Purpose: To provide guidance to practitioners caring for pediatric patients during a disaster.

Disclaimer: This guideline is not meant to be all inclusive, replace an existing policy and procedure at a hospital or substitute for clinical judgment. These guidelines may be modified at the discretion of the healthcare provider.

### Initial Management of All Pediatric Shock Patients

- Stabilize ABCs and c-spine (Airway, Breathing, and Circulation)
- Obtain weight (actual or use of weight/length based tool)
- Establish 2 peripheral IVs (consider large bore if possible) or if unable, establish intraosseous (IO) access
- Control any external bleeding
- Monitor Heart Rate (HR), Blood pressure (BP), Oxygen Saturation (SpO₂), mental status, temperature, perfusion, urine output, bedside glucose
- Perform history & physical exam
- Consult Pediatric Care Medical Specialist for assistance with care of the acutely and critically ill patient
- Establish perfusion checks q15 mins
- Control any external bleeding
- Develop and Treat Cause Section for additional information

### Management of all Pediatric Shock Patients

<table>
<thead>
<tr>
<th>Does patient have signs of organ dysfunction?</th>
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<tbody>
<tr>
<td>Yes</td>
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<tr>
<td>- Hypotension</td>
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<tr>
<td>- &lt; 2 y/o Systolic BP (SBP) &lt; 70mmHg</td>
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<td>- 2-10 y/o SBP &lt; (70+2 x age in years)</td>
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<td>- &gt;10 y/o SBP &lt;90mmHg</td>
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<td>- All ages: Diastolic BP (DBP) &lt;30mmHg</td>
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<td>- Capillary refill &gt; 2 seconds</td>
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<td>- Witnessed apnea</td>
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<td>- Need for FiO₂ &gt; than 0.50 to maintain SpO₂ &gt; 92</td>
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<td>- Altered mental status</td>
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<td>- Consult pediatric care medical specialist</td>
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<tr>
<td>No</td>
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</tbody>
</table>

- Begin IVF bolus (0.9 NS) 20mL/kg over 15 minutes or as fast as possible. Repeat x 1
- Consider need for intubation
- If cardiogenic shock suspected, administer IVF boluses at a rate of 5-10mL/kg over 10-20 minutes. Repeat PRN. Assess for pulmonary edema after each bolus
- Draw labs (blood gas, glucose, CBC, CMP, PT/PTT, lactic acid, blood culture, Type and Screen)

**REASSESS**

- Give IVF bolus (0.9NS) 20mL/kg over 15 minutes or as fast as possible. Repeat x 1
- Perform vital signs, perfusion and neuro checks q15mins
- If cardiogenic shock suspected, administer IVF boluses (0.9NS) at a rate of 5-10mL/kg over 10-20 minutes. Repeat PRN. Assess for pulmonary edema after each bolus
- Draw labs (blood gas, glucose, CBC, CMP, PT/PTT, lactic acid, blood culture, Type and Screen)

**REASSESS**

- Monitor vital signs & perform perfusion checks q 1 hr x 2
- Maintenance IVF
- Ongoing assessment: monitor for hypothermia and hypoglycemia
- Determine and treat cause (see Determine and Treat Cause Section for additional information)

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**Initial Management of All Pediatric Shock Patients**

<table>
<thead>
<tr>
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<tr>
<td>Perform history &amp; physical exam</td>
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<tr>
<td>Consult Pediatric Care Medical Specialist for assistance with care of the acutely and critically ill patient, to individualize the care of patient, if patient does not improve and needs to be admitted/transfered and as needed for further support and consult.</td>
</tr>
</tbody>
</table>
- Administer IVF bolus (0.9NS) 20mL/kg over 15 minutes or as fast as possible.
- Assess for clinical or laboratory signs of organ dysfunction:
  - Metabolic: base deficit > 5 (BE< -5); lactate > 2X upper limit of normal
  - Respiratory: PaO2/FiO2<300; PCO2>65 or greater than 20 above baseline
  - Hematologic: Platelets <80K (unexplained); INR>2
  - Renal: Creatinine > 2X upper limit of normal; oliguria<0.5mL/kg/hr
  - Hepatic: total bilirubin>4; AST> 2X upper limit of normal

**REASSESS**

- Fluid refractory
  - Begin vasoactive therapy and titrate to correct hypotension/poor perfusion:
    - Dopamine: 5-20mcg/kg/min Titrate in 1-4 mcg/kg/min
    - Dobutamine 2-20mcg/kg/min
  - Consider establish central line and arterial access if experienced/skilled practitioner available to place

**REASSESS**

- Fluid refractory/Dopamine Resistant
  - If SpO2 Sat<70%, hypotensive, and poor perfusion/vasoconstricted:
    - Transfuse with PRBCs if Hgb<10 (10mL/kg)
    - Epinephrine 0.1-1mcg/kg/min OR
    - Dobutamine 2-20mcg/kg/min
  - If SpO2 Sat>70%, hypotensive, and vasodilated:
    - Norepinephrine 0.1-2mcg/kg/min

**REASSESS**

- If at risk for adrenal insufficiency:
  - Hydrocortisone 2mg/kg bolus IV (max 100mg)
  - If SpO2 Sat<70%, normal blood pressure, and/or poor perfusion/vasoconstricted:
    - Nitroprusside OR
    - Milrinone
  - If SpO2 Sat>70% and hypotensive:
    - Titrate IVF
    - Continue Epinephrine
  - If SpO2 Sat>70% and hypotensive:
    - Titrate IVF
    - Continue Norepinephrine

**REASSESS**

- Monitor vital signs & perform perfusion checks q 1 hr x 2
- Ongoing assessment: monitor for hypothermia and hypoglycemia
- Maintenance IVF
- Consult pediatric care medical specialist
- Determine and treat cause (see Determine and Treat Cause Section)
- Admit patient (see sample admission orders):
  - Sepsis (see pg 4)
  - Hypovolemia (see pg 7)

**REASSESS**

- Improved, normalized
  - AND ≥ 40mL/kg IVF given

- Consult Pediatric Care Medical Specialist for additional orders and to request transfer
- Ongoing assessment: monitor for hypothermia and hypoglycemia
- Admit patient (see sample admission orders):
  - Sepsis (see pg 4)
  - Hypovolemia (see pg 7)
### Determine and treat cause

**Anaphylaxis:**
- Epinephrine 1:1000 0.1mL/kg (not to exceed 0.3 mg/dose) IM, every 15 minutes x 2 then every 4 hours OR
- Epinephrine Autoinjector 0.3mg IM (for patients>30kg) OR Junior Autoinjector 0.15mg (for patients 10-30kg) OR
- If hypotension continues after IVF bolus, Epinephrine 0.01mg/kg (1:10000) IV/IO every 3-5 minutes (max dose 1mg)
  - Monitor for respiratory depression
- Benadryl 1.25-1.5mg/kg IV/IO/IM every 4-6 hours (max dose 50mg)
  - Methylprednisone 2mg/kg IV/IO initially (max 60mg) then 0.5mg/kg every 6 hours or 1mg/kg every 12 hours (max 125mg/day).
- Pepcid 0.5mg/kg IV every 12 hours

**Cardiogenic shock:**
- Administer IVF boluses at a rate of 5-10mL/kg over 10-20 minutes. Repeat PRN. Assess for pulmonary edema after each bolus
- Consider Diuretics
- Consider Milrinone
- Consider need to increase cardiac output
  - Vasodilators
  - Inotropes
- Reduce metabolic demands:
  - Antipyretics/analgescics PRN

**Hemorrhage:**
- If signs/symptoms of shock and at risk for hemorrhage, consider administering PRBCs 10mL/kg
  - Administering 10mL/kg of PRBCs will increase hemoglobin by 2g/dL or hematocrit 4-6%

**Hypocalcemia**
- Calcium chloride: 10-20mg/kg (0.1-0.2mL/kg calcium chloride 10%) IV/IO infused at a rate that does not exceed 100mg/min OR

**Hypoglycemia**
- Birth-28 days: D10W 2mL/kg IV/IO
- >28 days-1 year: D12.5% 4-8mL/kg IV/IO
- >1 year: D25% 2-4mL/kg IV/IO
- D50% 1-2mL/kg IV/IO

**Obstructive shock:**
Treat underlie cause:
- Cardiac Tamponade (perform pericardiocentesis if experienced/skilled practitioner available)
- Tension Pneumothorax (perform needle decompression and place chest tube if experienced/skilled practitioner available)
- Closed ductus arteriosus
  - Prostaglandin E1 0.05-0.1mcg/kg/min continuous IV/IO
- Pulmonary embolism

**Spinal cord injury:**
If hypotensive/bradycardic after IVF boluses:
- Atropine 0.02 mg/kg IV/IO (min single dose 0.1mg/max single dose 1mg). May repeat every 3 minutes to max 2mg.
If continue to be hypotensive and bradycardic:
- Dopamine to maintain SBP >90
- Phenylephrine or vasopressin
- Consult neuro surgeon for further medical management

**Sepsis:**
- Antibiotics: broad spectrum antimicrobial agent
  - Neonates: Ampicillin and Cefotaxime OR Ampicillin and Gentamicin
- Antipyretics
Sample Pediatric Septic Shock Admission Orders

Admitting physician: _____________________________________________________________

Diagnosis: _____________________________________________________________________

Condition:  □ Critical  □ Serious   □ Stable

Weight (kg):__________________ Height(cm):__________________

Allergies: _____________________________________________________________________

Isolation: _____________________________________________________________________

Assessment:

□ Continuous cardiac monitoring
□ Continuous pulse oximetry
□ Blood pressure with all vital signs
□ Routine I&O
□ Strict I&O
□ Daily weight
□ Seizure precautions
□ Neuro checks every______ hours
□ All non-rectal temperatures > 38°C/100.4°F should be confirmed rectally on infants ≤60 days of age

Tests:

□ CBC with differential
   □ now (order if not performed prior to admission)
   □ at_______
   □ every _______ hours

□ CMP
   □ now (order if not performed prior to admission)
   □ at_______
   □ every _______ hours

□ BMP
   □ now (order if not performed prior to admission)
   □ at_______
   □ every _______ hours

□ Blood culture (order if not performed prior to admission)
□ Viral blood culture
□ Catheterized urinalysis  (order if not performed prior to admission)
□ Catheterized urine culture  (order if not performed prior to admission)
□ Stool culture
□ Stool for Rotavirus
□ Stool gram stain
□ RSV
□ Influenza
□ Viral culture
□ Chest x-ray (PA and lateral) (order if not performed prior to admission)
For infants ≤60 days of age with fever:
   □ CSF for (laboratory should perform these in ranking order as listed below)
      □ Cell count
      □ Glucose
Protein
Gram stain
Aerobic culture
Viral culture
Enterovirus PCR
Herpes PCR
Meningitis antigen profile
Conjunctiva viral culture
Viral culture of skin lesion on __________________
Rectal viral culture
____________________________________________________________
____________________________________________________________
_____________________________
_____________________________
Medications:
□ Fever/Pain Control:
□ Acetaminophen (Tylenol) (15mg/kg/dose)_______mg PO/GT every 4 hrs PRN for temperature 38.6°C/101.5°F or discomfort (max dose 3000mg/day)
□ Acetaminophen (Tylenol) (20mg/kg/dose)_______mg PR every 4 hrs PRN for temperature ≥ 38.6°C/101.5°F or discomfort (max dose 3000mg/day)
□ Ibuprofen (Motrin) (10mg/kg/dose)_______mg PO/GT every 6 hours PRN for temperature ≥ 38.6°C/101.5°F or discomfort (for infants >5 months)
□ Antibiotics:
□ Ceftriaxone _______mg IV every _____ hours (max 4gm/day)
□ Vancomycin _______mg IV every _____ hours (max 1gm/dose)
□ _____________________________________________________________________________
□ _____________________________________________________________________________
□ __________________________
□ For infants ≤60 days of age with fever:
□ Ampicillin _________mg IV every 6 hours (200 mg/kg/day)
□ Cefuroxime _________mg IV every 6 hours (200 mg/kg/day)
□ Acyclovir _________mg IV every _____ hours
(If greater than or equal to 35 weeks post-conceptual age, give 60 mg/kg/day divided every 8 hours. If less than 35 weeks post-conceptual age, give 40 mg/kg/day divided every 12 hours)
□ Gentamycin _________mg IV every _____ hours
□ Topical anesthetic for IV start and lab draws:
□ Apply topically once 30-90 minutes prior to procedure (maximum 1gm, 10 centimeter area squared, or application time of 2 hours)

IV Therapy:
□ Saline lock
□ D5 ½ NS with 20 mEq KCl/L running at ______ mL/hr (ensure patient is voiding)
□ __________________________ running at ______ mL/hr
□ __________________________ running at ______ mL/hr

Supplemental Oxygen Orders:
• If SpO₂< 90% on room air, apply oxygen to maintain SpO₂ 91-94%
  o Nasal Cannula
- Aerosol Mask
  - Titrate oxygen to maintain SpO₂ > 90%
  - Wean oxygen if oxygen saturation maintains 94%.
    - Decrease oxygen by ½ liter per minute (LPM) and reassess patient 5-10 minutes after change in oxygen
    - Do not decrease oxygen more frequently than every 60 minutes

- Ventilator Settings:____________________________________________
  - For more information, see: Use of Strategic National Stockpile (SNS) Ventilators in the Pediatric Patient: Instructional Guidelines with Training Scenarios, 2nd edition

- See Sample Pediatric Standard Admission Orders for additional examples for diet, IV, labs etc
Sample Pediatric Hypovolemic Shock Admission Orders

Admitting physician:____________________________________________________________

Diagnosis: ___________________________________________________________________

Condition: □ Critical □ Serious □ Stable

Weight (kg):__________________ Height(cm):__________________

Allergies: ___________________________________________________________________

Isolation: ___________________________________________________________________

Assessment:
□ Continuous cardiac monitoring
□ Continuous pulse oximetry
□ Blood pressure with all vital signs
□ Routine I&O
□ Strict I&O
□ Daily weight

Tests:
□ CBC with differential
  □ now (order if not performed prior to admission)
  □ at______
  □ every ______ hours

□ CMP
  □ now (order if not performed prior to admission)
  □ at______
  □ every _____ hours

□ BMP
  □ now (order if not performed prior to admission)
  □ at______
  □ every _____ hours

Medications:
□ Fever/Pain Control:
  □ Acetaminophen (Tylenol) (15mg/kg/dose)_________mg PO/GT every 4 hrs PRN for
  temperature ≥38.6°C/101.5°F or discomfort (max dose 3000mg/day)
  □ Acetaminophen (Tylenol) (20mg/kg/dose)_________mg PR every 4 hrs PRN for temperature ≥
  38.6°C/101.5°F or discomfort (max dose 3000mg/day)
  □ Ibuprofen (Motrin) (10mg/kg/dose)_________mg PO/GT every 6 hours PRN for temperature
  ≥ 38.6°C/101.5°F or discomfort (for infants >5 months)

□ Antiemetic:
  ________________________________

□ Antibiotics:
  ________________________________

□ Topical anesthetic for IV start and lab draws:
□ Apply topically once 30-90 minutes prior to procedure (maximum 1gm, 10 centimeter area squared, or application time of 2 hours)

**IV Therapy:**

- □ D5 ⅓ NS with 20 mEq KCl/L running at _____ mL/hr (ensure patient is voiding)
- □ ________________ running at _____ mL/hr
- □ ________________ running at _____ mL/hr

**Supplemental Oxygen Orders:**

- If \( \text{SpO}_2 < 90\% \) on room air, apply oxygen to maintain \( \text{SpO}_2 91-94\% \)
  - Nasal Cannula
  - Aerosol Mask
- Titrate oxygen to maintain \( \text{SpO}_2 > 90\% \)
- Wean oxygen if oxygen saturation maintains 94%.
  - Decrease oxygen by \( \frac{1}{2} \) liter per minute (LPM) and reassess patient 5-10 minutes after change in oxygen
  - Do not decrease oxygen more frequently than every 60 minutes

**Ventilator Settings:**

- For more information, see: Use of Strategic National Stockpile (SNS) Ventilators in the Pediatric Patient: Instructional Guidelines with Training Scenarios, 2nd edition

□ See **Sample Pediatric Standard Admission Orders** for additional examples for diet, IV, labs etc
## Definitions and Other Pediatric Shock Information

| TYPES |  
|---|---|
| **Distributive Shock**  
*Definition:* Excessive vasodilation and impaired distribution of blood flow  
*Common types:* Sepsis, anaphylaxis, spinal cord injuries (neurogenic) |  
| **Hypovolemic Shock**  
*Definition:* Deficiency of intravascular blood volume  
*Common causes:*  
1. Intravascular volume loss: gastroenteritis, burns, diabetes insipidus, heat stroke  
2. Hemorrhage: trauma, surgery  
3. Interstitial loss: burns, sepsis, nephrotic syndrome, intestinal obstruction, ascites |  
| **Obstructive Shock**  
*Definition:* Circulatory failure caused by a physical obstruction  
*Common causes:* Physical causes of shock should be considered (e.g. cardiac Tamponade or pulmonary embolism), especially in neonates who may have been born with obstructive congenital health disease (i.e. coarctation of the aorta, severe aortic valvular stenosis)  
*Presentation:* Neonates who present with signs of shock associated with enlarged liver, enlarged cardiac silhouette and/or heart murmur |  
| **Cardiogenic Shock**  
*Definition:* Impaired cardiac contractility  
*Common causes:*  
1. Congestive heart failure  
2. Cardiomyopathy  
3. Cardiac Tamponade  
4. Drugs  
5. Tension Pneumothorax |  

### Key Points

- **Stages of shock:** Compensated, Decompensated & Irreversible  
  - Tachycardia=Compensated  
  - Progression to next stage can be abrupt  
  - Adolescents compensate like kids, not adults  
  - Hypotension=Decompensated  

- **Early indicators of shock**  
  Hyperthermia/hypothermia, leukocytosis/neutropenia, unexplained tachycardia, tachypnea, poor distal perfusion
<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>DISORDERS</th>
<th>GOALS</th>
<th>THERAPIES</th>
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<tr>
<td>Respiratory</td>
<td>Acute respiratory distress syndrome</td>
<td>Prevent/treat: hypoxia and respiratory acidosis</td>
<td>Oxygen</td>
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<td></td>
<td>Respiratory muscle fatigue</td>
<td>Prevent barotrauma</td>
<td>Early endotracheal intubation and mechanical ventilation</td>
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<td>Central apnea</td>
<td>Decrease work of breathing</td>
<td>Positive end-expiratory pressure (PEEP)</td>
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<td>Permissive hypercapnia</td>
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<td>High-frequency ventilation</td>
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<td>Extracorporeal membrane oxygenation (ECMO)</td>
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<tr>
<td>Renal</td>
<td>Pre-renal failure</td>
<td>Prevent/treat: hypovolemia, hypervolemia,</td>
<td>Judicious fluid resuscitation</td>
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<td>Renal failure</td>
<td>hyperkalemia, metabolic acidosis,</td>
<td>Low-dose dopamine</td>
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<td>hypernatremia/ hyponatremia, and hypertension</td>
<td>Establishment of normal urine output and blood pressure for age</td>
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<td>Monitor serum electrolytes</td>
<td>Furosemide (Lasix)</td>
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<td>Dialysis, ultrafiltration, hemofiltration</td>
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<td>Hematologic</td>
<td>Coagulopathy (disseminated intravascular</td>
<td>Prevent/treat: bleeding</td>
<td>Vitamin K</td>
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<td>coagulation)</td>
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<td>Fresh frozen plasma</td>
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<td>Platelets</td>
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<td>Thrombosis</td>
<td>Prevent/treat: abnormal clotting</td>
<td>Heparinization</td>
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<td>Activated protein C</td>
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<td>Gastrointestinal</td>
<td>Stress ulcers</td>
<td>Prevent/treat: gastric bleeding</td>
<td>Histamine H2 receptor–blocking agents or proton pump inhibitors</td>
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<td>Avoid aspiration, abdominal distention</td>
<td>Nasogastric tube</td>
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<td>Ileus</td>
<td>Avoid mucosal atrophy</td>
<td>Early enteral feedings</td>
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<td>Bacterial translocation</td>
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<td>Endocrine</td>
<td>Adrenal insufficiency, primary or secondary</td>
<td>Prevent/treat: adrenal crisis</td>
<td>Stress-dose steroids in patients previously given steroids</td>
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<td>to chronic steroid therapy</td>
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<td>Physiologic dose for presumed primary insufficiency in sepsis</td>
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<td>Metabolic</td>
<td>Metabolic acidosis</td>
<td>Correct etiology</td>
<td>Treatment of hypovolemia (fluids), poor cardiac function (fluids,</td>
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<td>Normalize pH</td>
<td>inotropic agents)</td>
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<td>Improvement of renal acid excretion</td>
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<td>Low-dose (0.5-2 mEq/kg)</td>
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<td>sodium bicarbonate if the patient is not showing response, pH &lt; 7.1,</td>
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<td>and ventilation (CO2 elimination) is adequate</td>
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