**Fluids and Electrolytes**

Composition of body fluid compartments

- Adult body weight 60% water
  - 75% as neonate
  - 50% at 80 yrs
- Of this 60%
  - 40% intracellular fluid
  - 20% extracellular fluid
  - 15% interstitial fluid
  - 5% plasma

- Circulating Blood Volume (plasma + cells)
  7mls/kg=5000mls

IV fluids are given in order to:

1. Defend normal blood pressure: reduced ECF volume with haemodynamic collapse can be due to blood loss, decreased vasomotor tone as with medications, or third space loss into the interstitium due to sepsis, pancreatitis.

Developing haemodynamic collapse is treated with isotonic 0.9% sodium chloride given in 500ml-1000ml bolus (10mg/kg) and may be repeated, guided by the cardiovascular response.

2. Maintain ICF volume and Na concentration.
   All infused Na remains in the ECF, thus infused 0.9% sodium chloride expands the ECF. Water transfer across cell membranes keeps osmotic equilibrium.
   Water without Na (eg 5% dextrose after glucose metabolised) expands Total Body Water, 2/3 to ICF and 1/3 to ECF.
   Many hospitalised patients have elevated vasopressin due to pain, stress and illness. Isotonic 0.9% sodium chloride may be more appropriate for these patients.

3. Replace renal and insensible losses
IV Fluids need to be individualised

These guidelines are for most adult patients who have already been "fluid resuscitated" ie had their hypovolemia corrected and have normal cardiac and renal function (see below)

1. Assess current fluid status. Is the patient fluid overloaded, dry or euvolaemic
2. Review fluid balance chart and check daily weight
3. Monitor EUC
4. Assess ongoing fluid requirements and losses.
5. Switch to the oral route as soon as possible.
6. Reassess at least daily, depending on the stability of the patient

See table 1 for the current fluid solutions commonly used for IV fluid maintenance therapy.
See figure 1 for the current bedside IV fluid therapy chart.

Typical daily needs of an ADULT
A “standard” 70 kg patient, who is NBM, euvolaemic, not septic, has normal cardiac and renal function, and no additional ongoing fluid losses might reasonably have:

**basal fluid requirements**
- 1st 10 kg (body weight) 4mls/kg/hr
- 2nd 10 kg 2mls/kg/hr
- above 20 1 ml/kg/hr

70 kg is 2640mls/day
50kg is 2400mls/day
Average adult 2.5L/day (approx 40mls/kg)
= 100-120mls/hr (1000mls/10hrs or 1000mls/8hrs)

**electrolyte requirements**
- Na+ 2 mmol/kg/day =150mmol/L/day
- K+ 1mmol/kg/day =70 mmol/day

2 Fluids & Electrolytes
IV fluids must be tailored to the individual
Daily needs can be met, for example, with 1 litre of Normal saline and 2 litres of 5% Dextrose with premixed 30mmol KCL at 120mls/hr. Another approximation of daily requirements is met by 3 litres of 4% D+N/5 Saline using 2 premixed bags with 30mmol KCL added.

**Special Considerations**

- Smaller patients (weight < 50kg)
  - 2 litres of fluid per day is likely to be adequate.

- Reduced left ventricular function
  - The patient is at increased risk of fluid overload. Reduce volume given and monitor fluid status more frequently.

- Reduced renal function
  - In general, use no potassium and limit the volume given. Assess urine volume and give approximately: Urine vol + Other losses +500ml per day. If in doubt, seek advice.

Medications that increase potassium (eg. ACE inhibitors, Angiotensin II antagonists, spironolactone)

**Fluids & Electrolytes**

<table>
<thead>
<tr>
<th>fluid</th>
<th>dextrose</th>
<th>4% Dextrose 0.18% NaCl with 30mmol KCL</th>
<th>4% Dextrose N/5 saline</th>
<th>0.9% sodium chloride Normal saline</th>
</tr>
</thead>
<tbody>
<tr>
<td>glucose</td>
<td>50g</td>
<td>840kcal</td>
<td>40g</td>
<td>0</td>
</tr>
<tr>
<td>Na mmol</td>
<td>30</td>
<td>60</td>
<td>30 Na 60 Cl</td>
<td>150</td>
</tr>
<tr>
<td>K mmol</td>
<td>0</td>
<td>0</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Osmol</td>
<td>278</td>
<td>265</td>
<td>300</td>
<td>300</td>
</tr>
</tbody>
</table>

Formatted Table

No bullets or numbering
• Patients are at increased risk of hyperkalaemia. Monitor potassium levels more frequently.

Elderly patients (> 65 years)
• May have reduced cardiac and/or renal function. Give 2 litres per day and monitor frequently.

Obese
• Estimate fluid requirements and electrolyte doses based on lean body weight.

Special circumstances
• Septic patients have increased fluid requirements which vary from patient to patient.
• Postoperative patients, patients with severe nausea, vomiting, pain and stress, and young women may have increased levels of ADH. Fluids with a sodium concentration similar to plasma (such as 0.9% sodium chloride) may be more appropriate for such patients. For management of sodium disturbances refer to section heading Renal.
• Patients on dialysis, with burns, transplants, diabetic ketoacidosis or hyperosmolar coma have very specific fluid requirements. Refer to appropriate section heading

If you are not experienced with management of any of the above patients, please seek advice. Specialist Units have specific protocols for electrolyte disturbances and fluid therapy and these take precedence over the guidelines here.

Assessment of Hypovolemia
• Degree may be estimated from history and signs including: thirst, dry mucous membranes tachycardia, hypotension or postural drop, and low urine output.
• Management: Estimate the amount of deficit. Correct with a clinically appropriate replacement fluid such as 0.9% sodium chloride,
• unless cardiovascular compromise developing, administer replacement fluids approximately half over 8 hours and the
second half over 16 hours. If the patient has poor cardiac reserve, reduce the rate to half over 12 hours and the second half over 24 hours.

**Assessment of Fluid Overload**
- Signs include: increased daily weight, raised JVP, peripheral oedema, and overt LVF
- Management: Minimise fluid given, consider diuretic.
- In acute pulmonary oedema patients sit forward, sweaty, dyspnoeic, hypoxic, with crackles, and typical oedema on CXR. These patients need the usual treatment with upright positioning, frusemide, high flow O2, NIV.
- Hypotension with signs of overload- need urgent referral to a senior medical officer

**Ongoing fluid losses**
- Management: Estimate ongoing volume losses including vomiting, diarrhoea, nasogastric drainage and 3rd space losses, eg. with ileus. These should be added to the volume given daily. The type of fluid to use depends on the source of loss. Physiological losses should be replaced with maintenance fluid and pathological losses with replacement fluid such as 0.9% sodium chloride.

**Guidelines for the administration of Potassium K+**
Wherever possible use large volume fluids with preloaded KCL to avoid dangerous administration errors
- All potassium containing infusions must be given via an infusion pump.
- Maximum RATE: should not exceed 10mmol/hr Maximum concentration is 40mmol/L peripherally to prevent phlebitis unless use the isotonic, premixed potassium chloride 10mmol/100mL minibags (commercially pre-made) can be given peripherally. Minibags must be given via an infusion pump.
• Urgent replacement of 20mmol/l requires ECG monitoring in an HDU and administration through a large vein with high blood flow (eg. CVC)

• In renal failure including early AKI due to dehydration or shock do not replenish potassium until renal function is re-established and monitor EUC.

• Oral replacement can be utilised using sustained release KCL tabs 600mg=8mmol
  • Using up to 6 tabs daily

• Below 3.0 mmol/l usually requires intravenous replacement, usually requiring 60mmol or more over 24 hrs and requires repeat levels 4 hrs after starting treatment
<table>
<thead>
<tr>
<th></th>
<th>Plasma Bicarb</th>
<th>Hartmann's (compound sodium lactate)</th>
<th>Normal Saline (Sodium Chloride 0.9%)</th>
<th>3% Glucose 6.25% Sodium Chloride</th>
<th>5% Glucose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium (mmol/L)</td>
<td>140</td>
<td>129</td>
<td>150</td>
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<tr>
<td>Potassium (mmol/L)</td>
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<td>Magnesium (mmol/L)</td>
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<td>0</td>
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<tr>
<td>Osmolality (mOsm)</td>
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<td>274</td>
<td>300</td>
<td>282</td>
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<tr>
<td>Calcium (mmol/L)</td>
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<td>0</td>
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<tr>
<td>Lactate (mmol/L)</td>
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<td>29</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Glucose (mmol/L)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>222</td>
<td>278</td>
</tr>
</tbody>
</table>
Guidelines for Adult Intravenous Fluid Therapy

**ASSESS THE PATIENT**

1. **ABCD**
   - Assessment: Is the patient Hypovolaemic, Euvolaemic or Hypervolaemic?
   - Consider what is normal for the patient!
     - **HYPOVOLEMA**
       - Systolic BP < 90mmHg
     - Warm hands & feet
     - Capillary return = < 2sec
     - Urine output = < 0.5ml/kg/hr
   - **EUVOLAEMIA**
     - BP & Hb normal
     - Warm hands & feet
     - Urine output = > 0.5ml/kg/hr
   - **HYPERVOLAEMIA**
     - Peripheral oedema
     - Pulmonary oedema
     - Enlarged BP

2. **RESUSCITATE**
   - Replace Onging Losses
     - **MAINTENANCE**
       - Fluid 
       - Electrolytes

3. **FLUID REQUIMENTS**
   - **RESUSCITATE** if intravascular hypovolaemia is present.
     - Large IV boluses
     - Ringer’s lactate 1000ml, 5% albumin 250ml, of suitable replacement fluid
     - Fluids: 0.9% saline, intravenous fluids, isotonic saline
     - Intravenous fluid therapy
     - Intravenous fluid therapy
     - Intravenous fluid therapy

4. **REVIEW**
   - ABCDE**
     - Assessment: Is the patient Hypovolaemic, Euvolaemic or Hypervolaemic?
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     - Intravenous fluid therapy
     - Intravenous fluid therapy

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     - Intravenous fluid therapy
     - Intravenous fluid therapy

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     - **HYPERVOLAEMIA**
       - Peripheral oedema
       - Pulmonary oedema
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8. **FLUIDS & ELECTROLYTES**
   - **RESUSCITATE** if intravascular hypovolaemia is present.
     - Large IV boluses
     - Ringer’s lactate 1000ml, 5% albumin 250ml, of suitable replacement fluid
     - Intravenous fluid therapy
     - Intravenous fluid therapy

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     - Assessment: Is the patient Hypovolaemic, Euvolaemic or Hypervolaemic?
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     - Warm hands & feet
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          - Pulmonary oedema
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        - Assessment: Is the patient Hypovolaemic, Euvolaemic or Hypervolaemic?
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        - Urine output = < 0.5ml/kg/hr
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          - Pulmonary oedema
          - Enlarged BP

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        - Urine output = < 0.5ml/kg/hr
        - **HYPOVOLEMA**
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          - Pulmonary oedema
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