Organ Perfusion & Hormonal Replacement Guidelines:

**Goals:**
- Normal HR, SBP: (see chart below)
- Urinary output of 1-3 cc/kg/hr
- CVP 6-10 mmHg

<table>
<thead>
<tr>
<th></th>
<th>Kg/lb</th>
<th>Minimum Systolic BP</th>
<th>Normal Heart Rates</th>
<th>Normal Resp. Rates</th>
<th>ET Tube Size</th>
<th>Fluid Challenge (20 mL/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Premature</strong></td>
<td>&lt; 2.5/5.5</td>
<td>40</td>
<td>120-170</td>
<td>40-60</td>
<td>2.5-3.0</td>
<td>&lt; 50</td>
</tr>
<tr>
<td><strong>Term</strong></td>
<td>3.5/7.7</td>
<td>50</td>
<td>100-170</td>
<td>40-60</td>
<td>3.0-3.5</td>
<td>70</td>
</tr>
<tr>
<td><strong>3 months</strong></td>
<td>6/13.2</td>
<td>50</td>
<td>100-170</td>
<td>30-50</td>
<td>3.5</td>
<td>120</td>
</tr>
<tr>
<td><strong>6 months</strong></td>
<td>8/17.6</td>
<td>60</td>
<td>100-170</td>
<td>30-50</td>
<td>4.0</td>
<td>160</td>
</tr>
<tr>
<td><strong>1 year</strong></td>
<td>10/22</td>
<td>65</td>
<td>100-170</td>
<td>30-40</td>
<td>4.0</td>
<td>200</td>
</tr>
<tr>
<td><strong>2 years</strong></td>
<td>13/28.6</td>
<td>65</td>
<td>100-160</td>
<td>20-30</td>
<td>4.5</td>
<td>260</td>
</tr>
<tr>
<td><strong>4 years</strong></td>
<td>15/33</td>
<td>70</td>
<td>80-130</td>
<td>20</td>
<td>5.0</td>
<td>300</td>
</tr>
<tr>
<td><strong>6 years</strong></td>
<td>20/44</td>
<td>75</td>
<td>70-115</td>
<td>16</td>
<td>5.5</td>
<td>400</td>
</tr>
<tr>
<td><strong>8 years</strong></td>
<td>25/55</td>
<td>80</td>
<td>70-110</td>
<td>16</td>
<td>6.0</td>
<td>500</td>
</tr>
<tr>
<td><strong>10 years</strong></td>
<td>30/66</td>
<td>85</td>
<td>60-105</td>
<td>16</td>
<td>6.5</td>
<td>600</td>
</tr>
<tr>
<td><strong>12 years</strong></td>
<td>40/88</td>
<td>90</td>
<td>60-100</td>
<td>16</td>
<td>7.0</td>
<td>800</td>
</tr>
</tbody>
</table>

**Assessment:**
- Continuous arterial pressure monitoring
- Continuous ECG monitoring
- Hourly CVP recording if available
- Hourly urine output
- Urine specific gravity at initiation of donor management and consider with the suspicion of DI

**Interventions:**
- Consult pediatric intensivist/medical director
Hypotension:

- Assess for excessive fluid losses above intake:
  - Output > intake and urine output < 1 mL/kg/hr
  - If polyuria present, refer to DI Prevention/Treatment Guideline
- Evaluate for evidence of recent blood loss:
  - Confirm that the most recent Hct is > 30%
  - Reaffirm w/ an immediate repeat Hct and treat per Hematology Guidelines
- Initiate intervention for signs of continued hemorrhage (i.e., external, GI, urinary, abdominal): consult intensivist
- Assess recent CVP
- Assess for ECG changes:
  - Repeat ECG and maintain at bedside
  - Consult MD for interpretation
- Assess for evidence of ongoing severe infection, drug or other allergic reactions (i.e., due to blood transfusion), pericardial effusion, or hemo/pneumothorax:
  - Obtain a chest radiograph
  - Consult MD for interpretation
- Discontinue medications that may contribute to hypotension (i.e., anti-hypertensives, beta-blockers)
- Correct intravascular volume (pre-load) = CVP > 6. **Note:** Take into account fluid and electrolyte status, refer to Fluid Balance and Electrolytes Guideline
  - Start a fluid bolus of LR or 0.9% NS at 20 mL/kg, reassess, repeat x 2 if needed: consult intensivist/medical director
  - Colloid solutions may be preferred for repeated fluid challenges (5% albumin: 20 mL/kg)
  - Maintain CVP = 6-10
- Levophed (Norepinephrine) Infusion: 0.05-2 mcg/kg/min (do not exceed 2 mcg/kg/min) if so then add:
  - Phenylephrine infusion start at 0.1-0.5 mcg/kg/min and titrate up to maintain minimum acceptable blood pressure, maximum dose of 0.5 mcg/kg/min
  - Solumedrol 15 mg/kg IV over 30-60 minutes (consider repeat every 12 hrs if already given)
  - Consider Dopamine 2-20 mcg/kg/min
  - Consider Epinephrine Infusion: dose 0.1-1 mcg/kg/min
  - Consider Vasopressin Infusion: 0.3-2 milliunits/kg/min if urine output > 1 ml/kg/hr
    - **Consult pediatric intensivist, medical director, or transplant surgeon if higher doses of vasoactive agents are required**
  - For a low EF (<45%), a positive inotropic agent (i.e., milrinone) should be used: consult intensivist/medical director
    - Milrinone: dose 0.25-0.75 mcg/kg/min (no bolus, watch for vasodilation, may need alpha agonist agent)
    - Dopamine: dose 2-20 mcg/kg/min
    - Dobutamine: dose 2-20 mcg/kg/min
- Reassess: Hct, Electrolytes, and pH for correctable causes of hypotension (acidosis, anemia, and hypocalcemia should be reversed)
- Consider Hormone Replacement Therapy, refer to section Hormone Replacement Therapy

Hormone Replacement Therapy:

**Goals:**

- Improvement in cardiovascular lability
- Reduction in electrocardiographic abnormalities
- Reduction in acid-base disturbances
- Improvement in the suitability of organs for transplantation
**Assessment:**
- Reserve hormone replacement therapy for:
  - Unstable donors requiring dopamine at a dose of more than 10 mcg/kg/min or multiple pressors
  - An ejection fraction < 45% (serial echocardiograms after hormone replacement – recommended)

**Intervention:**
- Correct K+ > 3.5
- Correct CVP > 6
- Add 200 mcg T4 to 500 cc D5W or NS
- Give in sequential order:
  - Dextrose 200 mg/kg for infant/neonate or 1 gm/kg for child
  - 0.1 unit/kg Regular Insulin
  - 30 mg/kg Solumedrol over 30-60 minutes
  - T4 bolus then start infusion according to tables below:

<table>
<thead>
<tr>
<th>T4 (levothyroxine) bolus</th>
<th>T4 (levothyroxine) infusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>mcg/kg</td>
</tr>
<tr>
<td>0-6 mo</td>
<td>5</td>
</tr>
<tr>
<td>6-12 mo</td>
<td>4</td>
</tr>
<tr>
<td>1-5 yr</td>
<td>3</td>
</tr>
<tr>
<td>6-12 yr</td>
<td>2.5</td>
</tr>
</tbody>
</table>

- Wean vasoactive agents as able
- Wean T4 or DC for persistent tachycardia outside acceptable normal, or hemodynamic instability

**Dysrhythmia:**
- Obtain a 12 lead ECG (STAT)
- Send STAT electrolytes including Ca, Mg, and Phos
- Supraventricular Tachycardia:
  - Administer Adenosine 100 mcg/kg rapid IV push for clinically significant (symptomatic BP or HR > 200. Consider fluid status and oxygenation. If no effect within 2 minutes, repeat at 200 mcg/kg (max single dose = 12 mg)
  - If no response within 2 minutes, consider Amiodarone 5 mg/kg infused over 5-60 minutes, may repeat dose of 5 mg/kg, then infusion at 5-15 mcg/kg/min. Monitor for hypotension: consult w/ pediatric intensivist/cardiac transplant physician/medical director prior to administering Amiodarone
- Other Cardiac Arrhythmias:
  - Consult with pediatric intensivist/medical director for treatment recommendations

**Fluid Balance, Glucose & Electrolyte Guidelines:**

**Goals:**
- Serum Na+, K+, Cl-, Mg, Ca, and Phos within normal values
- Urinary output of 1-3 cc/kg/hr
- Serum glucose 90-150 mg/dL

**Assessment:**
- Serum electrolyte panels every 6 hrs (if patient on an insulin drip, check blood glucose every 1 hr and serum K+ every 2 hrs)
- Serum K+, Ca+, Mg and Phos at initiation of management and following replacement (ideally correct to within normal limits prior to echocardiogram)
- Consider eliminating dextrose if there are current or potential concerns about hyperglycemia
• **Hypoglycemia:**
  For serum glucose < 60 mg/dL give 2 ml/kg of D10; repeat glucose check in 1 hr
  
  **Consult pediatric intensivist/medical director**

**IV Fluids:**

- Administer maintenance IV fluids at a rate of:
  - 4 mL/kg for 1st 10 kg, then
  - 2 mL/kg for 2nd 10 kg, then
  - 1 mL/kg for every kg in weight thereafter

- Goal: to achieve output of 1-3 cc/kg/hr and CVP 6-8 mmHg after initial fluid resuscitation

**Oliguria/Polyuria:**

- Check urine specific gravity if urine output increases or color is pale
- Administer DDAVP if urinary output > 5 cc/kg/hr and specific gravity is 1.005 or less AND/OR serum sodium is rising:
  - Infuse 0.5 mcg/hr IV
  - Titrate to decrease UO to 3-4 mL/kg/hr
  - **Do not give within 4 hours of the OR**

- Consider Vasopressin Drip: give 0.5-1 milli-units/kg/hr IV and titrate to decrease UO to 3-4 mL/kg/hr

  Treatment of diabetes insipidus should consist of pharmacologic management to decrease but not completely stop urine output. Replacement of urine output with ¼ or ½ normal saline should be used in conjunction with pharmacologic agent to maintain serum sodium levels between 130-150 mEq/L.

- Administer Lasix 1 mg/kg IV push (max dose 20 mg) if urinary output < 1cc/kg/hr and SBP > minimum for age or CVP > 8

**Hypernatremia:**

<table>
<thead>
<tr>
<th>Serum Sodium</th>
<th>Fluid Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 130</td>
<td>D5% NS</td>
</tr>
<tr>
<td>131-140</td>
<td>D5% ½ NS</td>
</tr>
<tr>
<td>141-155</td>
<td>D5% ¼ NS</td>
</tr>
<tr>
<td>156 or greater</td>
<td>Institute hypernatremia protocol</td>
</tr>
</tbody>
</table>

- **Hypernatremia Protocol:**
  - Calculate Fluid Volume Deficit:
    - Current Na-Desired Na/Current Na x 1000mL/L x 0.6L/kg of body weight = mL/kg
    - Desired Na is usually 145 unless otherwise directed by pediatric intensivist/medical director
  - Replace 1/2 of fluid volume deficit with 0.25% NS over 2-3 hrs (or more rapidly if the donor is hypotensive), then reassess serum sodium. If Na+ remains > 156 or not trending lower, consider repeating protocol or contact accepting liver program for guidance
  - **Consult pediatric intensivist/medical director**

**Hypokalemia:**

- **Note:** Albuterol, Lasix, insulin, and hypothermia may depress K+ level: correct as necessary
- Administer KCl (adjust in cases of oliguria or polyuria)
- Recheck serum potassium 3 hrs after replacement complete

<table>
<thead>
<tr>
<th>Serum Potassium</th>
<th>KCL Replacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>K &lt; 3.5</td>
<td>0.1-0.2 mEq/kg/hr (max rate 0.5 mEq/kg/hr)</td>
</tr>
</tbody>
</table>
**Hyperkalemia:**
- Consider possible causes (renal failure, excess administration of potassium)
- Remove all K+ from IV fluids
- Consider giving Lasix for diuresis (if fluid status is stable)
- Consider administration of dextrose, insulin, and sodium bicarbonate: consult with intensivist
- Re-check levels 30 minutes after every dose and replace appropriately

**Hypomagnesemia:**

<table>
<thead>
<tr>
<th>Serum Magnesium</th>
<th>MgSO4 Replacement (max dose 2 gms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mg &lt; 2.0</td>
<td>25 mg/kg (infuse at 100 mg/min)</td>
</tr>
</tbody>
</table>

**Hypocalcemia:**
- Assess via serum ionized calcium level

<table>
<thead>
<tr>
<th>Serum ionized calcium</th>
<th>Calcium replacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca &lt; 1.2</td>
<td>10-20 mg/kg of calcium chloride per central line</td>
</tr>
<tr>
<td>Ca &lt; 1.2</td>
<td>20-40 mg/kg of calcium gluconate</td>
</tr>
</tbody>
</table>

**Hypophosphatemia:**
- Note: For renal insufficiency or creatinine clearance < 20, reduce replacement dosing by 50%

<table>
<thead>
<tr>
<th>Serum Phosphorus</th>
<th>NaPO4 or KPO4 Replacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.5 mg/dL</td>
<td>Give 0.2 mmol/kg IV over 4-6 hrs</td>
</tr>
</tbody>
</table>

**Hematology Guidelines:**

**Goals:**
- Hematocrit > 30%
- Platelet count > 20,000
- PT < 15 and PTT < 38

**Assessment:**
- Obtain CBC, PT/PTT/INR at the beginning of donor management and perform a physical assessment ASAP in trauma cases where active bleeding may be a concern

**Interventions:**

<table>
<thead>
<tr>
<th>Serum Blood Counts</th>
<th>Serum Blood Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hct &lt; 30</td>
<td>Consider: 10-15 mL/kg of PRBC</td>
</tr>
<tr>
<td>Platelets &lt; 20,000</td>
<td>consult liver transplant surgeon prior to infusion of any platelets</td>
</tr>
<tr>
<td>PT &gt; 15, PTT &gt; 38</td>
<td>Consider: 10-15 mL/kg FFP</td>
</tr>
</tbody>
</table>

- Consider Vitamin K if persistently elevated PT: consult with pediatric intensivist/medical director
- Recheck labs 1 hr after infusion and give additional treatments if necessary
- Keep 2 units PRBCs ahead
- If donor received blood transfusions prior to IDS arrival or there is active bleeding, keep 4 units ahead
- If donor exhibits consumption or dilutional coagulopathies and is not actively bleeding, treatment may not be necessary
- Note: Treatment is reserved for donors who appear to have continuing significant blood loss evidenced by: physical assessment, hemodynamic instability, changes in coagulation parameters
**Oxygenation & Ventilation Guidelines:**

**Goals:**
- Continuous SaO2 > 95%, PaO2 >100 torr, pH 7.35-7.45, pCO2 30-50, FiO2 40%, PEEP 5

**Assessment:**
- Continuous SaO2 oximetry monitoring
- ABG every 6 hrs (every 4 hrs if possible on potential lung donor), and 30 minutes after each ventilation adjustment and w/ any apparent change in function
  - Note: During active placement of lungs do ABGs every 3 hrs
- Peak inspiratory pressures with ABG (if possible lung donor)
- CXR on initiation of management (and every 4-6 hrs if possible on potential lung donor)
  - Note: CXR must be read by an MD: **consultation w/ MD should be a priority**
- For suspected pulmonary contusion, effusion, or COPD changes consider High Resolution Chest CT

**Oxygenation:**
- Consider therapeutic bronchoscopy: **consult with pediatric pulmonologist, if:**
  - An O2 ABG challenge has a PO2 with < 350 torr
  - Donor has clinical evidence of aspiration
  - Suspected mucous plugs
  - Upon center request
  - Heavy oropharyngeal bleeding or drainage
- Use bronchodilator every 4 hrs as recommended by pediatric pulmonologist/intensivist
- **Consider Open Lung Recruitment** (if evidence of atelectasis AND hemodynamically stable)

**Ventilation:**
- Adjust tidal volume and ventilation rate (see previous section) to maintain pCO2 between 30-50 torr
- After adjusting minute ventilation, administer NaHCO3 1 mEq/kg IV to correct acidosis (**hypernatremia** can be aggravated with repeat dosing), recheck ABG
- For extreme metabolic acidosis and high vasoactive requirement, ensure adequate fluid resuscitation has been given and then consider THAM (tromethamine) administration:
  - Base deficit x wt(kg) = mLs of 0.3 molar solution of THAM
- **Consult with pediatric intensivist for recommended best ventilator support**

**Atelectasis:**
- In cases with persistent or segmental atelectasis (by CXR) consider increasing PEEP
- Consider bronchoscopy in cases of segmental atelectasis: **consult pediatric pulmonologist/intensivist**

**Infiltrate:**
- Consider aggressive diuresis
- Consider repeat Solumedrol if last dose > 12 hrs
- If there are effusions present, consult for consideration of a chest tube
- Chest PT and suction
- Utilize HFCWO Vest whenever possible (20 minute cycle with a 1 hr 40 minute rest); do not draw ABG within 30 minutes of vest cycle, or during percussion

**Note:** If considering single lung transplant only – position good lung up.
Temperature Guidelines:

Goals:
- Temperature: 96.8-98.6° F or 36-37° C

Assessment:
- Monitor temperature every 2 hrs

Hypothermia:
- Apply external warming blankets, or heating devices; adjust room temperature to (76° F or 24° C)
- Adjust inspired air temperature on ventilator circuit between (90-98.6° F or 32-37° C)
- Administer all fluids and/or blood products via warming device
- Perform warmed NG lavage if temperature is less than (93.2° F or 34° C)

Infection Guidelines:

Goals:
- Prevention and treatment of common nosocomial infections

Assessment:
- Blood, urine and sputum cultures obtained at initiation of management
- Sputum gram stain (on all possible lung donors)

Interventions:
- If already on antibiotics:
  - Maintain current antibiotic regimen (based off culture sensitivity)
- If not on antibiotics:
  - Administer cefazolin 25 mg/kg IV (max 2000 mg) every 8 hrs (after cultures obtained)
  - If potential lung donor: Administer ceftazidime 50 mg/kg IV (max 2000 mg) every 8 hrs (after cultures obtained) instead of cefazolin
- Consult with pediatric intensivist or pharmacist for recommendation of antibiotics to cover unit specific organisms

Miscellaneous Guidelines:

- Spinal Reflexes:
  - If spinal reflexes are present, and may cause discomfort to the donor family and/or medical staff, attempt to explain the cause and effect of such reflexes
  - If explanations are not sufficient, consult with pediatric intensivist/medical director