<table>
<thead>
<tr>
<th>Electrolyte Imbalance</th>
<th>Etiology/Pathophysiology</th>
<th>Clinical Manifestations</th>
<th>Treatment/Management</th>
</tr>
</thead>
</table>
| **Hyperkalemia** >5.0mEq/L | Renal failure  
Over replacement/increased intake  
Cellular damage/lysis  
Spironolactone | Bradycardia  
Tremors  
Twitching  
Nausea/vomiting  
Tall peaked T waves | Dialysis  
Kaexylate  
Insulin/D50  
CaCl  
Albuterol/Mucamyst  
HCO3, CA |
| **Hypokalemia** <3.5 mEq/L | Renal loss-diuretic, RTA  
Inadequate intake  
GI loss – vomit/diarrhea  
Meds-  
Gent/ampho/steroids  
Cirrhosis  
CHF  
Burns  
Extracellular shift (alkalosis/insulin admin) | Tachycardia  
Hypotension  
Flaccid muscles  
Muscle cramping  
Anorexia  
Nausea/vomiting  
Flat T waves  
U wave  
V arrhythmias | Replete KCL  
Oral route preferred  
IV – 20meq/hr  
Treat cause |
| **Hypercalcemia** >10.2 mg/dl | Bone destruction or loss –  
Pagets disease  
Hyperparathyroidism  
Excessive intake Vit D  
Hypophosphatemia  
Decreased excretion | Short ST/QT  
Flaccid muscles  
Nausea/vomiting  
Bone pain  
Decreased DTRs  
Lethargy to Coma | Phosphate – PO or IV  
Diuretics  
Fluids  
Corticosteroids  
Mithramycin |
| **Hypocalcemia** <8.4 mg/dl | Low albumin  
Blood transfusion(citrate)  
Malabsorption  
Acute Pancreatitis  
Vit D deficiency  
Liver disease  
Cushings syndrome  
Alkalosis  
Diuretic therapy  
ARF/CRF  
Hypoparathyroidism  
Hypomagnesemia | Flat ST  
Small T wave  
Long QT interval  
Hypotension  
Decreased CO  
Bruiising/bleeding  
Tetany/seizure  
Muscle cramps  
Laryngeal spasm  
Confusion | Replete – PO preferred  
Ca Gluconate – 10-20ml  
over 5-10minutes  
Improve nutrition/albunin  
Vitamin D supplements  
Phosphate binders  
Monitor neuro & cardiac Status |
| **Hyperphosphatemia** >4.7 mg/dl | ARF/CRF  
Increased intake  
Chemo  
Lactic acidosis | Asymptomatic  
See hypocalcemia | Treat cause  
Phosphate binders  
Correct hypocalcemia  
Dialysis  
IV Fluids |
| **Hypophosphatemia** <2.5 mg/dl | ARDS  
Refeeding syndrome  
Low Mg/Ca  
ETOH | Muscle weakness  
Respiratory distress  
Decreased LOC | Treat cause  
Replete Phosphorous –  
PO or IV slowly to avoid low CA |
<table>
<thead>
<tr>
<th>Magnesium Imbalance</th>
<th>Signs</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hypermagnesemia &gt;1.95 mEq/l</strong></td>
<td>Renal failure, Adrenal insufficiency, Magnesium antacids, ARF/CRF, Hypoparathyroidism, Hypoaldosteronism</td>
<td>Bradycardia, Hypotension, Hypoactive reflexes, CNS depression, Resp depression, Flushing</td>
</tr>
<tr>
<td>Rare</td>
<td>Intracellular to extracellular shift (ketoacidosis, burns, rhabdomylosis)</td>
<td></td>
</tr>
<tr>
<td><strong>Hypomagnesemia &lt;1.5 mEq/l</strong></td>
<td>Inadequate intake (starvation/ETOH), CRF, Pancreatitis, Cirrhosis, GI losses/impaired absorption, Treatment of DKA</td>
<td>ST depression, T wave inversion, PR/QT prolong, Increased reflexes, Irritability, Tachycardia, Low K Ca Ph</td>
</tr>
<tr>
<td>Common</td>
<td></td>
<td></td>
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<tr>
<td><strong>Hypernatremia &gt;145 mEq/l</strong></td>
<td>Fluid loss, Inadequate intake, DI</td>
<td>Tachycardia, Hypotension, Muscle weakness, Thirst, CNS depression</td>
</tr>
<tr>
<td><strong>Hyponatremia &lt;135 mEq/l</strong></td>
<td>Overhydration, Decreased intake, Increased excretion (burns, GI losses, renal loses, CHF), SIADH</td>
<td>Edema, Mental status change, Headache, Muscle cramps, Fatigue, Progresses to coma and seizures</td>
</tr>
</tbody>
</table>
Sodium and Water Imbalances

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<th>Manifestations</th>
<th>Treatment</th>
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<tr>
<td>Sodium 135-145 mEq/L</td>
<td>Maintain extracellular fluid balance</td>
<td>Imbalance = fluid shifts, edema or dehydration</td>
<td></td>
</tr>
<tr>
<td>Hypernatremia</td>
<td>Total body water decrease, DI (no ADH response), Insensible losses without replacement of water</td>
<td>Thirst, CNS depression</td>
<td>Water replacement ADH for DI</td>
</tr>
<tr>
<td>Hyponatremia</td>
<td>Water ingestion &gt;25l/d, Renal diluting defect, Post op fluid admin, Non osmotic ADH release, Drugs – NSAIDS Oxytocin</td>
<td>Edema</td>
<td>Water restriction, Sodium replacement</td>
</tr>
</tbody>
</table>

| Mild Na <120         | Asymptomatic                                                             | Treat the cause                   |                                |
| Moderate Na <115     | CNS depression                                                           | Replete with NS Fluid restriction <1000cc/day |                                |
| Severe Na <110       | Coma, seizures, death                                                   | Replete with NS or hypertonic NS 3% Do not increase serum Na by more than 1mEq/l/h or 10 mEqL/day |                                |

Osmolality = 2 x Na + Glu / 18 = BUN / 2.8

Blood osmolality normally 280-300 mOsm/kg H2)

Free water deficit = (kg x 0.6) x \{(Na/140) – 1 \}