PALS Algorithms

1. PALS Systematic Approach Algorithm
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6. Pediatric Cardiac Arrest Algorithm
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8. Pediatric Tachycardia With a Pulse and Adequate Perfusion Algorithm
9. Pediatric Tachycardia With a Pulse and Poor Perfusion Algorithm
10. Pediatric Postresuscitation Care
PALS Systematic Approach Algorithm

The PALS Systematic Approach Algorithm outlines the approach to caring for a critically ill or injured child.

Initial Impression
(consciousness, breathing, color)

Is child unresponsive with no breathing or only gasping?

Yes
Shout for Help/
Activate Emergency Response
(as appropriate for setting)

Is there a pulse?

Yes
Open airway and begin ventilation
and oxygen as available

No

Is the pulse <60/min with
poor perfusion despite
oxygenation and ventilation?

Yes
Start CPR
(C-A-B)

If at any time you identify cardiac arrest

No
Go to
Pediatric Cardiac Arrest
Algorithm

After ROSC, begin Evaluate-Identify-Intervene
sequence (right column)

Evaluate
- Primary assessment
- Secondary assessment
- Diagnostic tests

Intervene

Identify

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### Management of Shock Flowchart

#### Hypovolemic Shock
**Specific Management for Selected Conditions**

<table>
<thead>
<tr>
<th>Nonhemorrhagic</th>
<th>Hemorrhagic</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 20 mL/kg NS/LR bolus, repeat as needed&lt;br&gt;• Consider colloid</td>
<td>• Control external bleeding&lt;br&gt;• 20 mL/kg NS/LR bolus, repeat 2 or 3× as needed&lt;br&gt;• Transfuse PRBCs as indicated</td>
</tr>
</tbody>
</table>

#### Distributive Shock
**Specific Management for Selected Conditions**

<table>
<thead>
<tr>
<th>Septic</th>
<th>Anaphylactic</th>
<th>Neurogenic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Algorithm:&lt;br&gt;• Septic Shock</td>
<td>• IM epinephrine (or autoinjector)&lt;br&gt;• Fluid boluses (20 mL/kg NS/LR)&lt;br&gt;• Albuterol&lt;br&gt;• Antihistamines, corticosteroids&lt;br&gt;• Epinephrine infusion</td>
<td>• 20 mL/kg NS/LR bolus, repeat PRN&lt;br&gt;• Vasopressor</td>
</tr>
</tbody>
</table>

#### Cardiogenic Shock
**Specific Management for Selected Conditions**

<table>
<thead>
<tr>
<th>Bradyarrhythmia/Tachyarrhythmia</th>
<th>Other (e.g., CHD, Myocarditis, Cardiomyopathy, Poisoning)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Algorithms:&lt;br&gt;• Bradycardia&lt;br&gt;• Tachycardia With Poor Perfusion</td>
<td>• 5 to 10 mL/kg NS/LR bolus, repeat PRN&lt;br&gt;• Vasoactive infusion&lt;br&gt;• Consider expert consultation</td>
</tr>
</tbody>
</table>

#### Obstructive Shock
**Specific Management for Selected Conditions**

<table>
<thead>
<tr>
<th>Ductal-Dependent (LV Outflow Obstruction)</th>
<th>Tension Pneumothorax</th>
<th>Cardiac Tamponade</th>
<th>Pulmonary Embolism</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Prostaglandin E₁&lt;br&gt;• Expert consultation</td>
<td>• Needle decompression&lt;br&gt;• Tube thoracostomy</td>
<td>• Pericardiocentesis&lt;br&gt;• 20 mL/kg NS/LR bolus</td>
<td>• 20 mL/kg NS/LR bolus, repeat PRN&lt;br&gt;• Consider thrombolytics, anticoagulants&lt;br&gt;• Expert consultation</td>
</tr>
</tbody>
</table>

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# Recognition of Shock Flowchart

<table>
<thead>
<tr>
<th>Clinical Signs</th>
<th>Hypovolemic Shock</th>
<th>Distributive Shock</th>
<th>Cardiogenic Shock</th>
<th>Obstructive Shock</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Patency</td>
<td>Airway open and maintainable/not maintainable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B Respiratory rate</td>
<td>Increased</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B Respiratory effort</td>
<td>Normal to increased</td>
<td>Labored</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B Breath sounds</td>
<td>Normal</td>
<td>Normal (£ crackles)</td>
<td>Crackle, grunting</td>
<td></td>
</tr>
<tr>
<td>C Systolic blood pressure</td>
<td>Compensated Shock → Hypotensive Shock</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C Pulse pressure</td>
<td>Narrow</td>
<td>Variable</td>
<td>Narrow</td>
<td></td>
</tr>
<tr>
<td>C Heart rate</td>
<td>Increased</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C Peripheral pulse quality</td>
<td>Weak</td>
<td>Bounding or weak</td>
<td>Weak</td>
<td></td>
</tr>
<tr>
<td>C Skin</td>
<td>Pale, cool</td>
<td>Warm or cool</td>
<td>Pale, cool</td>
<td></td>
</tr>
<tr>
<td>C Capillary refill</td>
<td>Delayed</td>
<td>Variable</td>
<td>Delayed</td>
<td></td>
</tr>
<tr>
<td>C Urine output</td>
<td></td>
<td>Decreased</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D Level of consciousness</td>
<td>Irritable early</td>
<td>Lethargic late</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E Temperature</td>
<td>Variable</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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# Management of Respiratory Emergencies Flowchart

**Upper Airway Obstruction**  
Specific Management for Selected Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Specific Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Croup</td>
<td>Anaphylaxis</td>
</tr>
<tr>
<td>Nebulized epinephrine</td>
<td>IM epinephrine (or autoinjector)</td>
</tr>
<tr>
<td>Corticosteroids</td>
<td>Albuterol</td>
</tr>
<tr>
<td></td>
<td>Antihistamines</td>
</tr>
<tr>
<td></td>
<td>Corticosteroids</td>
</tr>
</tbody>
</table>

**Lower Airway Obstruction**  
Specific Management for Selected Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Specific Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bronchiolitis</td>
<td>Asthma</td>
</tr>
<tr>
<td>Nasal suctioning</td>
<td>Albuterol ± ipratropium</td>
</tr>
<tr>
<td>Bronchodilator trial</td>
<td>Corticosteroids</td>
</tr>
<tr>
<td></td>
<td>Subcutaneous epinephrine</td>
</tr>
<tr>
<td></td>
<td>Magnesium sulfate</td>
</tr>
<tr>
<td></td>
<td>Terbutaline</td>
</tr>
</tbody>
</table>

**Lung Tissue Disease**  
Specific Management for Selected Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Specific Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonia/Pneumonitis</td>
<td>Infectious Chemical Aspiration Pulmonary Edema Cardiogenic or Noncardiogenic (ARDS)</td>
</tr>
<tr>
<td>Albuterol</td>
<td>Consider noninvasive or invasive ventilatory support with PEEP</td>
</tr>
<tr>
<td>Antibiotics (as indicated)</td>
<td>Consider vasoactive support</td>
</tr>
<tr>
<td></td>
<td>Consider diuretic</td>
</tr>
</tbody>
</table>

**Disordered Control of Breathing**  
Specific Management for Selected Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Specific Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased ICP</td>
<td>Poisoning/Overdose</td>
</tr>
<tr>
<td>Avoid hypoxemia</td>
<td>Antidote (if available)</td>
</tr>
<tr>
<td>Avoid hypercarbia</td>
<td>Contact poison control</td>
</tr>
<tr>
<td>Avoid hyperthermia</td>
<td></td>
</tr>
</tbody>
</table>
### Pediatric Advanced Life Support

#### Signs of Respiratory Problems

<table>
<thead>
<tr>
<th>Clinical Signs</th>
<th>Upper Airway Obstruction</th>
<th>Lower Airway Obstruction</th>
<th>Lung Tissue Disease</th>
<th>Disordered Control of Breathing</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Patency</td>
<td>Airway open and maintainable/not maintainable</td>
<td></td>
<td></td>
<td>Variable</td>
</tr>
<tr>
<td>B Respiratory Rate/Effort</td>
<td>Increased</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breath Sounds</td>
<td>Stridor (typically inspiratory)</td>
<td>Wheezing (typically expiratory)</td>
<td>Grunting Crackles</td>
<td></td>
</tr>
<tr>
<td>Barking cough</td>
<td>Prolonged expiratory phase</td>
<td>Decreased breath sounds</td>
<td>Normal</td>
<td></td>
</tr>
<tr>
<td>Hoarseness</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C Air Movement</td>
<td>Decreased</td>
<td></td>
<td></td>
<td>Variable</td>
</tr>
<tr>
<td>C Heart Rate</td>
<td>Tachycardia (early)</td>
<td>Bradycardia (late)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C Skin</td>
<td>Pallor, cool skin (early)</td>
<td>Cyanosis (late)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D Level of Consciousness</td>
<td>Anxiety, agitation (early)</td>
<td>Lethargy, unresponsiveness (late)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E Temperature</td>
<td>Variable</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Pediatirc Advanced Life Support

#### Identification of Respiratory Problems by Severity

<table>
<thead>
<tr>
<th>Respiratory Distress</th>
<th>Respiratory Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Open and maintainable</td>
<td>Not maintainable</td>
</tr>
<tr>
<td>B Tachypnea</td>
<td>Bradypnea to apnea</td>
</tr>
<tr>
<td>Work of breathing (nasal flaring/retractions)</td>
<td>Increased effort Decreased effort Apnea</td>
</tr>
<tr>
<td>Good air movement</td>
<td>Poor to absent air movement</td>
</tr>
<tr>
<td>C Tachycardia</td>
<td>Bradycardia</td>
</tr>
<tr>
<td>C Pallor</td>
<td>Cyanosis</td>
</tr>
<tr>
<td>D Anxiety, agitation</td>
<td>Lethargy to unresponsiveness</td>
</tr>
<tr>
<td>E Variable temperature</td>
<td></td>
</tr>
</tbody>
</table>
Pediatric Bradycardia
With a Pulse and Poor Perfusion Algorithm

Pediatric Advanced Life Support

Identify and treat underlying cause
- Maintain patent airway; assist breathing as necessary
- Oxygen
- Cardiac monitor to identify rhythm; monitor blood pressure and oximetry
- IO/IV access
- 12-Lead ECG if available; don't delay therapy

Cardiopulmonary compromise continues?

CPR if HR <60/min with poor perfusion despite oxygenation and ventilation

Support ABCs
- Give oxygen
- Observe
- Consider expert consultation

Cardiopulmonary Compromise
- Hypotension
- Acutely altered mental status
- Signs of shock

Bradyocardia persists?

Yes
- Epinephrine
- Atropine for increased vagal tone or primary AV block
- Consider transthoracic pacing/transvenous pacing
- Treat underlying causes

If pulseless arrest develops, go to Cardiac Arrest Algorithm

No

Doses/Details

Epinephrine IO/IV Dose:
0.01 mg/kg (0.1 mL/kg of 1:10 000 concentration). Repeat every 3-5 minutes. If IO/IV access not available but endotracheal (ET) tube in place, may give ET dose: 0.1 mg/kg (0.1 mL/kg of 1:1000).

Atropine IO/IV Dose:
0.02 mg/kg. May repeat once. Minimum dose 0.1 mg and maximum single dose 0.5 mg.
Pediatric Tachycardia With a Pulse and Adequate Perfusion Algorithm

Pediatric Advanced Life Support

Identify and treat underlying cause
- Maintain patent airway; assist breathing as necessary
- Oxygen
- Cardiac monitor to identify rhythm; monitor blood pressure and oximetry
- 12-Lead ECG if practical

QRS normal (≤0.09 sec)
- Evaluate rhythm

QRS wide (>0.09 sec)
- Evaluate QRS duration
- Evaluate rhythm

Probable sinus tachycardia
- Compatible history consistent with known cause
- P waves present/normal
- Variable R-R with constant PR
- Infants: rate usually <220/min
- Children: rate usually <180/min

Probable supraventricular tachycardia
- Compatible history (vague, nonspecific; history of abrupt rate changes)
- P waves absent/abnormal
- HR not variable with activity
- Infants: rate usually ≥220/min
- Children: rate usually ≥180/min

Possible supraventricular tachycardia (with QRS aberrancy)
- R-R interval regular
- Uniform QRS morphology

Probable ventricular tachycardia

Search for and treat cause

Consider vagal maneuvers

- Establish vascular access
- Consider adenosine 0.1 mg/kg IV (maximum first dose 6 mg)
  May give second dose of 0.2 mg/kg IV (maximum second dose 12 mg)
  Use rapid bolus technique

Expert consultation strongly recommended
- Search for and treat reversible causes
- Obtain 12-lead ECG
- Consider pharmacologic conversion
  - Amiodarone 5 mg/kg IV over 20 to 60 minutes
  or
  - Procainamide 15 mg/kg IV over 30 to 60 minutes
  - Do not routinely administer amiodarone and procainamide together
  - May attempt adenosine if not already administered

Consider electrical conversion
- Consult pediatric cardiologist
- Attempt cardioversion with 0.5 to 1 J/kg (may increase to 2 J/kg if initial dose ineffective)
- Sedate before cardioversion
Pediatric Tachycardia
With a Pulse and Poor Perfusion Algorithm

Identify and treat underlying cause
- Maintain patent airway; assist breathing as necessary
- Oxygen
- Cardiac monitor to identify rhythm; monitor blood pressure and oximetry
- IO/IV access
- 12-Lead ECG if available; don’t delay therapy

Narrow (≤0.09 sec) Evaluate QRS duration Wide (>0.09 sec)

Evaluate rhythm with 12-lead ECG or monitor

Probable sinus tachycardia
- Compatible history consistent with known cause
  - P waves present/normal
  - Variable R-R; constant PR
  - Infants: rate usually <220/min
  - Children: rate usually <180/min

Probable supraventricular tachycardia
- Compatible history (vague, nonspecific); history of abrupt rate changes
  - P waves absent/abnormal
  - HR not variable
  - Infants: rate usually ≥220/min
  - Children: rate usually ≥180/min

Possible ventricular tachycardia

Cardiopulmonary compromise?
- Hypotension
- Acutely altered mental status
- Signs of shock

Search for and treat cause
Consider vagal maneuvers (No delays)
Synchronized cardioversion
Consider adenosine if rhythm regular and QRS monomorphic

- If IO/IV access present, give adenosine
- OR
- If IO/IV access not available, or if adenosine ineffective, synchronized cardioversion

Doses/Details

Synchronized Cardioversion:
Begin with 0.5-1 J/kg; if not effective, increase to 2 J/kg. Sedate if needed, but don’t delay cardioversion.

Adenosine
IO/IV Dose:
First dose: 0.1 mg/kg rapid bolus (maximum: 6 mg).
Second dose: 0.2 mg/kg rapid bolus (maximum second dose: 12 mg).

Amiodarone
IO/IV Dose:
5 mg/kg over 20-60 minutes or
Procainamide
IO/IV Dose:
15 mg/kg over 30-60 minutes

Expert consultation advised
- Amiodarone
- Procainamide

Do not routinely administer amiodarone and procainamide together.

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Management of Shock After ROSC

Optimize Ventilation and Oxygenation
- Titrate FiO₂ to maintain oxyhemoglobin saturation 94%-99%; if possible, wean FiO₂ if saturation is 100%
- Consider advanced airway placement and waveform capnography

Assess for and Treat Persistent Shock
- Identify, treat contributing factors
- Consider 20 mL/kg IV/IO boluses of isotonic crystalloid. Consider smaller boluses (eg, 10 mL/kg) if poor cardiac function suspected.
- Consider the need for inotropic and/or vasopressor support for fluid-refractory shock.

*Possible Contributing Factors
- Hypovolemia
- Hypoxia
- Hypoglycemia
- Hypoglycemia
- Hypothermia
- Hypo-/hyperkalemia
- Hypo-/hyperkalemia
- Hypo-/hyperkalemia
- Tension pneumothorax
- Tension pneumothorax
- Tamponade, cardiac
- Toxins
- Toxins
- Thrombosis, pulmonary
- Thrombosis, coronary
- Trauma

Hypotensive Shock
- Epinephrine
- Dopamine
- Norepinephrine

Normotensive Shock
- Dobutamine
- Dopamine
- Epinephrine
- Milrinone

Estimation of Maintenance Fluid Requirements

- Infants <10 kg: 4 mL/kg per hour
  Example: For an 8-kg infant, estimated maintenance fluid rate
  = 4 mL/kg per hour x 8 kg
  = 32 mL per hour

- Children 10-20 kg: 4 mL/kg per hour for the first 10 kg + 2 mL/kg per hour for each kg above 10 kg
  Example: For a 15-kg child, estimated maintenance fluid rate
  = (4 mL/kg per hour x 10 kg)
  + (2 mL/kg per hour x 5 kg)
  = 40 mL/hour + 10 mL/hour
  = 50 mL/hour

- Children >20 kg: 4 mL/kg per hour for the first 10 kg + 2 mL/kg per hour for kg 11-20 + 1 mL/kg per hour for each kg above 20 kg.
  Example: For a 28-kg child, estimated maintenance fluid rate
  = (4 mL/kg per hour x 10 kg)
  + (2 mL/kg per hour x 10 kg)
  + (1 mL/kg per hour x 8 kg)
  = 40 mL per hour + 20 mL per hour
  + 8 mL per hour
  = 68 mL per hour

Following initial stabilization, adjust the rate and composition of intravenous fluids based on the patient's clinical condition and state of hydration. In general, provide a continuous infusion of a dextrose-containing solution for infants. Avoid hypotonic solutions in critically ill children; for most patients use isotonic fluid such as normal saline (0.9% NaCl) or lactated Ringer's solution with or without dextrose, based on the child's clinical status.