

8 VITAMINS, MINERALS & PARENTERAL SOLUTIONS

8.01 VITAMINS

WHO MODEL FORMULARY 2004 NOTES:

Vitamins are used for the prevention and treatment of specific deficiency states or when the diet is known to be inadequate. It has often been suggested but never convincingly proved, that subclinical vitamin deficiencies cause much chronic ill-health and liability to infections. This has led to enormous consumption of vitamin preparations, which have no more than placebo value. Most vitamins are comparatively non-toxic but prolonged administration of high doses of retinol (vitamin A), ergocalciferol (vitamin D₂) and pyridoxine (vitamin B₆) may have severe adverse effects.

Retinol (vitamin A) is a fat-soluble substance stored in body organs, principally the liver. Periodic high-dose supplementation is intended to protect against vitamin A deficiency which is associated with ocular defects particularly xerophthalmia (including night blindness which may progress to severe eye lesions and blindness), and an increased susceptibility to infections, particularly measles and diarrhoea. Universal vitamin A distribution involves the periodic administration of supplemental doses to all preschool-age children with priority given to age groups, 6 months to 3 years, or regions at greatest risk. All mothers in high-risk regions should also receive a high dose of vitamin A within 8 weeks of delivery. Since vitamin A is associated with a teratogenic effect it should be given in smaller doses (no more than 10 000 units/day) to women of child-bearing age. It is also used in the treatment of active xerophthalmia. Doses of vitamin A should be administered orally immediately upon diagnosis of xerophthalmia and thereafter patients with acute corneal lesions should be referred to a hospital on an emergency basis. In women of child-bearing age there is a need to balance the possible teratogenic effects of vitamin A should they be pregnant with the serious consequences of xerophthalmia. Where there are severe signs of xerophthalmia high dose treatment as for patients over 1 year should be given. When less severe symptoms are present (for example night blindness) a much lower dose is recommended. Vitamin A therapy should also be given during epidemics of measles to reduce complications.

Vitamin B is composed of widely differing substances which are, for convenience, classed as 'vitamin B complex'. **Thiamine** (vitamin B₁) is used orally for deficiency due to inadequate dietary intake. Severe deficiency may result in 'beri-beri'. Chronic dry 'beri-beri' is characterized by peripheral neuropathy, muscle wasting and weakness, and paralysis; wet 'beri-beri' is characterized by cardiac failure and oedema. Wernicke-Korsakoff syndrome (demyelination of the CNS) may develop in severe deficiency. Thiamine is given

by IV injection in doses of up to 300 mg daily (parenteral preparations may contain several B group vitamins) as initial treatment in severe deficiency states. Potentially severe allergic reactions may occur after parenteral administration. Facilities for resuscitation should be immediately available. **Riboflavin** (vitamin B₂) deficiency may result from reduced dietary intake or reduced absorption due to liver disease, alcoholism, chronic infection or probenecid therapy. It may also occur in association with other deficiency states such as pellagra. **Pyridoxine** (vitamin B₆) deficiency is rare as the vitamin is widely distributed in foods, but deficiency may occur during isoniazid therapy and is characterized by peripheral neuritis. It is also used in sideroblastic anaemia. **Nicotinamide** is used to prevent and treat nicotinic acid deficiency (pellagra).

Folic acid is essential for the synthesis of DNA and certain proteins. Deficiency of folic acid or vitamin B₁₂ is associated with megaloblastic anaemia. Folic acid should not be used in undiagnosed megaloblastic anaemia unless vitamin B₁₂ is administered concurrently, otherwise neuropathy may be precipitated (see section 8.02 WHO notes). Supplementation with folic acid 400 micrograms daily is recommended for women of child-bearing potential in order to reduce the risk of serious fetal neural tube defects.

Ascorbic acid (vitamin C) is used for the prevention and treatment of scurvy. Claims that ascorbic acid is of value in the treatment of common colds are unsubstantiated.

The term **vitamin D** covers a range of compounds including **ergocalciferol** (vitamin D₂) and **colecalfiferol** (vitamin D₃). These two compounds are equipotent and either can be used to prevent and treat rickets. Simple deficiency of vitamin D occurs in those who have an inadequate dietary intake or who fail to produce enough colecalfiferol (vitamin D₃) in their skin from the precursor 7-dehydrocholesterol in response to ultraviolet light. Children with dark skin must continue vitamin D prophylaxis for up to 24 months because of their inability to produce enough vitamin D₃ in their skin. Dark skin with a high melanin content must be exposed to daylight longer than light skin in order to obtain the same synthesis of vitamin D₃. Vitamin D is also used in deficiency states caused by intestinal malabsorption or chronic liver disease and for the hypocalcaemia of hypoparathyroidism.

Vitamin K is necessary for the production of blood clotting factors.

| GENERIC (TRADE) NAME | CAT. | INDICATION/DOSE |
|---|----------------|--|
| Ascorbic Acid (Vitamin C) Tab 250mg | MSL EML | <i>By mouth</i> , Adult & Child: Prophylactic, 25-75mg daily. Therapeutic, minimum 250mg daily. |
| Folic Acid 5mg Tab | EML | <i>By mouth</i> , Folate-deficient megaloblastic anaemia: Adult & Child > 1 yo, initially 5mg daily for 4 months; prophylaxis in chronic haemolytic states: 5mg daily depending on diet/haemolysis rate; Child <1yo 500 micrograms/kg/DAY. Prevention of first occurrence of neural tube defect in pregnancy: 200-500 micrograms daily up to the twelfth week; prevention of reoccurrence 5mg daily from at least 4 weeks before conception until twelfth week of pregnancy. |
| Phytomenadione (Vitamin K) Inj 10mg/ml, 1ml [Phytonadione] [Adult use only, NOT for child < 2 yo, contains benzyl alcohol.] | MSL EML | Hypoprothrombinaemia, warfarin overdose: severe haemorrhage Adult <i>by slow IV inj</i> 2.5-5mg, max 50mg (dilute in D5, max rate 1mg/minute); less severe bleeding <i>by IM/SC inj</i> undiluted 10-20mg; no or minor bleeding <i>by IM/SC inj</i> undiluted 500 micrograms. NOTE: Some commercial preps unsuitable for IV use. |
| Pyridoxine (Vitamin B₆) Tab 50mg | EML | <i>By mouth</i> , Deficiency states: Adult 25-50mg up to 3 times daily. Isoniazid neuropathy: Adult prophylaxis 10mg daily; therapeutic 50mg 3 times daily. Sideroblastic anaemia: Adult 100-400mg daily in divided doses. |

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| GENERIC (TRADE) NAME | CAT. | INDICATION/DOSE |
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| Retinol (Vitamin A) Tab 50 000 Units & 200 000 Units | EML | <p><i>By mouth</i>, Prophylaxis, Infant < 6 months 50 000 units, 6-12 months 100 000 units, every 4-6 months, preferably at measles vaccination; Child > 1 yo (preschool) & Adult, 200 000 units every 4-6 months; Adult pregnant woman, max 10 000 units daily <i>or</i> 25 000 units weekly; Adult mothers, 200 000 units at delivery or within 6 weeks.</p> <p>Treatment of xerophthalmia, Infant < 6 months, 50 000 units on diagnosis, repeated next day and then after 2 weeks; 6-12 months 100 000 units; Child > 1 yo & Adult (except woman of child-bearing age) 200 000 units on diagnosis, repeated next day and then after 2 weeks; Adult (woman of child-bearing age, see notes above), severe signs of xerophthalmia, as for other adults; less severe cases (e.g. night blindness), 5000-10 000 units daily for at least 4 weeks <i>or</i> up to 25 000 units weekly.</p> |
| MULTIVITAMIN PREPARATIONS | | |
| Multivitamin for Adults Tablet | | <i>By mouth</i> , Adults & Child >12 yo, one tablet daily or as required. |
| Multivitamin for Children, Chewable Tablet | | <i>By mouth</i> , 2-12yo, 1 tab daily or as needed. See product leaflet for detail |
| Multivitamin with Iron for Children, Chewable Tablet | | <i>By mouth</i> , 2-12yo, 1 tab daily or as needed. See product leaflet for detail |
| Multivitamin Suspension | | <i>By mouth</i> , 2-12yo 5ml daily; <2yo 2.5ml daily, or as needed. See product leaflet for detail |
| Vitamin B Complex Tab | | 1-2 tab daily as required, See product literature for details. |

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COMMENT/CAUTIONS:

- **RDA: (vitamin B₁/thiamine)** < 6 months 0.3mg, 6 months-1 yo 0.4mg, 1-3 yo 0.7mg, 4-6 yo 0.9mg, 7-10 yo 1mg, 11-14 yo 1.1-1.3mg, > 14 yo 1.5mg.
- **RDA: (vitamin B₂/riboflavin)** Child 0.4-1.8mg, Adult 1.2-1.7mg.
- **RDA: (vitamin B₆/pyridoxine)** 1-3 yo 0.9mg, 4-6 yo 1.3mg, 7-10 yo 1.6mg, Adult 2mg.
- **RDA (vit B₁₂/cyanocobalamin)** Child 0.3-2 micrograms, Adult 2 micrograms.
- **RDA: (vitamin C/ascorbic acid)** < 6 months 30mg, 6 months-1 yo 35mg, 1-3 yo 40mg, 4-10 yo 45mg, 11-14 yo 50mg, Adult 60mg.
- **RDA: (vitamin D/alfacalcidol/calcitriol):** < 6 months 7.5 micrograms (but if infants breast-fed and not exposed to sunlight an additional supplement of 5-7.5 micrograms should be given), up to 24 yo 10 micrograms, over 24 yo (adult) 5 micrograms, pregnant/lactating women 10 micrograms.
- **RDA: (folic acid):** Neonates to 6 months 25-35 micrograms, 6 months-3 yo 50 micrograms, 4-6 yo 75 micrograms, 7-10 yo 100 micrograms, 11-14 yo 150 micrograms, > 15 yo to Adult 200 micrograms.

8.02 ELECTROLYTES & MINERALS

WHO MODEL FORMULARY 2004 NOTES:

Calcium gluconate. Calcium supplements are usually only required where dietary calcium intake is deficient. This dietary requirement varies with age and is relatively greater in childhood/pregnancy/lactation due to an increased demand, and in old age, due to impaired absorption. In osteoporosis, a calcium intake which is double the recommended daily amount reduces the rate of bone loss. In hypocalcaemic tetany calcium gluconate must be given parenterally but monitor plasma calcium. Calcium gluconate is also used in cardiac resuscitation.

Iron-deficiency Anaemia. Anaemia has many different aetiologies. It occurs when the haemoglobin concentration falls below the normal range for the age and sex of the individual. It is essential that a correct diagnosis is made before initiating therapy. Any serious underlying cause of iron-deficiency anaemia, including gastric erosion and colonic carcinoma, should be excluded before giving iron replacement. **Ferrous salts** should be given orally, the choice of preparation depending on incidence of adverse effects and cost (as efficacy is similar). Ferric salts are much less well absorbed. For adult treatment of iron-deficiency anaemia, give elemental iron 100–200 mg daily with meals.

Approximate elemental iron content: ferrous fumarate 200 mg (65 mg iron), ferrous gluconate 300 mg (35 mg iron), ferrous succinate 100 mg (35 mg iron), ferrous sulfate 300 mg (60 mg iron), dried ferrous sulfate 200 mg (65 mg iron).

The haemoglobin concentration should rise by about 100–200 mg/100 ml per day or 2 g/100 ml over 3-4 weeks. After the haemoglobin has risen to normal, treatment should be continued for a further 3 months to replenish the iron stores. Iron intake in the evening has been reported to improve its absorption. Iron intake with meals may reduce bioavailability but improve tolerability and adherence. Gastrointestinal irritation may occur, nausea and epigastric pain are dose-related. Oral iron preparations may be constipating, particularly in the elderly; they may exacerbate diarrhoea in patients with inflammatory bowel disease; use with care in patients with intestinal strictures and diverticula. Parenteral iron may cause more harm than benefit (except in haemodialysis).

Megaloblastic anaemias result from a lack of either vitamin B₁₂ (hydroxocobalamin) or folate or both. The clinical features of folate-deficient megaloblastic anaemia are similar to those of vitamin B₁₂ deficiency except that the accompanying severe neuropathy does not occur; it is essential to establish the underlying cause in every case. **Hydroxocobalamin** is used to treat vitamin B₁₂ deficiency [not on Mercy Ships list].

Folate deficiency due to poor nutrition, pregnancy, antiepileptic drugs or malabsorption is treated with **folic acid** but this should never be administered without vitamin B₁₂ in undiagnosed megaloblastic anaemia because of the risk of precipitating neurological changes due to vitamin B₁₂ deficiency. Preparations containing a **ferrous salt and folic acid** are used for the prevention of megaloblastic anaemia in pregnancy. The low doses of folic acid in these preparations are inadequate for the treatment of megaloblastic anaemias. See section 8.01 for folic acid dose detail. To reduce risk of **neural tube defects** in babies, supplement folic acid in women planning a pregnancy (in diet or as supplement 400-500 micrograms daily) before conception and in the first 12 weeks of pregnancy. Women of increased risk (e.g. history of neural tube defect in a previous child) should receive 5mg folic acid daily. Women taking antiepileptic drugs should be counselled by their doctor before starting folic acid.

Compensation for **potassium** loss is necessary in patients taking digoxin or antiarrhythmic drugs (potassium depletion may induce arrhythmias); in patients with secondary hyperaldosteronism (renal artery stenosis, liver cirrhosis, the nephrotic syndrome, severe heart failure); and with excessive loss of potassium in faeces (chronic diarrhoea associated with intestinal malabsorption or laxative abuse). Consider also in the elderly since they often take inadequate amounts in the diet (but caution on use in renal insufficiency). Consider during long-term administration of drugs known to induce potassium loss (e.g. corticosteroids). Potassium supplements are seldom required with the small doses of diuretics given to treat hypertension. Potassium-sparing diuretics (rather than potassium supplements) are recommended for prevention of hypokalaemia due to diuretics such as furosemide or the thiazides when these are given to eliminate oedema (see section 2.01). Potassium depletion is frequently associated with metabolic alkalosis and chloride depletion and these disorders require correction.

| GENERIC (TRADE) NAME | CAT. | INDICATION/DOSE |
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| <p>Calcium Carbonate Cap 250mg [elemental Ca = 100mg/cap = 2.5mmol/cap = 5mEq/cap]</p> <p>Calcium Carbonate Cap 500mg [elemental Ca = 200mg/cap = 5mmol/cap = 10mEq/cap]</p> | MSL | <p><i>By mouth</i>, deficiency: Adult 250-500mg 3-4 times daily. Dose in elemental calcium for Hypocalcaemia: Neonate 50-150 mg/kg/DAY daily in 4-6 divided doses (max 1g/DAY); Child 45-65mg/kg/DAY in 4 divided doses, Adult 1-2g or more/DAY.</p> |
| <p>Calcium Chloride Inj 10% 1g/10ml [elemental Ca = 273mg/10ml =6.8mmol/10ml =13.6mEq/10ml]</p> | | <p>Acute hypocalcaemia: <i>By slow IV inj</i> 0.5-1g (undiluted at 0.5-1ml/minute); <i>or IV infusion</i> in doses up to 1g (dilute in 50ml NS give over 1 hour).</p> |
| <p>Calcium Gluconate Inj 10% 1g/10ml [elemental Ca = 89mg/10ml =2.25mmol/10ml =4.5mEq/10ml]</p> <p>[NOT for IM or SC Inj.]</p> | EML | <p>Acute hypocalcaemia: <i>By slow IV inj</i> 1-2g (2.25-4.5mmol Ca or 10-20ml). Cardiac resuscitation: <i>slow IV or intracardiac</i> 1g (2.25mmol Ca, 10ml) Hypocalcaemia tetany: <i>slow IV</i> 1g (2.25mmol Ca or 10ml) may be followed by <i>continuous IV infusion</i> of 4g/DAY (9mmol Ca or 40ml/DAY).</p> <p>Inject slow IV undiluted over 10-20 minutes, max rate 50mg/minute, or IV infusion dilute 1g with 20-50ml D5/NS and infuse over 1 hour or at a rate of 120-240mg/kg/hour.</p> |
| <p>Calcium Lactate 300mg Tab [elemental Ca = 40mg/tab = 1mmol/tab = 2mEq/tab]</p> | MSL | <p><i>By mouth</i>, Osteoporosis: Adult up to 6g daily in divided doses. Usual dose ~20mmol (20 tab) daily.</p> |
| <p>Ferrous Sulphate 200mg Tab [elemental iron Fe = 65mg/tab = 1mmol/tab]</p> | EML | <p><i>By mouth</i>, Iron-deficiency anaemia: Treatment, Adult & > 12yo, 1 tab 2-3 times daily after food. Prophylaxis, Adult (woman) 1 tab daily.; or Alternative treatment dosing: < 2yo 1mg/kg elemental iron daily; 2-12yo 2mg/kg elemental iron daily; Adult 60-120mg elemental iron daily.</p> |

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| GENERIC (TRADE) NAME | CAT. | INDICATION/DOSE |
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| <p>Ferrous Fumarate Suspension 100mg/5ml [elemental iron Fe = 33mg/5ml = ~0.5mmol/5ml]</p> | | <p><i>By mouth</i>, Iron-deficiency anaemia: Treatment, Adult 10-20ml twice daily; 6-12 yo 5-10ml twice daily; up to 6 yo 2.5-5ml twice daily. Prevention, Child < 5 yo elemental iron 2mg/kg (max 30mg) daily; > 5 yo elemental iron 30mg daily; <i>or</i> Alternative treatment dosing: < 2yo 1mg/kg elemental iron daily; 2-12yo 2mg/kg elemental iron daily. In women and children > 5 yo folic acid may also be given. Administer well-diluted with water, with a drinking straw to prevent tooth discoloration.</p> |
| <p>Magnesium Sulfate Inj 50% 5g/10ml [elemental Mg = 500mg/10ml = 20mmol/10ml = 40 mEq/10ml]</p> | EML | <p>Serious arrhythmia, emergency, in the presence of hypomagnesaemia: <i>By slow IV inj</i> 1-2g (4-8mmol Mg <i>or</i> 2-4ml) in 50-100ml D5 over 10-15 minutes repeated once if needed; <i>or by IV infusion</i> 2.5g (10mmol <i>or</i> 5ml) in 100ml D5/NS infused over 1 hour. Hypomagnesaemia, emergency: <i>By IV infusion</i> 1-2g (4-8mmol Mg <i>or</i> 2-4ml) in 100ml D5 over 1-2 minutes. Severe deficiency: <i>By IV infusion</i> 5g (20mmol Mg <i>or</i> 10ml) in 1000ml D5/NS, given over 3 hours.</p> <p>For IV inj or infusion dilute dose in 50-100ml D5, max conc 200mg/ml. An IV calcium solution (e.g. 10% calcium gluconate) should be readily available when magnesium sulphate injection is administered.</p> |
| <p>Potassium Chloride Tab 600mg (Slow K) [elemental K = 313mg/tab = 8mmol/tab = 8mEq/tab]</p> | EML | <p><i>By mouth</i>, Hypokalaemia prevention (see notes above): Adult 20-50 mmol daily in 2-3 divided doses after food, (max 100 mmol/DAY) adjust dose according to clinical response or need, monitor levels regularly.</p> |

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| GENERIC (TRADE) NAME | CAT. | INDICATION/DOSE |
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| <p>Potassium Chloride Inj 10% 1g/10ml (=100mg/ml) [elemental K = 524mg/10ml = 13.4mmol/10ml = 13.4mEq/10ml]</p> | <p>EML</p> | <p><i>By IV infusion</i>, Acute severe hypokalaemia: Adult, 10-20mmol K (~10-20ml), max 40mmol K (~40ml) infuse over 1-3 hours diluted in NS. Child 0.5-1mmol/kg/DOSE, max 30mmol (~30ml) may be infused at 0.3-0.5 mmol/kg/hour diluted in NS.</p> <p>NOTE: MUST dilute IV in NS before use (mix thoroughly), at a max rate of 20mmol/hour, IV concentration max 40mmol/L (peripheral line) and 80mmol/L (central line, with monitoring). ECG monitoring and repeated plasma potassium levels recommended before further doses.</p> |

COMMENT/CAUTIONS:

- **Iron therapy:** Give orally unless otherwise indicated. Start with low dose and increase gradually to improve tolerance, and administer with food. Adverse effects include nausea, epigastric pain, constipation or diarrhoea, and may cause stool discoloration.
- **Iron drug interaction:** Magnesium trisilicate reduces iron absorption; oral iron reduces absorption of tetracyclines and possibly penicillamine and fluoroquinolones such as ciprofloxacin (administer 2 hours later to avoid this).
- **Potassium:** May cause nausea/vomiting, do not combine with spironolactone or other potassium-sparing diuretics, reduce dose in elderly and renal failure. Potassium-rich foods may affect levels (e.g. dates, bananas, mangos, oranges, tomatoes).
- **RDA (Elemental calcium):** < 6 months 400mg, 6-12 months 600mg, 1-5 yo 800mg, 6- 10 yo 800-1200mg, 11 yo-Adult 1000-1500mg.
- **RDA (Elemental iron):** < 5 months 5mg, 5 months-10 yo 10mg, 11-18 yo (male) 12mg, 11-50 yo (female) 15mg, >18yo (male) or >50yo (female) 10mg.
- **RDA (Elemental magnesium):** < 12 months 40-60mg, 1-6 yo 80-120mg, 7-10 yo 170mg, 11-18 yo (male) 270-400mg (female) 280-300mg, > 19 yo (male) 350mg (female) 280mg.
- **RDA (Elemental potassium):** Neonates 2-6mmol/kg, Child 2-3mmol/kg, Adult 40-80mmol.

8.03 PARENTERAL SOLUTIONS

WHO MODEL FORMULARY 2004 NOTES:

Solutions of electrolytes are given intravenously, to meet normal fluid and electrolyte requirements or to replenish substantial deficits or continuing losses, when the patient is nauseated or vomiting and is unable to take adequate amounts by mouth. The nature and severity of the electrolyte imbalance must be assessed from the history and clinical and biochemical examination of each individual. Sodium, potassium, chloride, magnesium, phosphate, and water depletion can occur singly and in combination with or without disturbances of acid-base balance.

Isotonic solutions may be infused safely into a peripheral vein. More concentrated solutions, for example 20% glucose, are best given through an indwelling catheter positioned in a large vein.

Sodium chloride in isotonic solution provides the most important extracellular ions in near physiological concentrations and is indicated in *sodium depletion* which may arise from conditions such as gastroenteritis, diabetic ketoacidosis, ileus and ascites. In a severe deficit of from 4 to 8 litres, 2 to 3 litres of isotonic sodium chloride may be given over 2 to 3 hours; thereafter infusion can usually be at a slower rate. Excessive administration should be avoided; the jugular venous pressure should be assessed; the bases of the lungs should be examined for crepitations, and in elderly or seriously ill patients it is often helpful to monitor the right atrial (central) venous pressure.

Chronic hyponatraemia should ideally be managed by fluid restriction. However, if sodium chloride is required, the deficit should be corrected slowly to avoid risk of osmotic demyelination syndrome; the rise in plasma-sodium concentration should be limited to no more than 10 mmol/litre in 24 hours.

The more physiologically appropriate **compound solution of sodium lactate** (Ringers or Hartmann's solution) can be used instead of isotonic sodium chloride solution during surgery or in the initial management of the injured or wounded.

Sodium chloride and glucose solutions are indicated when there is *combined water and sodium depletion*. A 1:1 mixture of isotonic sodium chloride and 5% glucose allows some of the water (free of sodium) to enter body cells which suffer most from dehydration while the sodium salt with a volume of water determined by the normal plasma Na^+ remains extracellular. Combined sodium, potassium, chloride, and water depletion may occur, for example, with severe diarrhoea or persistent vomiting; replacement is carried out with sodium chloride intravenous infusion 0.9% and glucose intravenous infusion 5% with potassium as appropriate.

Glucose solutions (5%) are mainly used to replace *water deficits* and should be given alone when there is no significant loss of electrolytes. Average water requirement in a healthy adult are 1.5 to 2.5 litres daily and this is needed to balance unavoidable losses of water through the skin and lungs and to provide sufficient for urinary excretion. Water depletion (dehydration) tends to occur when these losses are not matched by a comparable intake, as for example may occur in coma or dysphagia or in the aged or apathetic who may not drink water in sufficient amount on their own initiative.

Excessive loss of water without loss of electrolytes is uncommon, occurring in fevers, hyperthyroidism, and in uncommon water-losing renal states such as diabetes insipidus or hypercalcaemia. The volume of glucose solution needed to replace deficits varies with the severity of the disorder, but usually lies within the range of 2 to 6 litres.

Glucose solutions are also given in regimens with calcium, bicarbonate, and insulin for the emergency treatment of *hyperkalaemia*. They are also given, after correction of hyperglycaemia, during treatment of diabetic ketoacidosis, when they must be accompanied by continuing insulin infusion.

If glucose or sugar cannot be given orally to treat *hypoglycaemia*, glucose 50% may be given intravenously into a large vein through a large-gauge needle; this concentration is very irritant on extravasation and it is also viscous and difficult to administer. Larger volumes of less concentrated glucose solutions (10% or 20%) can be used as alternatives and are less irritant.

Sodium hydrogen carbonate (sodium bicarbonate) is used to control severe *metabolic acidosis* (as in renal failure). Since this condition is usually attended by sodium depletion, it is reasonable to correct this first by the administration of isotonic sodium chloride intravenous infusion, provided the kidneys are not primarily affected and the degree of acidosis is not so severe as to impair renal function. In these circumstances, isotonic sodium chloride alone is usually effective as it restores the ability of the kidneys to generate bicarbonate. In renal acidosis or in severe metabolic acidosis of any origin, for example blood pH < 7.1, sodium hydrogen carbonate (1.4%) may be infused with isotonic sodium chloride when the acidosis remains unresponsive to correction of anoxia or fluid depletion; a total volume of up to 6 litres (4 litres of sodium chloride and 2 litres of sodium hydrogen carbonate) may be necessary in the adult. In severe shock due for example to cardiac arrest, metabolic acidosis may develop without sodium depletion; in these circumstances sodium hydrogen carbonate is best given in a small volume of hypertonic solution (for example 50 ml of 8.4% solution intravenously); plasma pH should be monitored. Sodium hydrogen carbonate is also used in the emergency management of *hyperkalaemia*.

| GENERIC (TRADE) NAME | CAT. | INDICATION/DOSE |
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| Dextrose Inj 5% 500ml & 1000ml (Glucose) | EML | Fluid replacement: <i>By IV infusion</i> according to patient's requirements. |
| Dextrose Injection Prefilled Syringe 50% 5g/10ml, 50mls (Glucose) | EML | Hypoglycaemia: <i>By IV infusion</i> Adult up to 25ml as 50% solution, or preferably diluted in WFI to 10-20% solution and given into a large vein through a large gauge needle. |
| Ringers Lactate Solution (Hartmann's or Compound Sodium Lactate Inj) [Na = 131, K = 5, Ca = 2, Cl = 111, HCO ₃ = 29 mmol/L] | EML | Fluid replacement or surgical use: <i>By IV infusion</i> according to patient's requirements. Contains CaCl 0.027%, KCl 0.04%, NaCl 0.6% & sodium lactate 0.25%. |
| Sodium Bicarbonate Inj 8.4% 10ml [Na = 230mg/10ml = 10mmol/10ml = 10mEq/10ml] Sodium Bicarbonate Inj 8.4% 50ml [Na = 1150mg/50ml = 50mmol/50ml = 50mEq/50ml] | EML | Metabolic acidosis: <i>by slow IV inj</i> (undiluted) or <i>by cont IV infusion</i> (diluted in D5/NS), according to individual patient condition, usually 2-5 mmol/kg over 4-8 hours; in emergency e.g. cardiac arrest give initial dose of 1 mmol/kg (1 ml/kg of 8.4% solution) followed by not more than 0.5 mmol/kg every 10 minutes. |
| Sodium Chloride Inj 0.9% 10ml, 100ml & 500ml [Na = 9g/L = 154mmol/L = 154mEq/L] | EML | For reconstitution use, or fluid/ electrolytes replacement as required. |
| Water for injection, Sterile 10ml | EML | For reconstitution of injections as required. |

8.04 PLASMA SUBSTITUTES

WHO MODEL FORMULARY 2004 NOTES:

Dextran 70 and **polygeline** are macromolecular substances which are metabolized slowly; they may be used to expand and maintain blood volume in shock arising from conditions such as burns or septicaemia. They are rarely needed when shock is due to sodium and water depletion as, in these circumstances, the shock responds to water and electrolyte repletion. Plasma substitutes should not be used to maintain plasma volume in conditions such as burns or peritonitis where there is loss of plasma protein, water and electrolytes over periods of several days. In these situations, plasma or plasma protein fractions containing large amounts of albumin should be given. Plasma substitutes may be used as an immediate short-term measure to treat massive haemorrhage until blood is available, but large volumes of some plasma substitutes can increase the risk of bleeding by depleting coagulation factors. Dextran may interfere with blood group cross-matching or biochemical measurements and these should be carried out before the infusion is started.

[Mercy Ships note: Dextran 70 is not on the Mercy Ships list and gelatin is stocked in place of polygeline. Gelatin has similar activity to polygeline but please refer to the individual product literature for detail.]

| GENERIC (TRADE) NAME | CAT. | INDICATION/DOSE |
|---|------------|--|
| Gelatin 3.5% or 4% 500ml Inj (Haemaccel or Gelofusine) | <i>MSL</i> | Correction of low blood volume, <i>by IV infusion</i> , initially 500-1000 ml of a 3.5-4% solution. See product literature for detail. |

8.05 IRRIGATION SOLUTIONS

| GENERIC (TRADE) NAME | CAT. | INDICATION/DOSE |
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| Balanced Salt Solution for Eye Irrigation, 500ml & Eye Drops, 18ml (BSS & BSS Plus) | D-eye drop | For intra-ocular and topical eye irrigation during surgical procedures. See product literature for detail. |
| Sodium Chloride 0.9% for Irrigation 1000ml | <i>MSL</i> | For irrigation use. |
| Water for Irrigation 1000ml | | For irrigation use. |