**Table 1. Levels of pediatric ALS resources in limited-resource settings.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Resource** | **Level 1** | **Level 2** | **Level 3** |
| **Continuum of Care** | pre-hospital emergency care | |  |
|  | hospital emergency and critical care | |
| **Facility** | home  community health office/clinic | primary health center  rural hospital | district hospital  emergency treatment center  hospital ward  + ICU |
| **System** | + referral  + transport (simplified BLS) | referral  transport (simplified BLS)  + hospital management | triage  hospital management |
| **Personnel** | family caretaker  community health worker  + paramedic/medical assistant  + nurse | nurse  paramedic/medical assistant  health extension officer  nurse practitioner  doctor | pediatrician  physician (internal medicine)  surgeon  obstetrician and gynacologist |
| **Laboratory** | none | blood glucose (rapid)  hemoglobin/hematocrit  urinalysis  malaria smear  type and crossmatch  + CBC | CBC  + basic chemistries  + body fluid culture  + blood bank |
| **Radiology** | none | + plain radiography  + ultrasound | plain radiography  ultrasound |
| **Equipment**  **Disposables** | stethoscope  MDI and spacer  + IV catheter  + IV fluid infusion set  + NG tube  + nebulizer | oxygen concentrator\*  nasal prongs  nasopharyngeal catheter  nebulizer\*  bag-mask device  IV catheter  IV fluid infusion set  NG tube\*  suction device\*  + CPAP device | oxygen cylinder  oxygen mask  oxygen mask with reservoir bag  CPAP device  urinary catheter  12-lead ECG  + NIPPV device  + endotracheal tube  + ETCO2 device  + monitor/defibrillator  + AED  + chest tube  + tracheostomy tube |
| **Monitoring** | respiratory rate  heart rate  temperature  capillary refill time | urine output  + blood pressure (appropriate cuff)  + pulse oximetry\* | blood pressure (appropriate cuff )  pulse oximetry  + continuous ECG |
| **Medication**  **Fluids** | antibiotics  oral rehydration solution (ORS, ReSoMal)  zinc  + albuterol/salbutamol/ipratropium  (nebulization solution/MDI)  + isotonic crystalloid | oxygen\*  dextrose\*  albuterol/salbutamol/ipratropium  (nebulization solution/MDI) epinephrine 1:1000  isotonic crystalloid  corticosteroids  whole blood  + diphenhydramine | diphenhydramine  + epinephrine 1:10 000  + dopamine  + aminophylline  + furosemide |
| **Management** | oral/IM medication  oral rehydration  warming techniques  overnight monitoring  vagal maneuvers  + bronchodilator therapy  (nebulizer\*/MDI and spacer)  + IV medication  + NG/IV/IO fluid resuscitation | free-flow oxygen delivery\*  suctioning\*  bronchodilator therapy  (nebulizer\*/MDI and spacer)  manual ventilation (bag-mask)  IV medication  NG/IV/IO fluid resuscitation  hypoglycemia treatment\*  blood transfusion  + CPAP ventilation | CPAP ventilation  + NIPPV  + defibrillation  + synchronized cardioversion  + vasoactive therapy  + anti-arrhythmic therapy  + bronchoscopy  + tracheostomy  + needle decomptession/tube thoracostomy |

Note: Resources at successive levels are cumulative; + indicates presence or absence of resource depending on locality; \*indicates resources requested for Level 135

**Table 2. Substitute pediatric ALS interventions in limited-resource settings.**

|  |  |
| --- | --- |
| **Unavailable Resource** | **Substitute Resource** |
| **RESPIRATORY DISTRESS AND FAILURE** | |
| *oxygen cylinder* | *oxygen concentrator (with power supply)22* |
| *pulse oximetry* | *clinical indicators of hypoxemia85* |
| *chest radiography* | *clinical indicators of pneumonia86,87* |
| *clinical tool predicting treatment failure of severe pneumonia88* |
| *oxygen mask* | *nasal prongs or nasopharyngeal catheter85* |
| *oxygen mask with reservoir bag* | *CPAP (nasal)89* |
| *nebulizer* | *MDI and spacer (sealed-bottle)90* |
| *mechanical ventilation* | *CPAP (bubble)91-93* |
| *NIPPV (with power supply)94-96* |
| *CPAP (bubble)* | *pressurized room air technology (with power supply)97* |
| *racemic epinephrine* | *epinephrine 1:100098* |
| **SHOCK** | |
| *BP cuff (appropriate size for age)* | *clinical indicator of hypotension = non-palpable peripheral pulses99* |
| *ScVO2 > 70%* | *CRT < 2 seconds100* |
| *IO needle* | *bone marrow needle101* |
| *large-bore standard hypodermic needle101* |
| *short, wide-gauge spinal needle with internal stylet101* |
| *dopamine (by central line)* | *dopamine (by peripheral line)*16 |
| **BRADYCARDIA WITH PULSE AND POOR PERFUSION** | |
| *epinephrine 1:10 000* | *dilute epinephrine 1:1000 1 mL by adding 9 mL normal saline102* |
| **SUPRAVENTRICULAR TACHYCARDIA** | |
| *ice (for vagal maneuvers) or synchronized cardioversion or adenosine or amiodarone or procainamide* | *digoxin (for termination and maintenance*\**)103,104* |
| *propranolol (for maintenance*\**)103,104* |
| **VENTRICULAR TACHYCARDIA WITH PULSE** | |
| *synchronized cardioversion or*  *amiodarone or procainamide* | *quinidine105,106* |
| *propranolol105,106* |
| **CARDIAC ARREST** | |
| *manual defibrillation* | *AED101* |
| *epinephrine 1:10 000* | *dilute epinephrine 1:1000 1 mL by adding 9 mL normal saline102* |

Note: Consider the external jugular vein as a viable site with a low complication rate for central venous access;107

\*Consider propranolol as first-line treatment (ie, preferable to digoxin) for maintenance in most cases of SVT

because of the concern for Wolff-Parkinson-White syndrome and possible atrial fibrillation with antegrade conduction

over the bypass tract108

**Table 3. Pediatric ALS interventions adapted for use in limited-resource settings for respiratory distress and failure.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **RESPIRATORY DISTRESS AND FAILURE** | | | | | | | |
| **Level** | | | **Intervention** | **Upper Airway Obstruction** | **Lower**  **Airway Obstruction** | **Lung**  **Tissue**  **Disease** | **Disordered Control of Breathing** |
| **1** | **2** | **3** | Open airway—suctioning, positioning, maneuvers (head-tilt chin lift/jaw thrust), adjuncts (NPA/OPA)101,102 | maintainable airway | | | |
| Antibiotics (oral/IM/IV)74,102 | diphtheria  epiglottitis  tracheitis (bacterial) |  | pneumonia (suspected bacterial) |  |
| Bronchodilator—Albuterol/ Salbutamol, Ipratropium (MDI/neb)102 |  | asthma  bronchospasm |  | |
|  | Corticosteroid (oral/IM)102 | croup  airway edema |
| Epinephrine 1:1000 (neb)102 |  |
| Pulse oximetry74,102 | clinical signs of hypoxemia | | | |
| Free-flow oxygen (nasal prongs, nasopharyngeal catheter, oxygen mask with/without reservoir)74,102 | hypoxemia | | | |
| Bag-mask ventilation101 | respiratory failure | | | |
| CPAP ventilation89,91-93 |
|  | NIPPV94,96 |
| Furosemide (IV/IO)102 |  | | pulmonary edema |  |
| Aminophylline (oral/IV)102 |  | | | apnea |
| Bronchoscopy102,117 | foreign body |  | | |
| Tracheostomy102, 117,118 | severe UAO |  | | |

**Table 4. Pediatric ALS interventions adapted for use in limited-resource settings for shock.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **SHOCK** | | | | | | | |
| **Level** | | | **Intervention** | **Hypovolemic** | **Distributive** | **Cardiogenic** | **Obstructive** |
| **1** | **2** | **3** | Low-osmolarity ORS (oral/NG)102,114  ReSoMal\* (oral/NG)102,109 | compensated shock  compensated shock with malnutrition | | | |
| Zinc (oral)102,114,115 | diarrhea |  | | |
| Antibiotics (oral/IM/IV)74,102,119 | bloody diarrhea  cholera | sepsis |  | |
| Vagal maneuvers—ice, other101 |  | | SVT |  |
| Isotonic crystalloid—normal saline, Ringer’s Lactate (IV/IO)36,102,114,116 | hypotension  (with/without malnutrition) | | | |
| Warming techniques—skin-to-skin, clothing, hats, blankets, heat, other102 | hypothermia | | | |
|  | Dextrose (oral, IV/IO)36,102,116 | hypoglycemia | | | |
| Whole blood (IV/IO)102 | severe anemia |  | | |
| Epinephrine 1:1000 (IM)102 |  | anaphylaxis |  | |
| Corticosteroid (oral/IM)102 |
| Diphenhydramine (IM/IV/IO)101 |
|  | Vasoactive therapy (IV/IO)36,102,116 | hypotension, myocardial dysfunction, CHF | | | |
| Furosemide (IV/IO)102 |  | | CHF |  |
| Epinephrine 1:10 000 (IV/IO)101 | bradycardia with pulse/poor perfusion |
| Anti-arrhythmic therapy (IV/IO)101,103,104 | SVT  VT with pulse |
| Synchronized cardioversion101 |
| Needle decompression/  tube thoracostomy101 |  | tension pneumothorax |

Note: \*Recommendations for treatment of dehydration in the infant/child with SAM specify Rehydration Solution for Malnutrition (ReSoMal) instead of standard ORS.102,109

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