1.0 PURPOSE
1.1 To establish guidelines to identify and standardize the handling and use of High-Alert Medications in patient-care areas, and to outline the steps necessary to increase awareness of these medications to prevent errors that may result from confusion thereby improving patient safety.

2.0 DEFINITION
2.1 High-Alert Medications: Are drugs that bear a heightened risk of causing significant patient harm when they are used in error. Although mistakes may or may not be common with these drugs, the consequences of an error are clearly more devastating to patients.

3.0 RESPONSIBILITY
3.1 Physicians: are responsible to write daily orders for concentrated electrolytes, heparin, insulin and all narcotic and controlled drugs for inpatients.
3.2 Nurses: are responsible for
   3.2.1 Administering IV KCL infusions.
   3.2.2 Clarifying with the Physician the dosage ordered prior to administering dosages of KCL that exceed maximum recommended dosages.

3.0 CROSS REFERENCES POLICY
4.1 Narcotic & Controlled Drugs Policy.
4.2 Nursing Role in Medication Administration List of High-Alert Medication.
4.3 List of High-Alert Medications.

5.0 POLICY
5.1 The pharmacy department will provide general guidelines for the proper handling of high-Alert Medications including a defined list, in accordance with the CBAHI Standards (See attached list & guidelines for certain High-Alert Medications).
5.2 Concentrated electrolytes (Potassium & Sodium Phosphate, Potassium Chloride, and Sodium Chloride) are High-Alert Medications and should not be stocked in patient care areas except as part of the crash cart medications.

5.3 Some critical care areas (ICU, ED and OR) may stock limited quantities of these concentrated electrolytes in a separate, locked and properly labeled cabinet away from the regular ward stock medications and closely monitored by nursing and pharmacy staff.

5.4 High-Alert medications must be properly labeled with Red warning sticker “High-Alert” for further dilution.

5.5 Dextrose 50% may be stocked for dialysis patients to treat sudden hypoglycemia.

5.6 Double checking is mandatory prior to administering any of the selected High-Alert medications, and at time of shift report or any transfer of care.

6.0 PROCEDURE

6.1 General Guidelines To Reduce The Risk Of Using High-Alert Medications:

   6.1.1 Using “U” instead of units in physician orders for heparin and insulin is not accepted.

   6.1.2 All intravenous drips (infusion) should have standardized drug concentrations (in mEq or mMole).

   6.1.3 Heparin vials should not be placed in refrigerators to prevent potential mix-up with insulin vials.

   6.1.4 Dextrose 50% is allowed to be stocked for dialysis patients as it is indicated for treatment of sudden hypoglycemia which may occur during dialysis.

   6.1.5 All High-Alert medications should carry a red warning sticker “High-Alert”.

   6.1.6 Limit access to High-Alert medications.

   6.1.7 Employ independent double checks.

   6.1.8 Improve access to information about High-Alert medications (e.g. educational material).

6.2 Safety procedures during the ordering, preparation, dispensing and administration of High-Alert medications include:

   6.2.1 Prescribing:

      6.2.1.1 Verbal Orders are only allowed during emergency situation while Telephone Orders are not allowed when prescribing High-Alert medications.

      6.2.1.2 Only consultants and specialists should prescribe High-Alert medications.
6.2.1.3 All physicians must write daily orders for concentrated electrolytes, heparin, insulin and all narcotic and controlled drug infusions, regarding admitted patients.

6.2.2 Storage and Dispensing:

6.2.2.1 High-Alert medications should NOT be stored in floors, only a limited quantity will be kept in a separate, locked cabinet away from regular medication stocks in certain areas such as (Operating Room, Emergency Room, and Intensive Care Units).

6.2.2.2 Intravenous anesthetic and skeletal muscle relaxants agent should only be stocked in ICU, OR and ER.

6.2.2.3 Each drug should be stored in separate labeled plastic container.

6.2.2.4 Narcotic and controlled medications should be tightly controlled all over the hospital to prevent misuse or dangerous mix-up, to be kept in separate steel cabinets with double locks (Ref. to Narcotic & Controlled Drugs Policy).

6.2.2.5 Dispensing of such drugs (Narcotic & Controlled) only against treating consultant or specialist’s written order.

6.2.3 Administration:

6.2.3.1 Nurses must double check all High-Alert medications before administration; **Double check is defined as:**

6.2.3.1.1 Independently comparing the label and product contents in hand versus the written order.

6.2.3.1.2 Independently verifying any calculations for doses that require preparation (e.g. if the medication is not dispensed in the exact patient specific unit).

6.2.3.1.3 Ensuring the accuracy of infusion pump programming for continuous intravenous infusion of medication.

6.2.3.2 Standardized dose calculation tables (i.e. x ml = y mcg) should be utilized for high-alert medications on all patient care areas.

6.2.3.3 Whenever administration of High-Alert medication by continuous intravenous infusion is ordered, a second nurse should verify:

6.2.3.3.1 The 7 rights (right patient, right medication, right dose, right frequency, right time, right route, and right documentation).

6.2.3.3.2 The intended infusion is going into the intended canal by physically tracing the line from the solution, through the pump and to the insertion site.

6.2.3.3.3 The infusion pump is programmed at the proper rate.

6.2.3.4 Any time a patient is transferred between units the nurse transferring patient and the nurse accepting the patient should check continuous
intravenous infusion of all High-Alert medications at the bedside, the nurse should check for the right patient, right medication, right rate of infusion and right concentration of medication versus the written order.

6.2.3.5 All continuous intravenous High-Alert medication infusion should be administered via an IV pump.

6.2.3.6 In emergency situations the ICU physician can start this medicine but must inform the treating consultant as soon as possible.

6.3 **Potassium & Sodium Phosphate:**

6.3.1 **Solutions:** There are two types of phosphate solutions, Potassium Phosphate and Sodium Phosphate.

6.3.1.1 **Potassium phosphate** I.V. solution provides (45 mMol P/15ml):

\[
3 \text{ mMol phosphorus/ml} = (6 \text{ mEq phosphorus/ml}) + 4.4 \text{ mEq K+/ml}
\]

6.3.1.2 **Sodium phosphate** I.V. solution provides (45 mMol P/15ml):

\[
3 \text{ mMol phosphorus/ml} = (6 \text{ mEq phosphorus/ml}) + 4 \text{ mEq Na+/ml}
\]

6.3.2 **Prescribing:**

6.3.2.1 The physician shall prescribe the phosphate salt according to the patients' needs and electrolyte balance requirements.

6.3.2.2 The normal laboratory range for phosphorus is (2.5 - 4.5 mg/dl). For mild to moderate hypophosphatemia (1 - 2.4 mg/dl), oral agents may be used.

6.3.2.3 For severe hypophosphatemia (< 1 mg/dl, or < 2 mg/dl if TPN is to be started, or < 2.5 mg/dl with symptoms), parenteral phosphate replacement is generally indicated.

6.3.3 **Phosphate Replacement In Adults:**

<table>
<thead>
<tr>
<th>Indication</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Mild to moderate hypophosphatemia:</td>
<td>1. <strong>K-Phosphate</strong> or <strong>Na-Phosphate</strong>:</td>
</tr>
<tr>
<td>(1 - 2.4 mg/dl) without symptoms</td>
<td>0.16 mMol phosphate/ kg IV over 6 hours.</td>
</tr>
<tr>
<td>2- Severe Hypophosphatemia:</td>
<td>1. <strong>K-Phosphate</strong> or <strong>Na-Phosphate</strong>:</td>
</tr>
<tr>
<td>level &lt; 1 mg/dl, or</td>
<td></td>
</tr>
<tr>
<td>&lt; 2mg/dl if TPN is to be started, or</td>
<td>Usual dose 0.2 - 0.24 mMol phosphate/kg IV</td>
</tr>
<tr>
<td></td>
<td>over 6 hours.</td>
</tr>
<tr>
<td>&lt; 2.5 mg/dl with symptoms</td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>--</td>
</tr>
<tr>
<td>3- Maximum Phosphate dose:</td>
<td>1. <strong>K-Phosphate or Na-Phosphate:</strong> 0.24 mMol phosphate/kg over 6 hours <em>(Usually not &gt; than 45 mMol phosphate/24 hrs)</em></td>
</tr>
<tr>
<td>4- Normal daily dose:</td>
<td>1. <strong>K-Phosphate or Na-Phosphate:</strong> 0.14 - 0.4 mMol phosphate/kg over 24 hours <em>(Includes dietary intake of phosphorus)</em></td>
</tr>
</tbody>
</table>

6.3.4 Empiric dosing recommendations are for adults with normal organ function but not replacing the clinical judgment for individual patient care.

6.3.5 Oral dosing ranges may differ from manufacturers’ labeling for phosphorus supplementation.

6.3.6 Use ideal body weight (IBW) for dosing if total body weight is > than 20% over IBW.

6.3.7 Note: the replacement dose is in addition to routine daily dose of 0.14 - 0.4 mMol phosphorus/kg/day.

6.3.8 A minimum of 4 to 6 hours infusion is required for parenteral phosphate.

6.3.9 Risks of rapid IV infusion include hypocalcemia, hypotension, muscular irritability, calcium deposits, renal function deterioration, and hyperkalemia (from K content in K phosphate).

6.4 **Potassium Chloride:**

6.4.1 **Solutions:**

6.4.1.1 Potassium chloride is available as 15% KCL solution containing (2 mEq/ml) in 10 ml.

6.4.2 **Prescribing:**

6.4.2.1 Potassium chloride is administered upon a written physician order as a continuous or intermittent infusion only.

6.4.2.2 Limited quantities of concentrated KCL (2mmol/ml, 10ml vial) will be available as ward stock for IV admixture in the Operating Room (OR) and all Intensive Care Units. The stock room for KCL should be locked up in a separate, labeled cabinet away from the regular ward stock medications. These stocks are available for emergency use only.
6.4.2.3 All IV fluids in which concentrated KCL is added require thorough mixing via rigorous inversion and agitation of the IV bag.

6.4.2.4 At **no** time is Potassium Chloride administered by IM or IV push. And **no** other IV push medications should be administered via IV lines through which a large concentration of potassium is on-going.

6.4.2.5 Continuous ECG monitoring is required if an adult patient is receiving Potassium Chloride at any rate higher than 10 mmol/hr or pediatric patient receiving KCL infusions exceeding 0.5 mmol/kg/hour.

6.4.2.6 Potassium chloride infusion rates higher than 10 mmol/hr or at a concentration more than 10 mmol/100ml should be done through central line only.

6.4.2.7 The maximum recommended concentration of KCL is 100 mmol per liter of either 0.9% sodium chloride (NS) or Dextrose 5% in Water (D5W) to run through either central or peripheral IV line.

6.4.2.8 Normal Saline diluent must be used for all potassium chloride loading dose. Dextrose may aggravate hypokalemia especially if the serum potassium is 2.5 mmol/l or less.

6.4.2.9 The maximum adult dose may not exceed 200 mmol per 24 hours in most cases. Some cases may require up to 400 mmol per 24 hours (receiving Amphotericin B, diuretics, having severe diarrhea, etc.). In these cases serum K level should be checked every 6-8 hours.

6.4.3 Administration:

6.4.3.1 Central line IV intravenous KCL infusion of 20 mmol / 100 ml normal saline might be prepared and administered when the patient’s serum potassium level is less than 2.5 mmol/L, fluid restricted, and/or the patient is symptomatic (i.e dysrrhythmias). If this high concentration is used, the patient should be kept under close observation and continuous ECG monitoring. No more than 100ml/ (20 mmol of KCL) to be prepared or administered at a time and recommended doses not to be exceeded.

6.4.3.2 A maximum KCL infusion rate of 40 mmol /hour through central line might be administered only in emergency situations. These situations are limited to the following: an adult patient with serum potassium concentration extremely low (< 2.0 mmol/L), the patient is symptomatic, and is
6.4.3.3 Prior to administering dosages of KCL that exceed maximum recommended dose or concentration, the nurse will:

6.4.3.3.1 Clarify with the Physician the dosage ordered.
6.4.3.3.2 Notify the head nurse/charge nurse (if issue is not resolved, check with nursing supervisor).

6.4.3.4 Only registered nurses are allowed to administer I.V. KCL infusions. Nurse must follow the medication administration procedures written in the policy (Nursing Role in Medication Administration).

6.4.4 Guidelines for Potassium Replacement:

<table>
<thead>
<tr>
<th>Deficit Level</th>
<th>Serum K+ Levels</th>
<th>IV Administration</th>
<th>Oral Administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Deficit</td>
<td>Serum K+ &lt; 2.0 mMol/L</td>
<td>IV: 40 mMol KCl in 100ml IV fluid over 1 hour.</td>
<td>Oral: 28-42 mMol K every 2-4 hours if tolerated (dissolved in 100-150 ml of water).</td>
</tr>
<tr>
<td>Severe Deficit</td>
<td>Serum K+ : 2.0 – 2.5 mMol/L</td>
<td>IV: 20 - 30 mMol KCl in 100ml IV fluid over 1hr.</td>
<td>Oral: 28 mMol K per hour if tolerated (dissolved in 100-150 ml of water).</td>
</tr>
<tr>
<td>Moderate Deficit</td>
<td>Serum K+ : 2.5 – 3.0 mMol/L</td>
<td>IV: 30 mMol K/Liter at a rate of 5 – 10 mMol/hr.</td>
<td>Oral: 28 mMol K three times a day (dissolved in 100-150 ml of water).</td>
</tr>
<tr>
<td>Mild Deficit</td>
<td>Serum K+ : 3.0 – 3.5 mMol/L</td>
<td>Oral: 28 mMol K three times a day (dissolved in 100-150 ml of water).</td>
<td></td>
</tr>
</tbody>
</table>

6.4.4.1 Note:

6.4.4.1.1 Concentration available is 20 mEq/10 ml (15%KCL) containing 2 mEq K+/ml and 4 mOsmol/ml.
6.4.4.1.2 Potassium salt MUST BE DILUTED prior to use.
6.4.4.1.3 In the ward, if rate of IV potassium should exceed 30 mMol/hr = continuous ECG monitoring required.
6.4.4.1.4 In the ICU, the rate of IV potassium SHOULD NOT exceed 40 mMol/hr, with continuous ECG monitoring.
6.4.4.1.5 DO NOT add potassium to a hanging IV bottle.
6.4.4.1.6 Intravenous potassium solution MUST BE administered via a volumetric pump.
6.5 **Sodium Chloride:**

6.5.1 **Solutions:**

6.5.1.1 **Sodium Chloride 3% I.V. solution provides (5 mEq Na+/10ml):**

<table>
<thead>
<tr>
<th>1 mEq of NaCl</th>
<th>= 58.5 mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 mEq of NaCl</td>
<td>= 29.25 mg</td>
</tr>
</tbody>
</table>

| Na+ | = 0.5 mEq/ml |
| Cl- | = 0.5 mEq/ml |

6.5.1.2 **Sodium Chloride 14.61% I.V. solution provides (125 mEq Na+/50ml):**

<table>
<thead>
<tr>
<th>1 mEq of NaCl</th>
<th>= 58.5 mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5 mEq of NaCl</td>
<td>= 146.25 mg</td>
</tr>
</tbody>
</table>

| Na+ | = 2.5 mEq/ml |
| Cl- | = 2.5 mEq/ml |

6.5.2 **Prescribing:**

6.5.2.2 There are two types of hypertonic sodium solutions concentrates, Sodium Chloride 3% and Sodium Chloride 14.61%.

6.5.2.3 Treatment with hypertonic saline solution is advocated only for patients with severe hyponatremia who have profound neurological symptoms.

6.5.2.4 **The hypertonic (14.61%) saline contains 2500 mEq/L of NaCl.**

6.5.2.5 **The hypertonic (3%) saline contains 513 mEq/L of NaCl.**

6.5.2.6 Treatment of hyponatremia can be divided into two steps:
6.5.2.6.1 **First step:** The physician must decide whether immediate treatment is required. This decision is based on the presence of symptoms, the degree of hyponatremia, whether the condition is acute (arbitrarily defined as a duration of less than 48 hours) or chronic (serum sodium levels < 125 mEq/L), and the presence of any degree of hypotension.

6.5.2.6.2 **Second step:** Determine the most appropriate method of correcting the hyponatremia. Shock resulting from volume depletion should be treated with intravenous isotonic saline.

6.5.2.7 Hyponatremia can be corrected with:

6.5.2.7.1 Administration of hypertonic saline solution (3%) at a rate of about 1 ml/kg per hour.

6.5.2.7.2 A loop diuretic may be added to enhance water excretion if urine osmolality is greater than 300 mOsm/kg. With the use of this combination therapy, sodium lost in the urine is replaced with an equal amount of sodium in a smaller volume.

6.5.2.7.3 The serum concentration should be raised no more than 25 mEq/L in the first 48 hours, at a rate no more than 2 mEq/L per hour, and the target goal should be 120 to 125 mEq/L.

6.5.2.7.4 The rate of correction should be slower (0.5 to 1 mEq/L per hour).

6.5.2.7.5 Appropriate treatment of hyponatremia depends upon the correct classification of hyponatremia, the concomitant disease state, the severity of symptoms, and the severity of hyponatremia.

6.5.2.8 To correct acute, serious hyponatremia (serum sodium level < 120 mEq/L):
6.5.2.2.1 \[ \text{mEq Sodium} = \left[ (\text{desired serum sodium (mEq/L)} - \text{actual serum sodium (mEq/L)}) \right] \times [0.6 \times \text{wt (kg)}]. \]

6.5.2.2 For acute correction use 125 mEq/L as the desired serum sodium; acutely correct serum sodium in 5 mEq/L/dose increment; more gradual correction in increments of 10 mEq/L/day is indicated in the asymptomatic patient.

6.5.2.3 In general, 300-500 ml of 3% NaCl is a reasonable dose in most adult patients with severe symptomatic hyponatremia.

6.5.2.4 Give IV over first 1 – 2 hours until resolution of seizures or herniation.

7.0 FORMS

7.1 N/A.

8.0 EQUIPMENT

8.1 N/A.

9.0 REFERENCES

9.1 Management of Hyponatremia, KIAN PENG GOH, M.R.C.P., Alexandra Hospital, Singapore.


9.3 List of High-Alert Medications: Institute for Safe Medication Practice (ISMP).