Clinical Manual of Emergency Pediatrics

Sixth Edition

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Preface

In this sixth edition of the *Clinical Manual of Emergency Pediatrics*, we have endeavored to remain true to our original intention: to provide a dependable, comprehensive, portable handbook that offers concise advice regarding the approach to the majority of conditions seen in a pediatric emergency department. For each topic, we have included essential points and priorities for diagnosis, management, and follow-up care, as well as indications for hospitalization and a bibliography to guide further reading.

There has been a significant paradigm shift in the care of sick and injured children. Many patients now receive acute care in primary care offices and free-standing urgicenters, which may lack the full range of resources that are available in the emergency department setting. Ill children are hospitalized less often, and they tend to be discharged back to their primary care providers sooner than ever before. In addition, increasing numbers of chronically ill and medically fragile children are receiving care in ambulatory sites. As a result of these changing practices, physicians working in non-emergency settings, such as private offices and clinics, may be faced with potential, or real, pediatric emergencies. Now, more than ever, these caregivers, as well as emergency physicians, can benefit from a practical handbook which provides a summary of the myriad acute conditions that may be encountered, along with a clear guide as to how to differentiate among them.

Since the publication of the first edition of this manual, online and portable resources have become readily available. However, many are not geared to pediatric conditions or presentations. It is our observation that there is a lack of detail, particularly when discussing differential diagnoses. Our hope is that this manual, which gathers the necessary facts and management recommendations in a user-friendly, easily accessible format, will facilitate decision-making and safe care.

In the sixth edition, we have maintained the book's unique features while making many changes that increase its utility. Because the scope of childhood illnesses and injuries seen in acute care settings is constantly increasing, we have revised and updated every chapter. We have added new sections on anti-NMDA receptor encephalitis, bedside ultrasound, commercial sexual exploitation of children, fever of unknown origin, newer "designer" drugs of abuse, ovarian emergencies, the returned traveler, and the "ouchless" emergency department. The endocrinology, gastroenterology, infectious diseases, ingestions, and neurology sections have been completely revised and updated.

A word of caution is in order. Although a manual for emergency care can be very useful, it may tempt physicians, particularly those still in training, to look for automatic solutions. It is not our intent that this text be used as a protocol book. We urge students and house staff to not use this manual as a substitute for their own critical thinking and sensitivity when caring for children and their families.

We owe special thanks to our associate editor, Sandra J. Cunningham, and assistant editor, James A. Meltzer, for their contributions and diligent editing. Their careful attention to detail has greatly improved the quality of the book, and helped to ensure that our recommendations were updated and evidence-based. Although the content of this sixth edition reflects the hard work of all the contributors and section editors, the final

manuscript reflects our approach to any given illness or problem, and we are responsible for the book's content.

By what they have taught us and by their example, we are especially grateful to the pediatric emergency department nurses, attendings, and nurse practitioners at NYC Health + Hospitals Jacobi. We have become better teachers and caregivers by observing them and their interactions with patients and families.

We are particularly indebted to the Pediatric house staff, the Emergency Medicine house staff, and the Pediatric Emergency Medicine fellows at NYC Health + Hospitals Jacobi, as well as the medical students of the Albert Einstein College of Medicine. We have had the privilege of teaching and learning from all of them over the years. Their thoughtful questions provided the impetus for this manual.

This book is dedicated to the memory of Dr. Lewis M. Fraad, our beloved mentor, whose name has been memorialized in the name of our department, Lewis M. Fraad Department of Pediatrics at NYC Health + Hospitals Jacobi. Day in and day out he set an example for all of us by combining intellectual rigor with a deep respect for children and their families. He will always be with us when we are at our best.

Pediatric Emergency Management Code Card

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Anaphylaxis

Epinephrine: (1:1000) 0.01 mL/kg (max. 0.5 mL): IM thigh q 15 min × 3
H1: Diphenhydramine 1–2 mg/kg slow IV/IM (max. 50 mg)
H2: Famotidine 0.25 mg/kg IV (max. 20 mg)
Methylprednisolone: 2 mg/kg IV (max. <12 yr: 60 mg; ≥12 yr: 125 mg)
Bronchospasm: see Status Asthmaticus
Hypotension: Epinephrine infusion 0.1–1 mcg/kg/min)
Stridor: see Croup

Antibiotics (First Dose)

Ampicillin 100 mg/kg, Clindamycin 10 mg/kg, Gentamicin 2.5 mg/kg
Unasyn 50 mg/kg, Vancomycin 15 mg/kg, Zosyn 100 mg/kg of piperacillin
Cefoxitin 40 mg/kg, Ceftriaxone/Cefepime/Cefazolin/Cefotaxime 50 mg/kg

Asthma (Status Asthmaticus)

Albuterol neb: <20 kg, 2.5 mg; ≥20 kg, 5 mg
Albuterol continuous: 0.5 mg/kg/h
Albuterol MDI: 4–8 puffs (90 mcg/puff) q20 min
Ipratropium neb: <12 yr: 250 mcg; ≥12 yr: 500 mcg q20 min × 3 with albuterol
Prednisone 1–2 mg/kg/day (max. 60 mg) PO, then 1–2 mg/kg/day
Methylprednisolone: 1–2 mg/kg (max. 125 mg) PO/IV/IM
Dexamethasone: 0.6 mg/kg (max. 10 mg) PO/IV/IM once
Magnesium sulfate: 40 mg/kg (max. 3 g) IV over 20 min (in 50 mL NS)
Epinephrine (1:1000): 0.01 mL/kg (max. 0.3 mL) SQ q 15 min × 3
Terbutaline 0.01 mg/kg IV load over 5 min then 0.2–10 mcg/kg/min
HFNC (with FiO_2 to keep O_2 sat >92%): <6 mo: 4–8 L/min; ≥ 6 mo: 6–10 L/min
BiPAP: IPAP = 8–10 cm H_2O/EPAP = 4–5 cm H_2O

Adrenal Crisis

Hydrocortisone stress dose: <3 yr: 25 mg; 3–12 yr: 50 mg; ≥12 yr: 100 mg

Burns

Parkland Formula for second and third-degree burn surface area:
NS/LR: 4 mL/kg/day × % BSA burn (half first 8 h, half over next 16 h)
Add maintenance fluids; do not add K^+ for first 48 h; < 20 kg add D_5

Diabetic Ketoacidosis

Deficit: NS/RL 10 mL/kg IV bolus over 1 h, may repeat × 1
Then NS or 0.45 NS with K^+ (½ KAcetate + ½ KPO_4) at 1½ maintenance
K^+: <3: add 60 mEq/L; 4–5: add 40 mEq/L; 5–6: add 20 mEq/L; >6: none
Add maintenance IVF over 24 h: use D_5 W if glucose <250–300 mg/dL
After 1 h: start IV regular insulin at 0.1 unit/kg/h
(if <5 yr or glucose >800 mg/dL: use 0.05 unit/kg/h)

Hypoglycemia

Glucose: <5 yr: 5 mL/kg D_{10} W; ≥5 yr: 2 mL/kg D_{25} W
Glucose infusion: D_5–$D_{12.5}$ at 6–8 mg/kg/min
Glucagon (IV/IM/SC q 20 min): <20 kg: 0.5 mg; ≥20 kg: 1 mg

Hypocalcemia

Ca Cl (10%): 0.2 mL/kg via central IV over 5–10 min (max. 1 g)
Ca gluconate (10%): 0.6 mL/kg (60 mg/kg) IV over 5–10 min (max. 3 g)

Hyperkalemia

Regular insulin 1 unit/5 g glucose plus 0.5–1 g/kg glucose
Albuterol neb <20 kg: 2.5 mg; ≥20 kg: 5 mg q 20 min × 2
Ca gluconate (10%) 0.6 mL/kg
K^+: 6–7 mEq/L: furosemide 1 mg/kg IV (max. 40 mg)
Kayexalate (no sorbitol): 1 g/kg (max. 50 g) PR

Hypertensive Emergency/Urgency

Hydralazine: 0.1–0.2 mg/kg (max. 20 mg) IV bolus q 4h
Isradipine: 0.05–0.1 mg/kg PO (max. 5 mg)
Labetalol: 0.25–1 mg/kg (max. 20 mg) IV over 2 min q 10 min
Labetalol infusion: 0.4–1 mg/kg/h (max. 3 mg/kg/h)
Nicardipine infusion: 0.5–2 mcg/kg/min

Increased Intracranial Pressure

Keep head in midline and elevate head of bed to 30°
Maintain euvolemia: NS at two-thirds maintenance

Mannitol: 0.5–1 g/kg (max. 25 g) IV over 20–30 min
Maintain pCO_2 30–35 mmHg; pO_2 80–100; pH 7.3–7.5

Rapid-Sequence Intubation (IV)

Premedicate (if indicated): atropine 0.02 mg/kg (max. 0.4 mg)
Sedation: etomidate 0.1–0.3 mg/kg (not in septic shock) or midazolam 0.1 mg/kg (max. 5 mg)
Asthma: ketamine 1–2 mg/kg or etomidate 0.1–0.3 mg/kg
Head injury/increased ICP: etomidate 0.1–0.3 mg/kg
Shock: None or ketamine 1 mg/kg or fentanyl 1 mcg/kg
Paralysis: rocuronium 1–1.2 mg/kg or vecuronium 0.1 mg/kg (max10 mg) or succinylcholine
(with atropine) infant 2–3 mg/kg; child/adolescent 1–1.5 mg/kg (max. 150 mg)

Status Epilepticus

Lorazepam: 0.1 mg/kg (max. 2–4 mg) slow IV, can repeat in once in 5 min
No IV: Diazepam 0.2–0.5 mg/kg PR (max. 20 mg); midazolam 0.2 mg/kg IM (max. 10 mg)
Fosphenytoin 20 mg PE/kg IV/IO over 10–15 min (max. 1.5 g PE)
Phenobarbital 15 mg/kg IV (max. 1 g) over 15–20 min (first-line for infants < 2 mo)
Valproate 30–40 mg/kg (max. 3 g) IV over 60 min
Levetiracetam 30–60 mg/kg IV load (max. 4.5 g)

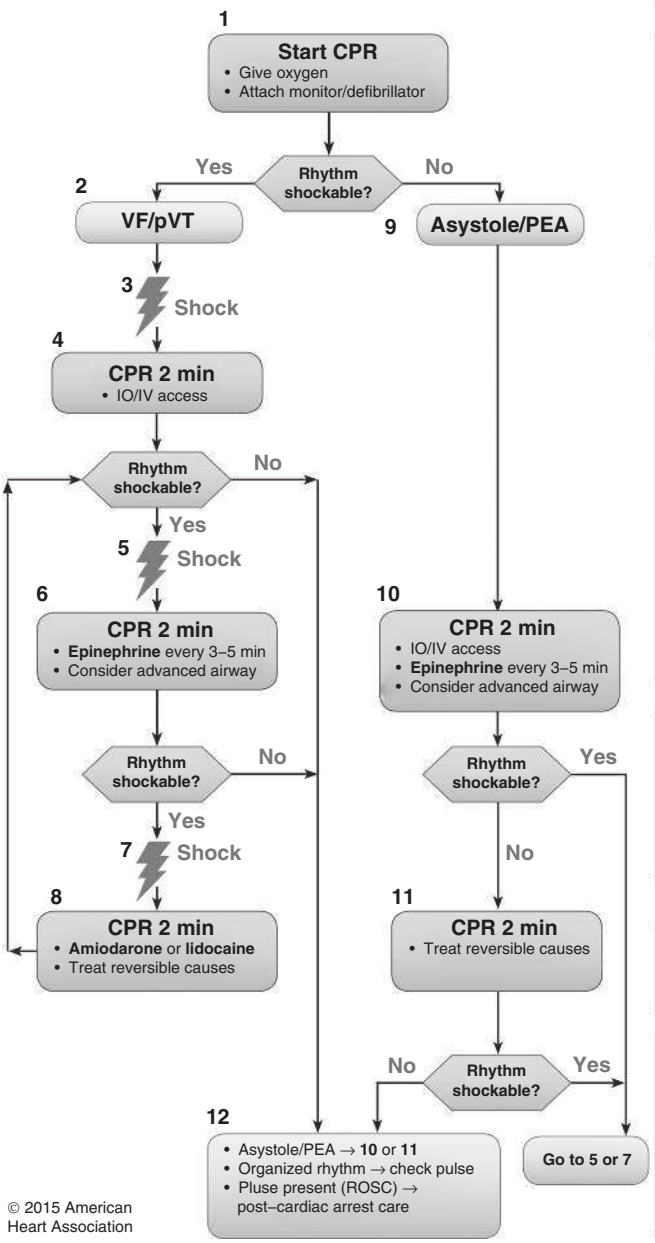
Sedation and Analgesia

Dexmedetomidine 2 mcg /kg IV over 10 min
Etomidate: 0.15–0.2 mg/kg (max. 20 mg)
Fentanyl: 1–5 mcg /kg IV (max. 100 mcg); 1.5 mcg/kg intranasal (max. 60 mcg)
Hydromorphone: 0.015 mg/kg (max. 2 mg) IM/IV/SC
Ketamine: 1.5 mg/kg IV; 3–4 mg/kg IM (max. 75–150 mg)
Ketorolac 0.5 mg/kg (max. 30 mg) IM/IV
Midazolam: 0.1 mg/kg (max. 5 mg); 0.25–0.4 mg/kg intranasal (max. 5 mg)
Morphine: 0.1–0.2 mg/kg (max. 15 mg) IM/IV/SC
Pentobarbital 1–2 mg/kg IV (max. 100 mg); 2–4 mg/kg IM (max. 100 mg)
Propofol: 1.5 mg/kg (max. 30 mg), then 0.5 mg/kg (max. 20 mg)

Stridor/Croup

Racemic epi (2.25%) 0.05 mL/kg (max. 0.5 mL) in 3 mL NS via nebulizer q 20 min
Dexamethasone 0.3–0.6 mg/kg (max. 10 mg) IM/IV/PO

Pediatric Cardiac Arrest Algorithm–2015 Update



CPR Quality

- Push hard (≥1/3 of anteroposterior) diameter of chest) and fast (100–120/min) and allow comlete chest recoil.
- Minimize interruptions in compressions.
- Avoid excessive ventilation.
- Rotate compressor every 2 minutes, or sooner if fatigued.
- If no advanced airway, 15:2 compression-ventilation ratio.

Shock Energy for Defibrillation

First shock 2 J/kg, second shock 4 J/kg, subsequent shocks ≥4 J/kg, maximum 10 J/kg or adult dose

Drug Therapy

- **Epinephrine IO/IV dose:** 0.01 mg/kg (0.1 mL/kg of 1:10 000 concentration). Repeat every 3–5 minutes. If no IO/IV access, may give endotracheal dose: 0.1 mg/kg (0.1 mL/kg of 1:1000 concentration).
- **Amiodarone IO/IV dose:** 5 mg/kg bolus during cardiac arrest. May repeat up to 2 times for refractory VF/pulseless VT.
- **Lidocaine IO/IV dose:** Initial: 1 mg/kg loading dose. Maintenance: 20–50 mcg/kg per minute infusion (repeat bolus dose if infusion initiated >15 minutes after initial bolus therapy.)

Advanced Airway

- Endotracheal intubation or supraglottic advanced airway
- Waveform capnography or capnometry to confirm and monitor ET tube placement
- Once advanced airway in place, give 1 breath every 6 seconds (10 breaths/min) with continuous chest compressions

Return of Spontaneous Circulation (ROSC)

- Pulse and blood pressure
- Spontaneous arterial pressure waves with intra-arterial monitoring

Reversible Causes

- **H**ypovolemia
- **H**ypoxia
- **H**ydrogen ion (acidosis)
- **H**ypoglycemia
- **H**ypo-/hyperkalemia
- **H**ypothermia
- **T**ension pneumothorax
- **T**amponade, cardiac
- **T**oxins
- **T**hrombosis, pulmonary
- **T**hrombosis, coronary

Glasgow Coma Scale				Modified Gla	
Score	**Eye opening**	**Verbal**	**Motor**	**Eye opening**	**Verbal**
6	–	–	Obeys	–	–
5	–	Oriented	Localizes	–	Coos/b
4	Spontaneous	Confused	Withdraws	Spontaneous	Irritable
3	To speech	Inappropriate words	Abnormal flexion	To speech	Cries to
2	To pain	Nonspecific sound	Abnormal extension	To pain	Moans
1	None	None	None	None	None

Newborn resuscitation in the ED

A. Warm, position, clear airway, dry, stimulate, reposition

B. HR <100/min: O_2 by face mask, BVM, or ETT at 40–60/min

C. HR <60/min: Chest compressions at 90/min with 30 breath/min

D. HR <60/min: Epinephrine (1:10,000 = 0.1 mg/mL) IV 0.1 mL/kg; ETT 0.5 mL/kg

Meconium with apnea or HR <100/min or limp or cyanotic: Direct ETT suction

Endotracheal tube size

Uncuffed: (Age +16)/4 | Cuffed: (Age +14)/4 | Premature: Gestational age (wks)/10

Endotracheal tube depth: 3 × (endotracheal tube size)

Systolic BP

Minimum: 70 + 2 × (age in years) | Maximum: 110 + 2 × (age in years)

Anion gap

= $Na^+ - (Cl^- + HCO_3^-)$; normal = 10–14 mEq/L)

Osmolality

= 2 × (Na^+ + Glucose/18 + BUN/ 2.8); normal = 275–295 mOsm/L

Acid–base

pCO2 ↑ by 10 mmHg → pH ↓ 0.08 | HCO3 ↓ by 10 mEq/L → pH ↓ 0.15

Transfusion of pRBC/platelets/fresh frozen plasma/albumin/cryoprecipitate

= 10 mL/kg

Initial ventilator settings

<10 kg: Pressure-limited with IP 20 cm H_2O | >10 kg: volume-preset with TV 8–10 mL/kg

Rate: Infant 20–30/min; child 18–24/min; adolescent 14–20/min

PIP =20–30 cm H_2O | PEEP = 4–5 cm H_2O | Inspiratory time = 0.5–1 second | I: E = 1:2

BiPAP: Initial IPAP = 8–12 cm H_2O | EPAP = 4–5 cm H_2O