/ml].*	Continuous infusion not exceeding 24 hours. Continuous Infusion dose: 0.2mcg-1.4mcg/kg/hr Loading dose: 1mcg/kg over 10 minutes Maintanence dose: 1) ***ICU sedation:*** 0.4mcg/kg/hr; then titrate between 0.2-0.7mcg/kg/hr. 2) ***Sedation for surgery/procedure:*** 0.6mcg/kg/hr; then titrate between 0.2-1mcg/kg/hr	Dilution Guide for High Alert Medication, KKM, 2011
5.	Diazepam 10mg/2ml	NS D5%	IV push /IM : no need to dilute IV Infusion: Diluted with 250ml of NS or D5% (amount of diazepam ≤20mg) *[not recommended]*	IV push: not more 5mg/min^2 via large vein. Infants/Children: Rate<= 1-2mg/min^2	Product Insert Dilution Protocol Hosp Tuanku Ampuan Najihah, Kuala Pilah 2017
6.	Digoxin 0.5mg/2ml	NS D5%	Diluted with a 4-fold or greater volume of NS or D5% or dilute 0.5mg (1 ampoule) in 50ml NS or D5%.	Administer over 10-20 minutes Loading dose should be administer in divided doses with approximately HALF the total dose as a first dose the further fractions given at intervals of 4-8 hours.	Product Insert Dilution Guide for High Alert Medication, KKM, 2011

No	Medication	Diluent	Dilution (Adult)	Usual Infusion Rate	Reference
				(example: 0.5mg in 50ml NS or D5% over 20 minutes then 0.25mg in 50ml NS or D5% over 20 minutes at interval 6 hours for 2 doses)	
7.	Dobutamine 250mg/20ml	D5%	Single strength: 250mg in 50ml D5% Double strength: 500mg in 50ml D5% ***Dilute before use**	0.5-1mcg/kg/min up to 2.5-20mcg/kg/min (Max: 40mcg/kg/min)	Dilution Guide for High Alert Medication, KKM, 2011
8.	Dopamine 200mg/5ml	NS	Single strength: 200mg in 50ml NS Double strength: 400mg in 50ml NS ***Dilute before use**	Initiate 2-5mcg/kg/min then increase 5-10mcg/kg/min up to 20-50mcg/kg/min	Dilution Guide for High Alert Medication, KKM, 2011
9.	Ephedrine 30mg/ml		SC, IM: no dilution needed Slow IV push: Dilute with 10ml NS to make 3mg/ml.	25mg-50mg administered via SC or IM. IV push: 10-25mg, may be repeated every 5-10minutes until desired response.	Product insert Drug Information Handbook 2012
10.	Esmolol 100mg/10ml	D5% NS	Slow IV push: No dilution required. IV Infusion: Dilute with NS or D5% to final concentration of 10mg/ml Administration: Peripheral or Central IV Route	Loading dose: 0.5-1mg/kg slow IV bolus over 1min. Maintanence dose: IV Infusion 1) ***Intra-op tachycardia and hypertension***: 0.15-0.3mg/kg/min	Product Insert Drug Information Handbook 2012

No	Medication	Diluent	Dilution (Adult)	Usual Infusion Rate	Reference
				2) ***Rate control in SVT and AF***: 0.05-0.2mg/kg/min; additional bolus of 0.5mg/kg may be repeated another 2 times if no initial response.	
11	Etomidate 20mg/10ml Inj		Reconstitution and further dilution: not required	IV bolus: Inject dose over 30-60 seconds	Product insert Dilution Protocol Hospital Selayang 2nd Edition, 2015
12.	Fentanyl 0.1mg/2mg		IM, Slow IV Bolus: No dilution required.	Slow IV Bolus over 1-2 min. IV Infusion: 1-5mcg/kg/h ***(for sedation)***	Product insert Handbook of Drugs in Intensive Care 2006.
13.	Glyceryl Trinitrate 50mg/10ml	NS D5%	50mg in 250-500ml (100-200mcg/ml) *Max concentration: 100mg in 250ml (400mcg/ml)* ****Dilute before use***	5mcg/minute. Increase by 5mcg/min every 3-5 min to 20mcg/min. If no response increase by 10mcg/min every 3-5 minutes up to 200mcg/min	Dilution Guide for High Alert Medication, KKM, 2011
14.	Heparinol 5000IU/ml	NS D5%	**SC**: Administer undiluted **IV bolus**: Administer undiluted with loading dose over 10 minutes **IV infusion**: Dilute 5mL (25,000 units) with diluent up to 50mL	**Acute coronary syndrome or in place of warfarin-**Initial bolus 60 units/kg over 10 mins (with fibrinolytic: max 4000 units, without fibrinolytic:max 5000 units; initial rate: 12 units/kg/hrs (max 1000 units/hour)	Dilution Protocol Hop Tuanku Ampuan Najihah, Kuala Pilah 2017 Dilution Guide for High Alert

No	Medication	Diluent	Dilution (Adult)	Usual Infusion Rate	Reference
				Neuro/vascular surgery-Initial bolus: 70 units/kg over 10 minutes (max 5000units); initial rate: 15 units/kg/hrs (max 1000units/hr) **Pulmonary emboli and deep vein thrombosis-** Initial bolus: 80 units/kg over 10mins (max 5000units); initial rate: 15units/kg/hr (max 1000 units/hr)	Medication, KKM, 2011
15.	Ketamine 500mg/10ml	NS D5% WFI	Slow IV Bolus: Dilute with an equal volume of diluent IV Infusion: Dilute with diluent to a concentration of 1-2mg/ml	IV bolus: infuse over 1 min IV Infusion: 0.1-0.5mg/min	Micromedex Drug Information Handbook 2012
16.	Labetalol 25mg/5ml	NS D5%	IV Bolus: No dilution required Continuous IV Infusion: dilute 100mg (4 amp = 20ml) with 30ml D5% or NS *[final concentration = 2mg/ml]*	IV Bolus: 10mg (2ml) over 1 min repeated every 10minutes **OR** 0.25mg/kg *[Max: 200mg]* IV Infusion: 0.5-2mg/min *[Max total dose: 300mg]* *Dose can be increased every 30minutes	Dilution Guide for High Alert Medication, KKM, 2011 Dilution Protocol Hop Tuanku Ampuan Najihah, Kuala Pilah 2017
17.	Lignocaine 100mg/5ml	NS D5%	Standard diluent: 400mg/50mL in D5% or NS	IV 50-100mg under ECG monitoring. Rate of injection 25-50mg per min. Second dose can be given after 5 min. Not more than 300mg administered during one hour period.	Product Insert HSI High Alert Medication Dilution Protocol 2012

No	Medication	Diluent	Dilution (Adult)	Usual Infusion Rate	Reference
				IV infusion:1-4mg/min	
18.	Magnesium Sulphate 2.47g(10mmol) / 5ml	D5% NS	IM: May be injected undiluted or diluted. If diluted, add 1 amp to 5ml diluents. IV Infusion: Final concentration: ≤20% (200mg/ml) Each ampoule dilute with at least 7.5ml of NS or D5% Maximum rate: 2-4g/H ***Kindly refer to Magnesium Infusion Protocol HEBHK Medical Department for other indications.***	***1) Treatment or prophylaxis of hypomagnesemia*** IM: 1g 6 hourly for 4 doses or 250mg/kg within a period of 4 hours if required IV Infusion: 5g added in 1L diluent over 3 hours. Total daily dose: 30-40g/24h ***2) Pre-eclampsia and eclampsia*** Initial dose: IV 4g in 250ml infuse over 20min Maintenance dose: IV Infusion of 1-2g/hour **OR** IM 4-5g q 4hours as needed. Max dose: 30-40g/24h	Micromedex Dilution Guide for High Alert Medication, KKM, 2011
19.	Midazolam 15mg/2ml, 5ml/1ml	NS D5% D10%	IM, IV Bolus: No dilution required	IV bolus: over 1-2 minutes IV Infusion: 0.5-6mg/h	Product Insert

No	Medication	Diluent	Dilution (Adult)	Usual Infusion Rate	Reference
			IV Infusion: Diluted 15mg to 100-1000ml diluent. [*Max concentration: 0.5mg/ml*]		Handbook of Drugs in Intensive Care 2006 Dilution Guide for High Alert Medication, KKM, 2011
20.	Morphine 10mg/ml	D5% NS WFI	IM, SC: No dilution required Slow IV bolus: Dilute in 4-5ml WFI or NS IV Infusion: 0.1-1mg dilute in 1ml NS or D5% PCA: Dilute with NS [*Final concentration = 1mg/ml*]	Slow IV Bolus: over4-5mins IV Infusion: 1-5mg/h **OR** according to clinical response Epidural: 0.1-1mg/h	Dilution Guide for High Alert Medication, KKM, 2011 Handbook of Drugs in Intensive Care 2006
21.	Noradrenaline 4mg/4ml	D5% NSD5	Single strength: 4mg in 50ml D5% Double strength: 8mg in 50ml D5% ***Dilute before use**	0.5-1mcg/min titrate accordingly (usually: 8-30mcg/min)	Dilution Guide for High Alert Medication, KKM, 2011
22.	Phenobarbitone 200mg/ml	WFI	IM, SC: No dilution required IV Route: Dilute to 10 times its volume with WFI	50mg-100mg/min	Product Insert Globalrph
23.	Phenylephrine 10mg/ml	NS	IV bolus: no dilution required IV Infusion: Single strength: 25mg in 250ml NS (0.1mg/ml) Double strength: 50mg in 250ml NS (0.2mg/ml)	IV bolus: 100-500mcg/dose IV Infusion: 0.4-9.1mcg/kg/min Max rate: 2mg/kg/min (infants), 30mg/min (children), 60mg/min (adults)	Globalrph Drug Information Handbook 2012

No	Medication	Diluent	Dilution (Adult)	Usual Infusion Rate	Reference
					Dilution Guide for High Alert Medication, KKM, 2011
24.	Polyvalent Antivenom	NS D5%	Reconstitute with 10ml WFI.	Dose dependent on the snake type, the time between the bite and clinical symptoms. Slow IV: Inject reconstituted solution 2ml/min IV Infusion: Dilute reconstituted solution in 5-10ml/kg body weight. Administer for at least 1 hour.	Dilution Guide for High Alert Medication, KKM, 2011
25.	Potassium Chloride 1g (13.4mmol K^+)/10ml	NS D5%	By slow IV infusion depending on the deficit or the daily maintenance requirements. 1g diluted in 500 ml NS or D5% ***Dilute before use**	Given slowly over 2-3 hours	Dilution Guide for High Alert Medication, KKM, 2011
26.	Potassium Dihydrogen Phosphate 1.361g (10mmol K^+, 10mmol PO_4^-, 20mmol H^+) / 10ml	NS D5%	IV infusion 10-20mmoles of phosphate daily For peripheral line, should not exceed 10mmol/250ml. ***Dilute before use**	Maximum rate should not exceed 20mmol phosphate/hour. IV doses should be incorporated into patient's maintenance IV fluid and administer over 6-12 hours. Minimum infusion time is 4 hours.	Product Insert Dilution Guide for High Alert Medication, KKM, 2011

No	Medication	Diluent	Dilution (Adult)	Usual Infusion Rate	Reference
27.	Propofol 200mg/20ml	NS D5%	Slow IV bolus: no dilution required Continuous IV Infusion: May be given diluted or undiluted, If diluted, max dilution must exceed 1 part of propofol 1% (10mg/ml) with 4 parts diluent. Minimum concentration: 2mg/ml	Continuous IV Infusion: 1) ***Maintenance of anaesthesia:*** 4-12mg/kg/h 2) ***Sedation during intensive care***: 0.3-4mg/kg/h	Product Insert
28.	Propanolol 1mg/ml	NS D5%	IV push: 1-3mg dilute in 50ml D5% IV Infusion: 15mg in 250ml diluent	IV bolus: (max rate: 1mg/min) IV Infusion: 2-3mg/h	Global rph
29.	Rocuronium Bromide 10mg/ml	Can be administered undiluted. If to be diluted, use NS, D5%	Dilute to a concentration of 0.5 mg/ml up to 2 mg/ml Solutions containing 0.5 mg/ml or 2 mg/ml rocuronium bromide in the recommended diluents should be administer immediately after mixing and completed within 24 hours.	***1) Intubation:*** **(rapid sequence intubation)** Initial:0.6-1.2 mg/kg IV, Maintenance: 0.1-0.2mg/kg IV repeated as needed **(tracheal intubation)** Initial:0.6 mg/kg IV Maintenance: 0.01- 0.012 mg/kg/minute continuous IV infusion. ***2) Skeletal muscle relaxation:*** Initial: 0.6mg/kg IV	Micromedex Formulari Ubat Kementerian Kesihatan Malaysia, 2010 Dilution Guide for High Alert Medication, KKM, 2011

No	Medication	Diluent	Dilution (Adult)	Usual Infusion Rate	Reference
				Maintenance: 0.1-0.2mg/kg IV repeated as needed or 0.01- 0.012 mg/kg/minute continuous IV infusion.	
30.	Short-Acting Insulin (Actrapid)	NS	SC: to be used undiluted IV Infusion: Dilute 50 units insulin in 50ml *NS* *[Final concentration: 1 unit/ml]*	IV Infusion: Adjusted based on hourly blood glucose measurements.	Dilution Guide for High Alert Medication, KKM, 2011
31.	Streptokinase 1.5MU Injection	NS D5	Reconstitution 5ml of WFI should be added to the vial then mixed gently Dilution 1, 500, 000 Unit to be diluted in 95ml diluent (15 000units/mL)	MI: 1 500 000 Units over 30 minutes-1 hour PE: 250, 000 Units by IVI over 30 mins, then 100, 000 Units every hour for up to 12-72 hours with monitoring of clotting factors	Dilution Guide for High Alert Medication, KKM, 2011
32.	Suxamethonium Chloride 50mg/ml Injection	D5 NS	IVI: dilute with 50-100ml of diluent (1-2mg/ml)	Infuse at rate of 2.5 to 4mg/min	Product leaflet Suxamethonium Cl-Fresenius June 2016 Dilution Protocol Hop Tuanku Ampuan Najihah, Kuala Pilah 2017
33.	Tenecteplase 10,000 unit (50mg) Injection	Prefilled syringe of 10ml WFI	Use the prefilled syringe of 10ml WFI to dilute *Final volume 10ml* *(1ml=5mg=1000 unit)*	IV Bolus: Infuse over 5-10 sec	Product leaflet Metalyse

No	Medication	Diluent	Dilution (Adult)	Usual Infusion Rate	Reference
34.	Urokinase 250,000 IU Injection	NS	Reconstitution: Reconstitute with small amount of WFI DVT & PE: Dilute in 15mL solution Peripheral vascular occlusion: Dilute in 200mL solution Hyphaema: Dilute in 2mL NS Clotted arterio-venous shunts: Dilute in 2-3mL NS	DVT & PE: given over 10mins followed by IVI of 4400IU/kg/hr 12-24hr Peripheral vascular occlusion: Infuse into clotat 4000IU/min for 2hrs Hyphaema: 5000IU dissolve in 2mLto be used for eye procedure Clottedarterio-venous shunts: Clamped off for 2-4hrs, for venous side, infusion of 5000IU in 200mL run over 30min is recommended	Product leaflet Urokinase-GCC Inj

*Note: **NS**=Normal Saline (Sodium Chloride 0.9%), **D5%**=Dextrose 5%, **WFI**= Water for Injection*

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