Tarascon Pediatric Emergency Pocketbook

Seventh Edilion

From the pubJishers of the *Tarascon Pocket Pharmacopoeia*®

Pra&hant Mahajan, MD

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Prashant Mahajan, MD, MPH, MBA

Professor of Emergency Medicine and Pediatrics
Vice-Chair, Department of Emergency Medicine
Section Chief, Pediatric Emergency Medicine
University of Michigan
C. S. Mott Children's Hospital of Michigan

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CONTENTS

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ABBREVIATIONS

bid	twice per day
BP	blood pressure
cm	centimeters
CNS	central nervous system
CSF	cerebrospinal fluid
dl	deciliter
D_5W	5% dextrose in H_2O ($D_{10}W$, 10% dextrose; $D_{25}W$, 25% dextrose; $D_{50}W$, 50% dextrose)
ET	endotracheal
F	French
g	grams
Hb	hemoglobin
HR	heart rate
ICP	intracranial pressure
Ig	immunoglobulin
IM	intramuscular
IV	intravenous
J	joules
kg	kilogram
m^2	square meter
mcg	micrograms
mEq	milliequivalent
ml	milliliters

mm	millimeters
ms	milliseconds
NS	normal saline
O_2	oxygen
PO	by mouth
PMN	neutrophil
PR	by rectum
prn	as needed
RR	respiratory rate
SC	subcutaneous

1 ■ ABUSE (NONACCIDENTAL TRAUMA)

ABUSE (NONACCIDENTAL TRAUMA)

SUSPECT IF:

1. **History:** Delay in seeking care, inconsistent stories, inappropriate affect of caregivers, pattern of injury does not match history.
2. **Pattern of Injury:**
   - **Bruising:**
     - If present on any region in infants <4 months of age or in a child that is not mobile
     - If located on neck, ear, torso, genitalia, buttocks in a child <4 years of age
     - If shape of causative agent is maintained, typically hand/finger markings, buckle, belt, looped cord, spatula, cigarette or car cigarette lighter, hanger, kitchen utensil or teeth[1]
   - **Burns:**
     - If there are clear demarcation lines; these are seen in immersion injuries
     - If the splash-burn injury is not consistent with the developmental age of the child
     - If the scald is of uniform depth, has sharply delineated borders, if flexures are spared, if there is involvement of buttocks, perineum and lower limbs, if there is a glove or stocking distribution, or if there is symmetrical distribution
   - **Cold injuries:** If the child presents with signs of cold injuries or hypothermia with no obvious medical explanation
3. **Fractures:** Long bone fractures especially in a child that is not walking
   - Fractures in children <18 months
   - Multiple fractures at one time and/or at different stages of healing
   - Rib fracture in the absence of major injury, birth trauma, or underlying bone disease
   - Scapula, skull, and sternum fractures
   - Avulsion fracture of clavicle or acromion
   - Metaphyseal corner fractures, bucket handle fractures
   - Spinal fractures
   - Fractures on either side of the spine and close to the sternum (shaken baby)
4. **Intracranial injuries:** If multiple hemorrhages over convexity of brain or, in interhemispheric fissures or, if hypoxic ischemic injury or, if associated with retinal hemorrhages
5. **Visceral injuries:** In the absence of major accidental trauma or unsuitable explanation
6. **Oral injury:** Frenular tear highly suspicious

Because the history is unreliable and physical examination findings are not sensitive, abusive head trauma (AHT) is notoriously difficult to diagnose and the consequences of missing AHT can be devastating. The neurological examination is tremendously limited in children <1-year-old, and AHT is more common than anyone likes to think. The Pittsburg Infant Brain Injury Score is a clinical predictor rule developed to help clinicians consider AHT as a cause of an infant's presenting symptoms. This should be considered in infants who present with a brief, resolved, unexplained event (BRUE), emesis (>4 episodes) without diarrhea, seizures, scalp

swelling, bruising, lethargy, or other neurologic symptoms. The 5-point clinical prediction rule includes: abnormal skin exam (2 points); age≥3 months (1 point); head circumference >85th percentile (1 point); and serum hemoglobin <11.2 g/dl (1 point). Using a prediction rule cut-off score of 2 points yielded sensitivity of 93%, specificity of 53%, and positive predictive value of 39% for abnormal neuroimaging. Clinicians should also measure hemoglobin and obtain a head circumference to help make their decision. Head CT or MRI should be routinely used in these children who meet the above criteria.[2,3]

Suspect sexual abuse: If a girl or boy has genital/anal lesion without any explanation or if there is associated genital symptoms with behavioral or emotional changes. If there is anal fissure or gaping anus with no medical explanation. If there are one or more foreign bodies in vagina or anus.

Consider sexual abuse: If a child younger than 13 years has Hepatitis B or anogenital warts or sexually transmitted infections like gonorrhea, chlamydia, syphilis, genital herpes, hepatitis C, HIV, or trichomonas infection and there is no evidence of mother to child transmission during birth or nonsexual transmission from a member of the household. Consider sexual abuse if the above mentioned symptoms are seen in older children from nonconsensual sexual activity, or if the relationship is incestuous, or is with a person in a position of trust, or if there is clear difference in mental capacity between the young person and their sexual partner.

Table 1-1 Appearances of Bruises Over Time

- Bruises of any color (red, blue, purple, yellow, green, gray) can occur at any time.
- Evidence for accurately dating bruises is lacking.
- Abuse should be suspected if injuries occur over nonbony prominences such as ears, neck, face, hands, back, buttocks, forearm, foot, and abdomen, especially in children <4 years, or if the mechanism does not fit the injury pattern.

Description

Modified from Maguire S, Mann M. Systematic reviews of bruising in relation to child abuse—what have we learnt: an overview of review updates. *Evid Based Child Health.* 2013;8(2):255-263.

Table 1-2 Bony Injuries Associated with Child Abuse

Fractures associated with a high or moderate specificity for abuse	• Rib fractures (especially posteromedial have highest probability of abuse), scapular fractures, sternal fractures • Metaphyseal-epiphyseal fractures [e.g., corner fractures (bucket-handle fractures), metaphyseal lucency] • Spinous process, vertebral body fractures, and subluxations • Fractures in different stages of healing or delayed presentation • Fractures inconsistent with history or

	developmental age • Skull fractures—if multiple, bilateral, or cross suture lines • Pelvic fractures (rare) or spine fractures without significant force • Femur fractures in nonambulatory patients • Midshaft humeral fractures ≤1–2 years old
Fractures associated with a low specificity for abuse	• Clavicle fractures due to birth (infants <22 days or infants <30 days with a healing fracture) • Distal tibia spiral fractures (toddler's fracture), unless nonambulatory • Supracondylar fractures, fractures of the hands or feet (except digital fractures in nonambulatory infants or multiple fractures) • Torus fractures of long bones

Description

Modified from Kemp A, Dunstan F, Harrison S, et al. Patterns of skeletal fractures in child abuse: systematic review. *BMJ.* 2008;337:a1518; Borg K, Hodes D. Guidelines for skeletal survey in young children with fractures. *Arch Dis Child Educ Pract Ed.* 2015;100:253-256; Flaherty EG, Perez-Rossello JM, Levine MA, et al. Evaluating children with fractures for child physical abuse. *Pediatrics*. 2014;133:e477-e489.

Table 1-3 Appearances of Fractures Over Time

Age of fracture	Fracture appearance
4–10 days	Resolution of soft-tissue swelling
10–14 days	New periosteal bone
14–21 days	Fracture line definition lost and soft callus present
21–42 days	Hard callous present
2–24 months	Remodeling of fracture

Description

Table 1-4 Head Injury Associated with Abuse

- Subdural hematoma
- Extra-axial hemorrhages (esp. interhemispheric, multiple bleeds, or in posterior fossa)
- Parenchymal brain injury (e.g., contusion, axonal injury, laceration)
- Retinal hemorrhage (usually bilateral)

Description

Modified from Kemp AM. Abusive head trauma: recognition and the essential investigation. *Arch Dis Child Educ Pract Ed*. 2011;96(6):202-208; Choudhary AK, Servaes S, Slovis TL, et al. Consensus statement on abusive head trauma in infants and young children. *Pediatr Radiol*. 2018;48(8):1048-1065.

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3. Hymel KP, Armijo-Garcia V, Foster R, et al. Validation of a clinical prediction rule for pediatric abusive head trauma. *Pediatrics*. 2014;134(6):e1537-e1544.

2 ■ ADVANCED LIFE SUPPORT

VITALS AND RESUSCITATION EQUIPMENT

Table 2-1 Age-Based Estimates for Vital Signs and Weight

Age	Weight (kg)	Heart rate[1] BPM*	Respiratory rate/minute	Systolic BP[2] mm Hg	Diastolic BP[2] mm Hg
Premature	1	145	~ 40	42 ± 10	21 ± 8
Premature	1–2	145	~ 40	40 ± 10	28 ± 8
Newborn	2–3	125	~ 40	60 ± 10	37 ± 8
1 month	4	120	24–35	80 ± 10	46 ± 16
6 months	7	130	24–35	89 ± 29	60 ± 10
1 year	10	120	20–30	96 ± 30	66 ± 25
2–3 years	12–14	115	20–30	99 ± 25	64 ± 25
4–5 years	16–18	100	20–30	99 ± 20	65 ± 20
6–8 years	20–26	100	12–25	100 ± 15	60 ± 10
10–12 years	32–42	75	12–25	110 ± 17	60 ± 10
>14 years	>50	70	12–18	118 ± 20	60 ± 10

*BPM—beats per minute.

[1]Heart rate rises 10–14 beats/minute for each 1°C rise in temperature. [2]BP—mean ± 2 standard deviations.

Modified from Thompson, M., Harnden, A., Perera, R., Mayon-White, R., Smith, L., McLeod, D., & Mant, D. Deriving temperature and age appropriate heart rate centiles for children with acute infections. *Archives of Disease in Childhood*, 2009;94(5):361-365. doi:10.1136/adc.2008.145011

Description

Table 2-2 Resuscitation Equipment: First Drug Dose Based on Length, Weight, or Age[1]

Age	3 months	6 months	1 year	2 years	3 years	5 years	10 years
Length (cm)	**50–58**	**58–70**	**70–85**	**85–95**	**95–107**	**107–124**	**138**
Weight (kg)	**5–6**	**7–8**	**9–11**	**12–14**	**15–17**	**18–24**	**32**
Bag mask	Infant	Infant	Child	Child	Child	Child	Adult
Oral airway	Infant	Infant	Child	Child	Child	Child	Sm[2] adult
LMA	1	1	2	2	2	2.5	3
O_2 mask	Newborn	Newborn	Peds	Peds	Peds	Adult	Adult
ET tube[3]	3–3.5	3.5–4	3.5–4	4–4.5	4.5	5	6–6.5
Laryngoscope	1 Miller	1 Miller	1 Miller	2 Miller	2[4]	2[4]	2–3[4]
Suction catheter	8F	8F	8–10F	10F	10F	10F	10F
NG tube	5–8F	5–8F	8–10F	10F	10–12F	12–14F	16–18F
Urine catheter	5–8F	5–8F	8–10F	10F	10–12F	10–12F	12–14F

Length (cm)	**50–58**	**58–70**	**70–85**	**85–95**	**95–107**	**107–124**	**138**
Weight (kg)	**5–6**	**7–8**	**9–11**	**12–14**	**15–17**	**18–24**	**32**
Chest tube	10–12F	12–14F	16–20F	20–24F	20–24F	24–32F	28–32F
Amiodarone	25–30	35–40	45–55	60–70	75–85	90–120	160
Ampicillin	250–300	350–400	450–550	600–700	750–850	900–1,200	1,600
Atropine	0.1–0.12	0.14–0.16	0.18–0.22	0.24–0.28	0.3–0.34	0.36–0.48	0.6
Bicarb (mEq)	5–6	7–8	9–11	12–14	15–17	18–24	32
Ceftriaxone	250–300	350–400	450–550	600–700	750–850	900–1,200	1,600
Cefotaxime	250–300	350–400	450–550	600–700	750–850	900–1,200	1,600
Defibrillator (J)	10–12	14–16	18–22	24–28	30–34	36–48	64
Dextrose (g)	5–6	7–8	9–11	12–14	15–17	18–24	32
Epinephrine	0.05–0.06	0.07–0.08	0.09–0.11	0.12–0.14	0.15–0.17	0.18–0.24	0.32
Lidocaine	5–6	7–8	9–11	12–14	15–17	18–24	32
Lorazepam	0.5–0.6	0.7–0.8	0.9–1.1	1.2–1.4	1.5–1.7	1.8–2.4	3.2
Normal saline[5]	100–120	140–160	180–220	240–280	300–340	360–480	640
Succinylcholine	10–12	14–16	14–16	18–21	15–17	18–24	32

[1]All drugs are in mg unless otherwise specified. [2]Sm—small. [3]Uncuffed (if cuffed ET tube used in child, subtract 1). [4]Miller or Macintosh. [5]Bolus in ml for hypovolemia.

Description

CPR, NEWLY BORN

Table 2-3 CPR Maneuvers and Techniques in Newborns, Infants, and Children

Maneuver	Newly born/neonate	Infant (<1 year)	Child (1–8 years)
Open Airway	*Head tilt, chin lift (jaw lift without head tilt if trauma), all ages*		
Breathing *Initial*	May require 30–40 cm H_2O pressure	Two breaths to make chest rise	Two breaths to make chest rise
Subsequent (if no CPR)	30–60 breaths/minute	12–20 breaths/minute	12–20 breaths/minute
Subsequent (during CPR)	30–60 breaths/minute	8–10 breaths/minute	8–10 breaths/minute
Circulation[1] *Check pulse*	Umbilical/brachial	Brachial or femoral	Carotid
Compress at	Lower 1/3 sternum	Lower 1/3 sternum	Lower 1/3 sternum
Compress with	Two thumbs encircle chest with hands	Two thumbs encircle chest with hands	Heel of one hand
Depth	*One-third depth of chest for all listed ages*		
Rate[2]	120/minute	100–120/minute	100–120/minute
Ratio[3,4]	3:1—interpose breaths	15:2	15:2
Foreign Body Airway Obstruction[5]	Back blows Chest thrusts	Back blows Chest thrusts	Chest thrust, back blows, or abdominal thrusts

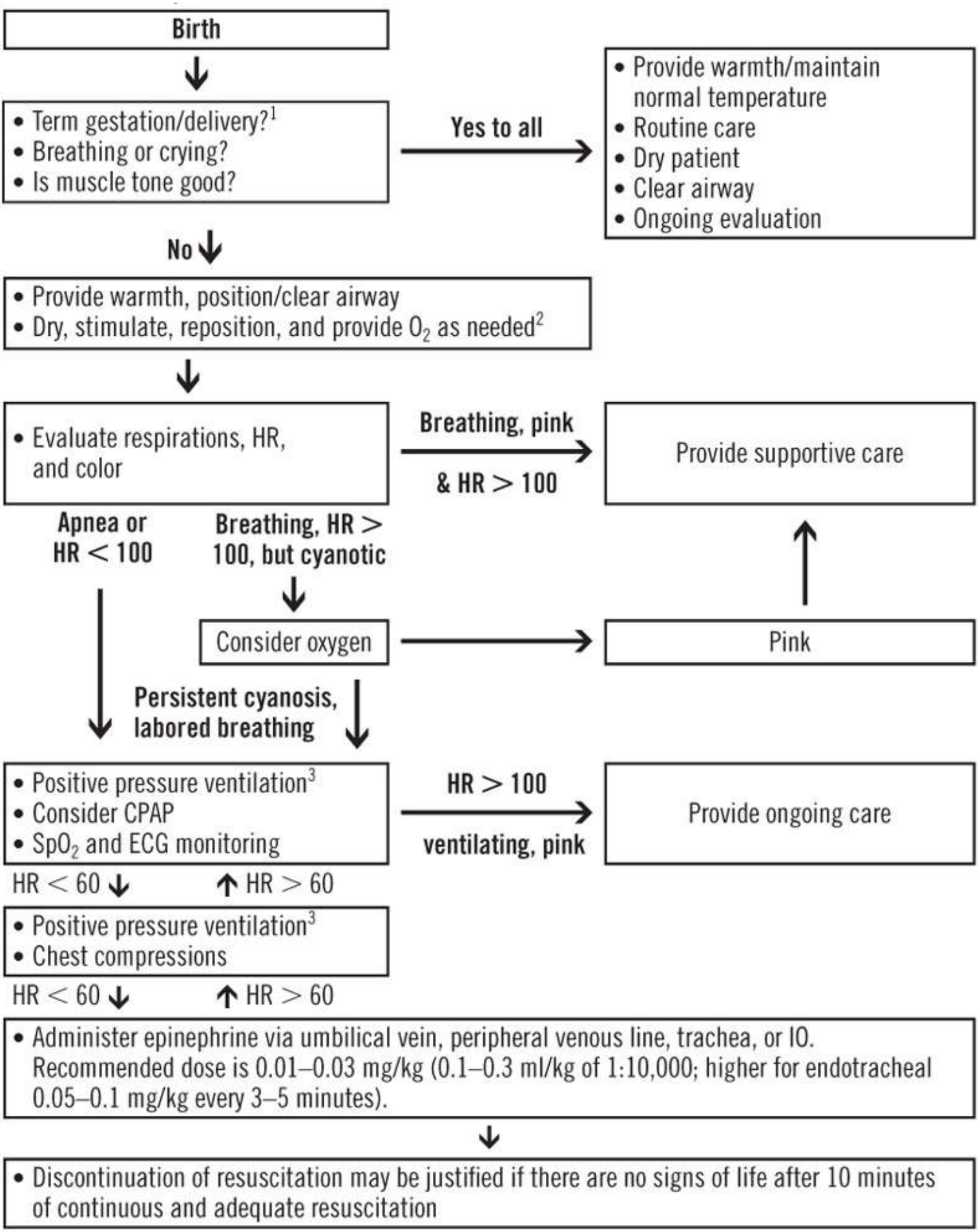
[1]Also check for normal breathing, movement, or coughing. Gasping is not considered as breathing normally. Laypeople do not check pulse. [2]Total number of events: compressions plus breaths per minute. [3]Ratio of 3:1 in neonates with 90 compressions and 30 breaths per minute. Rescuers may consider higher ratios of 15:2 if cardiac etiology is suspected for the arrest. Coordinated CPR should be continued until HR is ≥60/minute. [4]Ratios are for two-person CPR only. [5]Only if obstruction is severe and victim is unable to make a sound. Older than age 1 year, chest thrusts transmit higher airway pressures and induce less trauma than abdominal thrusts.

Visit the following website for current recommendations: https://www.ilcor.org/consensus-2015/costr-2015-documents/

Modified from Gateway to ILCOR 2010. www.americanheart.org/ILCOR

Description

Table 2-4 Newly Born Resuscitation



[1]Meconium management: *Intrapartum*—Do not deep suction mouth, pharynx, and nose after

delivery of the head. *Following delivery*—Place on mother and suction with bulb syringe and gentle cutaneous stimulation while drying recommended if vigorous infant. Immediate positive pressure ONLY if (1) depressed respirations, (2) absent or diminished muscle tone, or (3) HR < 100 beats/minute. Suctioning of the trachea before initiating positive pressure ventilation (positive pressure) is NOT recommended. [2]Begin positive pressure/resuscitation with 21% FiO_2 and titrate up as required (≤ 35 weeks 25–30% FiO_2). [3]Consider endotracheal (ET) intubation (ETI) if positive pressure ventilation is ineffective at this step. ETI also indicated if ineffective bag mask ventilation, chest compressions, ET medication administration, congenital diaphragmatic hernia, or birth weight < 1,000 g.

Modified from American Heart Association and American Academy of Pediatrics. 2005 American Heart Association (AHA) guidelines for cardiopulmonary resuscitation (CPR) and emergency cardiovascular care (ECC) of pediatric and neonatal patients: neonatal resuscitation guidelines. *Pediatrics*. 2006;117(5):e1029-e1038.

Description

Table 2-5 Newly Born Resuscitation—Withholding or Discontinuing

Withhold resuscitation (Do not begin)	• Death is certain based on weight (<400 g), age < 22 weeks, or congenital anomaly incompatible with life (e.g., anencephaly, trisomy 13 or 18) • If condition with uncertain prognosis (22–24 weeks), survival borderline, high morbidity, and anticipated burden to child are high, then follow parent's wishes • Resuscitation is nearly ALWAYS indicated if high survival and acceptable morbidity (e.g., ≥ 24 weeks and most congenital malformations)
Discontinue (stop) resuscitation	• If no signs of life (no heart rate or respirations) after 10 minutes of continuous and adequate resuscitation

Description

Modified from American Heart Association Recommendations. Visit the following website for updated recommendations: https://eccguidelines.heart.org/circulation/cpr-ecc-guidelines/

Table 2-6 Size of Endotracheal Tube/Laryngoscope Blade for Newly Born

Gestational age	Birth weight (g)	Size of ET tube[1,2]	Blade size[3]
<28 weeks	< 1,000	2.5	Number 0 straight
28–34 weeks	1,000–2,000	2.5–3.0	Number 0 straight
34–38 weeks	2,000–3,000	3.0–3.5	Number 0 straight
>38 weeks	Term (>3,000)	3.5	Number 0–1 straight

[1]Internal diameter in millimeters. [2]Depth at gum line = Infant's nasal-tragus length (NTL) + 1 cm. [3] Wide/fat straight blades (e.g., Wis-Hipple, Flagg) may be superior to thin (Miller) blades for manipulating normally large neonatal/infant tongues.

Description

Table 2-7 Normal Blood Pressure for Different Birth Weights

Weight	<1 kg	1–2 kg	2–3 kg	> 3 kg
Systolic BP	40–60	50–60	50–70	50–80
Diastolic BP	15–35	20–40	25–45	30–50

Description

Table 2-8 Apgar Scoring[1]

Sign	0	1	2
Heart rate	Absent	<100	>100
Respiratory effort	Absent	Slow/irregular	Good, cry
Muscle tone	Flaccid	Some extremity flexion	Active motion
Reflex irritability	No response	Grimace	Vigorous cry
Color	Pale	Cyanotic	Completely pink

[1]Apgar is checked at 1 and 5 minutes postdelivery. A score of 0–3 requires intense resuscitation, a score of 4–7 requires some intervention, and a score of 7–10 is normal.

Description

GLUCOSE AND HYPOGLYCEMIA

Hypoglycemia = a blood glucose <40–45 mg/dl in neonates (<35–40 if premature). Due to inaccuracy of bedside glucose, give glucose to all neonates with bedside glucose <50 mg/dl. *Dose:* 5 to 10 ml/kg of D_{10}.

Table 2-9 Normal Arterial Blood/Hematocrit (Hct) Values in Full-Term Newly Born[1]

Age	PaO_2	$PaCO_2$	pH	Base excess	Hct (vol.%)
1 hour	63 mm Hg	36 mm Hg	7.33	–6.0 mEq/L	53
24 hours	73 mm Hg	33 mm Hg	7.37	–5.0 mEq/L	55

[1]Healthy newborns take >10 minutes to achieve a pre-ductal O_2 saturation > 95%, and up to 1 hour post-ductal.

Description

Drug Therapy

IO route can be used for therapy if IV or umbilical vein unavailable.

Epinephrine—Indicated if HR < 60 after 30 seconds of effective ventilation and high-quality CPR. Dose at 0.01–0.03 mg/kg IV/IO/umbilical vein (0.1–0.3 ml/kg of 1:10,000; higher for endotracheal 0.05–0.1 mg/kg every 3–5 minutes) (0.1–0.3 ml/kg of 0.1 mg/ml) every 3–5 minutes prn. ET dose 0.05–0.1 mg/kg, 0.5–1 ml/kg; of 1 mg/ml.

Dopamine—Use if unresponsive hypotension. See Table A-2 for infusion.

Glucose—Hypoglycemia is most common in premature or small-for-gestational-age infants following a prolonged and difficult labor, mothers on ritodrine or terbutaline, and infants of mothers with diabetes. Hypoxia, hypothermia, hyperthermia, and sepsis deplete glucose stores. Treat with 5–10 ml/kg of $D_{10}W$ IV push, then infuse 6–8 ml/kg/minute.

Naloxone—0.01–0.1 mg/kg IV/ET/umbilical vein/IM/SC if severe respiratory depression and maternal narcotic administration in prior 4 hours. Caution: Naloxone may precipitate seizures if mother used narcotics chronically.

Sodium bicarbonate—Do not use unless specific circumstances or severe and refractory acidosis. 1–2 mEq/kg IV/umbilical vein of 0.5 mEq/ml solution over ≥ 2 minutes. IV push may cause venous irritation/CNS bleed.

Volume: NS or O neg blood at *10 ml/kg IV/umbilical over 5–10 minutes*. Do not use LR for fluid resuscitation.

UMBILICAL ARTERY/VEIN CATHETERIZATION

The umbilical vein is a single thin-walled vessel that is the preferred access site during newly born resuscitation. Prep abdomen/cord in a sterile manner. Loosely tie umbilical tape to cord base for anchoring/hemostasis. Cut cord with scalpel 2 cm from abdominal wall.

Umbilical vein—Remove visible clot, flush catheter with heparin. Use 3.5–4F catheter if <2 kg and 5–8F for >2 kg neonates. Advance umbilical catheter (5–8F) through vein until blood return or 4–5 cm. Lateral clavicle to umbilicus length in cm × 0.6 places catheter tip above diaphragm. Tighten umbilical tape to secure catheter and withdraw after resuscitation.

Umbilical artery—After dilating with iris forceps, insert tip of catheter to lumen. (1) Use nomogram with total body length to estimate depth; **OR** (2) for thoracic umbilical artery

catheter, estimate shoulder to umbilicus (S-U) distance. If (S-U) < 13 cm, insert S-U distance + 1 cm. If S-U > 13 cm, insert to depth of S-U distance + 2 cm; **OR** (3) if birth weight < 1.5 kg insertional length = [4 × weight (kg) + 7] cm. Correct position verified by catheter position between T6 and T10 on radiography.

Modified from Wright, I. M. R., Owers, M., & Wagner, M. The umbilical arterial catheter: A formula for improved positioning in the very low birth weight infant. Pediatric Critical Care Medicine, 2008:9(5):498-501.

INTRAOSSEOUS (IO)

May be placed more quickly than umbilical line in critically ill, term neonates. Place IO in proximal tibia (1–2 cm distal + medial to tuberosity), distal tibia (medial malleolus; tibial shaft junction), or distal femur (as condyle tapers into shaft). After site is sterilized, puncture skin, direct needle slightly away from growth plate. Push and rotate gently until "pop" and advance 0.5–1 cm. Confirm by (1) aspiration of marrow OR (2) easy infusion of 3 ml NS with aspiration of injected fluid that returns with pink tinge. Aspirate for labs (hemoglobin, type and cross-match, electrolytes, BUN, creatinine, blood count) and infuse medications/fluid/blood with large syringe. Pressure infusion required for infusion. Any advanced life support drug or blood can be given IO. Watch for extravasation. Remove as soon as alternate access site is obtained.

See specific scenarios next.

Table 2-10 Management of the Critically Ill Neonate (≤ 28 days old)

Perform Initial Resuscitation
• Check O_2 saturation, administer 100% O_2, ventilate or intubate if needed. • Apply cardiac monitor; assess heart rate, rhythm, perfusion, blood pressure; and examine. • Obtain IV/IO access and administer NS (10 ml/kg in newborn, 20 ml/kg if older) if hypoperfusion (e.g., low blood pressure, altered mentation, poor skin signs) ***UNLESS*** congestive heart failure present (see Congestive Heart Failure, which follows). • Check glucose, administer D_{10} (5–10 ml/kg) if <30–40 mg/dl newborn, <50 mg/dl in infant • Labs (cultures, CBC, electrolytes, UA), ECG, CXR, and other tests (e.g., ultrasound, CT) as indicated.

Description

Address Following Scenarios If Present	
Scenario	**Management Considerations**
HR > 220 beats/minute →	• Cardioversion (synchronized) at 0.5–1 J/kg if shock, extreme dyspnea, or otherwise unstable • Adenosine or amiodarone (see pages 48, 336)
Congestive Heart Failure →	• Lasix 1 mg/kg IV, ± dobutamine or dopamine • See pages 52–53, 336 • See unresponsive hypoxia, which follows
Cyanosis—unresponsive *(pO_2 < 50 after 100% O_2 administration X 10 minutes)* →	• *No congestive heart failure present:* "Tet spell": knee-chest position, saline IV (if no congestive heart failure), $NaHCO_3$, phenylephrine, and prostaglandin E1 (see page 337) • *Congestive heart failure present*: e.g., transposition of great arteries; treat congestive heart failure (see previous), and prostaglandin E1
Acute Stridor *(intubate if needed)* →	• Consider laryngomalacia, tracheomalacia, or brainstem lesion (bilateral vocal cord paralysis)
Bilious Vomiting →	• IV fluids, NG tube, ± IV antibiotics • Surgical consult (± upper GI series after consult) • See pages 284–285
Lethargy with Recurring Hypoglycemia, or Acidosis, High Ammonia →	• IV fluids, replace glucose • Management differs with metabolic error • See pages 197–198, metabolic errors
Hypoglycemia, Low Sodium, High Potassium, ± Ambiguous Genitalia →	• IV fluids, treat hypoglycemia • Hydrocortisone 25 mg IV (draw extra blood) • See pages 69–70, adrenal crisis
Inconsistent Story (Trauma or Altered Sensorium) →	• CT head (abdomen/pelvis), skeletal survey • Manage trauma, pages 315–329 • Report to police, child protective services
Other Cases →	• Consider sepsis and administer fluids, antibiotics, vasopressors, and blood as needed

Figure 2-1 Management considerations for the critically ill neonate (≤ 28 days old)
Description

Table 2-11 Pulseless Cardiac Arrest

Provide CRP, attach monitor and defibrillator, estimate weight using Broselow-Luten tape, and assess rhythm

VF/Pulseless VT[1]

Defibrillation[3]
- Shock once at 2 J/kg or
- Use AED > 1 year
- **Resume CPR for 5 cycles (2 minutes)**

PEA[2] or Asystole

- **Resume CPR**
- Give epi[4] IV or IO at 0.01 mg/kg (0.1 ml/kg)
- Repeat every 3–5 minutes

During CPR—15 compressions and 2 breaths for two-person CPR, secure airway and confirm placement with waveform capnography. After intubation perform CPR without pausing for breaths (8–10 breaths/minute) via ET tube

Search for and treat causes of cardiac arrest: hypovolemia, hypoxia, hydrogen ion (acidosis), hypo/hyperkalemia, hypoglycemia, hypothermia, toxins, tamponade, tension pneumothorax, trauma, thrombosis (coronary or pulmonary)

If VF/pulseless VT persist after 2 minutes CPR
- Shock at 4 J/kg or use AED > 1 year
- Resume CPR
- Give epinephrine IV/IO or ET tube

Resume CPR
For 5 cycles (2 minutes)
- If pulseless VT or VF, see VT/VF algorithm to left

After 5 cycles of CPR, recheck rhythm; if VF/pulseless VT persist:
Shock once at 4–10 J/kg or use AED > 1 year

Consider one of the following:
(1) **Amiodarone** 5 mg/kg IV/IO (max 300 mg, repeat second dose if necessary)
(2) **Lidocaine** 1 mg/kg IV/IO
(3) **Magnesium** sulfate 25–50 mg/kg IV/IO (max 2 g) if Torsades de pointes

→ After meds, continue CPR for 5 cycles (2 minutes) and recheck rhythm:
If VF/pulseless VT, resume CPR, recheck rhythm 2 minutes followed by shock and epi every 3–5 minutes and antiarrhythmics
If Asystole/PEA, treat per PEA/asystole

[1]VF—ventricular fibrillation; VT—ventricular tachycardia. [2]PEA—pulseless electrical activity. [3]Biphasic defibrillation is superior to monophasic. Limited evidence suggests 2 J/kg is too low a dose. May give 2–10 J/kg, not to exceed adult dose. [4]Give epinephrine (epi) every 3–5 minutes.

VASCULAR ACCESS

See pages 6–7 for techniques of umbilical vein/artery and intraosseous access, and page 97 for subcutaneous fluid options (not for use during acute resuscitation).

Table 2-12 Central Venous Catheter Diameter Based on Age and Site (int. diameter-French)

Age (years)	Weight (kg)	Internal jugular vein	Subclavian vein	Femoral vein
0–0.5	3–7	3F	3F	3F
0.5–2	7–15	3F	3F	3–4F
3–6	15–25	4F	4F	4–5F
7–12	25–60	4–5F	4–5F	5–8F

Description

Table 2-13 Right Internal Jugular and Right Subclavian (SC) Central Venous Catheter Depth (cm)[1,2]

Initial catheter insertion based on patient height/length	Height < 100 cm	Height ≥ 100 cm
	Initial Catheter Depth = Height (cm)/10 – 1 cm	Initial Catheter Depth = Height (cm)/10 – 2 cm

Initial catheter insertion based on patient weight (Note: Chart and formula are based on patient's weight when known, and age is only approximated based on patient's weight)	Approx. age	Weight (kg)	Length/Depth (cm)
	0–2 months	3.0–4.9	5
	> 2–5 months	5.0–6.9	6
	6–11 months	7.0–9.9	7
	1–2 years	10.0–12.9	8
	> 2–6 years	13.0–19.9	9
	> 6–9 years	20.0–29.9	10
	> 9–12 years	30.0–39.9	11
	> 12–14 years	40–50	12

[1]If <100 cm, puncture skin for SC vein 1 cm lateral to mid clavicle, 2 cm lateral if ≥100 cm.
[2]Formulas will place 97–98% of catheters above right atrium.

Modified from Dean B. Andropoulos, The Optimal Length of Insertion of Central Venous Catheters for Pediatric Patients, *Anesthesia & Analgesia*. 2001;93(4):883-886.

Description

Table 2-14 Femoral Vein Catheter Mean Length/Insertion Depth

Age	Weight (kg)	Height (cm)	Length (cm)	Age	Weight (kg)	Height (cm)	Length (cm)
1 month	4.2	55	15.7	2 years	12.8	88	24.2
3 months	5.8	61	17.3	4 years	16.5	103	28.1
6 months	7.8	68	19.1	6 years	20.5	116	31.4
9 months	9.2	72	20.1	8 years	26	127	34.2
1 year	10.2	76	21.1	10 years	31	137	36.8
1.5 years	11.5	83	22.9	12 years	39	149	39.9

Description

3 ■ AIRWAY AND ANESTHESIA

Table 3-1 Endotracheal Tube (ET Tube) Size and Depth, and Laryngoscope Size

Age	Laryngoscope[1]	Weight (kg)	ET tube size	ET tube depth[2]
Premature	Straight 0	1.5	2.5–3.0	8
Term	Straight 0–1	3.0	3.0–3.5	9
3 months	Straight 1	5–6	3.5	9–10
6 months	Straight 1	7–8	3.5–4.0	10
1 year	Straight 1	10	4.0–4.5	11
2 years	Straight 1	12	4.0–4.5	12–13
3 years	Miller/Macintosh 2	14	5.0	15
4 years	Miller/Macintosh 2	16	5.5	16.5
5 years	Miller/Macintosh 2	18	5.5	16.5
6–7 years	Miller/Macintosh 2	20–22	6.0	18
8–10 years	Miller/Macintosh 2	25–30	6.0–6.5	18–18.5
10–12 years	Miller/Macintosh 2	30–35	6.5	18.5
12–14 years	Miller/Macintosh 3	35–40	7.0	21

[1]Wide/fat straight blades (Wis-Hipple, Flagg) may be superior to thin (Miller) blades for manipulating normally large tongues in infants younger than 1 to 2 years old. [2]The calculation (internal diameter × 3 cm) can be used to estimate ET tube depth (at incisors or gum line) if older than 2 years old. If younger than 2 years old, this calculation slightly overestimates ET tube depth.

Description

ET TUBE SELECTION

- Uncuffed tube internal diameter estimate (mm) = (age in years ÷ 4) + 4.
- Cuffed tube internal diameter estimate (mm) = (age in years ÷ 4) + 3.
- Note in previous table, these formulas may overestimate tube size if younger than 2 years old.
- Use uncuffed ET tubes or low-pressure/high-volume cuffed tubes for those younger than 8 years. If cuffed tube is used, keep inflation pressure less than 20 cm H_2O.
- See pages 5–6, and previously for age, length/weight-based estimate for ET tube size.

GLIDESCOPE (VIDEO-ASSISTED) DIFFICULT AIRWAY OPTION

A curved plastic laryngoscope blade with 60° upward angulation and video incorporated into the undersurface of its curved side allows for a better larynx view.

Technique—(1) Insert the blade down *midline* of the tongue until the glottis/vocal cords are seen; (2) insert ET tube stylet in front of the camera; (3) advance disengaged ET tube (without advancing stylet) through the glottis, into the trachea.

Table 3-2 GlideScope Video Laryngoscope (GVL) Sizes

GlideScope video laryngoscope (GVL) sizes www.verathon.com	Age (approximate)	Weight	GVL size[1,2]
	Premature–neonate	< 3.6 kg	GVL 1
	Newborn–1 year	1.8–10 kg	GVL 2
	1–18 years	10 kg to adult	GVL 3
	12 years to adult	40 kg to obese	GVL 4
	12 years to adult	40 kg to obese	GVL 5

[1]Video baton 1–2 used with GVL 1 and 2, video baton 3–4 used with GVL 3 and 4. [2]A rigid stylet (GlideRite) can be used with the GVL 3, 4, and 5 with ET tubes that have ≥6 mm internal diameter.

Description

Table 3-3 Steps for Rapid Sequence Intubation (RSI)

Equipment
• Ready two wall-suction devices with Yankauer tips; check laryngoscope lights. • Appropriate-size ET tube and backup 0.5 to 1 size smaller; consider stylet. • Check integrity of cuff, if present (use no cuff or low-pressure cuff for those younger than 8 years).
Patient Preparation and Medications
• Raise bed (e.g., patient's nose at intubator's xiphoid), prepare alternate airway: jet ventilation, cricothyrotomy (older than 8 years), estimate weight (e.g., Broselow-Luten tape). • Confirm working pulse oximeter, cardiac monitor, end-tidal CO_2 detector. • Specify person for (1) cricoid pressure (uncertain benefit, may obstruct airway), (2) neck immobilization, (3) handling ET tube, (4) watching O_2 saturation and cardiac monitors, and (5) medications. • Position head appropriately (sniffing position if no trauma). • Draw up all drugs in syringes and ensure secure IV access is available. • Preoxygenate with 100% oxygen for at least 3–4 minutes (if time permits). • Consider lidocaine 1–1.5 mg/kg (max 100 mg) IV if head injury (however, no clear evidence that in acute traumatic injury pretreatment with lidocaine before RSI reduces ICP).

- **Atropine** 0.01 mg/kg IV (no minimum dose but max dose is 0.5 mg), use if neonate, preexisting bradycardia, or in those who receive a second dose of succinylcholine (current PALS recommendations do not include routine use and do not require a minimum dose).
- Most experts do not routinely use atropine as a defasciculating agent.
- Administer *sedating* and then *paralyzing* agent IV; apply Sellick maneuver.

Description

Modified from de Caen AR, Berg MD, Chameides L, et al. Part 12: Pediatric advanced life support: 2015 American Heart Association guidelines update for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation*. 2015;132(18 Suppl 2):S526-S542.

Table 3-4 Drugs for Rapid Sequence Intubation

Agent	Dose IV (mg/kg)	Onset (minutes)	Key properties
***Defasciculating drug**—for use if using succinylcholine as paralytic*			Not recommended in children by most experts (esp. younger than 5 years)
Rocuronium	0.06–0.1	2–3	
Vecuronium	0.01	3	Minimal tachycardia
Sedating drug			
Etomidate	0.3–0.4	<1	Minimal blood pressure effect
Fentanyl	2–6 mcg/kg	1–2	↑ ICP, chest wall rigidity
Ketamine	1–2	<1	↑ BP, ↑ ICP, ↑ GI, and eye pressure
Midazolam	0.1–0.2	1–3	Hypotension
Thiopental	3–5	<1	Hypotension, bronchospasm
Paralyzing drug			
Rocuronium[1,2]	0.6–1.2	0.5–1.5	*Esmeron,* rapid onset, lasts 25–60 minutes
Succinylcholine[3]	1–2	<1	Fasciculation ↑ BP, ICP, GI, eye pressures, malignant hyperthermia, hyperkalemia
Vecuronium[2]	0.1–0.2	1–4	Prolonged action
***Reversal drug* (if nondepolarizing agent used)**			
Sugammadex* (*Bridion*)	16 mg/kg for neuromuscular blockade due to a single dose of rocuronium 2–4 mg/kg (routine reversal dose)	3 minutes	Only for use in older than 2 years; can cause anaphylaxis, bradycardia

[1]Caution: Hyperkalemic cardiac arrest may occur if muscular dystrophy (especially if undiagnosed). [2]Use initial priming dose (1/10 of paralyzing dose) 3 minutes prior to paralyzing

dose of rocuronium or vecuronium to speed time to paralysis. [3]Use 2–3 mg/kg if younger than 1 year, 1.5–2 mg/kg at 1–5 years, and 1–1.5 mg/kg for older than 5 years.

Pongrácz A, Szatmári S, Nemes R, Fülesdi B, Tassonyi E. Reversal of neuromuscular blockade with sugammadex at the reappearance of four twitches to train-of-four stimulation. *Anesthesiology*. 2013;119(1):36-42.

Modified from Walls RM, Murphy MF. *Manual of Emergency Airway Management*. 3rd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2008, 432 pp.

Description

Table 3-5 Checklist After Performing Intubation

- Check tube placement (CO_2 detector/capnography preferred).*
- Inflate cuff (if present) then release cricoid pressure.
- Measure and record tube depth (see below).
- Reassess clinical status, ↓ HR = esophageal intubation.
- Obtain CXR to verify correct placement depth.
- Consider longer-acting sedative and paralytics.

Description

*Use DOPE mnemonic to check when poor oxygenation or ventilation occur: Displacement, Obstruction, Pneumothorax, Equipment failure.

Table 3-6 Formulae for Estimating Depth of ET Tube After Intubation

- Distance in cm from mid-trachea to incisors/gum line = 3 × (ET tube ID*)
- Distance in cm from mid-trachea to incisors/gum line = 12 + (age in years)/2
- Distance in cm from mid-trachea to incisors/gum line = (height in cm)/10 + 5
- Distance in cm from mid-trachea to nares (for nasotracheal) = 12 + (age in years)/2

Description

*ID—internal diameter (in mm).

Table 3-7 Laryngeal Mask Airway (LMA) Sizes

Mask size	Patient weight (kg)	Maximum cuff volume (ml)	Maximum ET tube* size (mm) uncuffed
1	<5	≤4	3.5
1.5	5–10	≤7	4
2	10–20	≤10	4.5
2.5	20–30	≤14	5
3	30–50	≤20	6
4	50–70	≤30	6
5	70–100	≤40	7
6	>100	≤50	7

*Maximum ET tube size that can be placed through an *LMA Classic* if it is used as a conduit during tracheal intubation. If *LMA Fastrach* is used, an 8.0 mm cuffed ET tube can be placed through a 3, 4, or 5 LMA. *LMA Supreme* allows drainage of gas and fluids away from the airway; *LMA CTrach* aids in difficult intubations.

Description

Table 3-8 Tracheostomy Tube Replacement Sizes

Age	Size	Inner diameter (mm)	Outer diameter (mm)	Suction catheter size (French)*
Premature	00	3.1	4.5	6
Newborn–3 months	0	3.4	5.0	6, 8
3–10 months	1	3.7	5.5	6, 8
10–12 months	2	4.1	6.0	6, 8
13–24 months	3	4.8	7.0	8, 10
2–9 years	4	5.0	8.5	8, 10
10–11 years	6	7.0	10.0	12, 14
≥ 12 years	6	7.0	10.0	12, 14
	8	8.5	12.0	14, 16
	10	9.0	13.0	16, 18

*Size of catheter for suctioning tracheostomy tube.

Data from J. Byron Mullins, Airway resistance and work of breathing in tracheostomy tubes,

Laryngoscope. 1993;103:1367.

Description

RESCUE PROCEDURE FOR TRANSTRACHEAL JET VENTILATION

Place a 14-gauge IV catheter attached to a 5 ml syringe through a cricothyroid membrane. Remove the needle, leaving the catheter, and confirm placement by aspirating air. Attach a 3.0 mm ET tube adapter to the IV catheter, or attach a 3 ml locking syringe (without plunger) to a 3 mm ET tube adapter. Attach a 10–50 pounds per square inch (psi) 100% O_2 source (15 l/minute) and deliver O_2 at 20 bursts/minute with an inspiratory to expiratory ratio of 1:3.

Table 3-9 Parameters for Transtracheal Jet Ventilation

Age (years)	Initial PSI	Tidal volume (ml)
< 5	5	100
5–8	5–10	240–340
8–12	10–25	340–625
> 12	30–50	700–1,000

Description

Table 3-10 Initial Ventilator Settings for Volume Limited Ventilators

Age (years)	Tidal volume (ml/kg)	Rate[1]	Inspiratory time[2]	PEEP[3]
0–1	8–10	20	0.8	3–5
1–3	10	16	0.9	3–5
4–10	8	12	1	3–5
≥ 11–12	6–8	10	1	3–5

[1]Breaths/minute. [2]Seconds. [3]Positive End-Expiratory Pressure, cm H_2O.

Description

Table 3-11 Guidelines for Mechanical Ventilation

Item	Neonates and young infants (younger than 1 year)[1]	Older children

Ventilator	Pressure-limited if weight < 10 kg	Volume limited
Resp rate	30–40 per minute	Normal for age (12–20)
I:E ratio[2]	1:2	1:2
PEEP[3]	Start at 3–5 cm H_2O	Start at 3–5 cm H_2O
PSV	Initial pressure support ventilation (PSV) 10 cm H_2O, may ↑ to 35 cm	
FiO_2	5–10% above preintubation FiO_2, adjust to oxygen saturation	
Setting	Begin peak inspiratory pressure at 16 mm Hg, ↑ 2 mm Hg until adequate excursion	Tidal volume 5–8

Description

[1]Pressure-limited ventilators may also be used in disorders causing low lung compliance (e.g., acute respiratory distress syndrome) since mean airway pressure is more easily manipulated. See pages 273–274 for *noninvasive ventilation*. [2]Inspiratory/expiratory ratio: During ventilation of lungs with normal compliance and diffusion characteristics I:E is typically 0.5 (1:2). In poorly compliant lungs with impaired diffusion, inspiration may be prolonged (or inverted > 1) to an I:E of 2 or 3:1. Prolonged inspiration can ↑ mean airway pressure and ↓ cardiac output. Shortened exhalation may lead to overdistention and gas trapping. [3]Positive end expiratory pressure is used to recruit lungs and restore functional residual capacity (FRC) preventing atelectasis.

ANALGESIA

Table 3-12 Maximum Dose of Local Anesthetics Without (*and With*) Epinephrine

Bupivacaine (*Marcaine, Sensorcaine*)[1]	2.5 mg/kg (*3 mg/kg*)
Lidocaine (*Xylocaine*)[2]	5 mg/kg (*7 mg/kg*)
Mepivacaine (*Carbocaine*)	4 mg/kg (*7 mg/kg*)
Prilocaine (never use for younger than 6 months old)	5.5 mg/kg (*8.5 mg/kg*)

Description

[1]Due to cardiac toxicity, never use for IV regional anesthesia or hematoma block.[2]For IV regional anesthesia (Bier blocks) max lidocaine dose is 3 mg/kg with even less for mini-Bier block. Use preservative-free lidocaine without epinephrine for Bier or hematoma blocks.

Table 3-13 Oral Analgesic Agents (Liquid Preparations)

Agent	Dose (mg/kg)	Frequency	Concentration and comments
Acetaminophen	15	Every 4 hours	80 mg/0.8 ml (dropper) or 160 mg per 5 ml
Acetaminophen with codeine	0.5 to 1	Every 4–6 hours	Acetaminophen 120 mg + codeine 12 mg per 5 ml (dose in mg/kg based on codeine)

Aspirin	10–15	Every 4 hours	No elixir available
Hydrocodone*	0.1–0.2	Every 4–6 hours	*Hycet elixir* (2.5 mg hydrocodone/ 108 mg Tylenol/5 ml also contains 7% alcohol) *Lortab elixir* (2.5 mg hydrocodone/ 167 mg Tylenol/5 ml also contains 7% alcohol)
Ibuprofen (suspension)	5–10	Every 6–8 hours	*Children's Motrin* or *Advil:* 100 mg per 5 ml
Oxycodone*	0.05 to 0.2	Every 4–6 hours	5 mg/5 ml (solution) and 20 mg/ml (concentrate)—exercise *caution* because the presence of two preparations and a high concentration increases dosing error risk. Max dose 10 mg
Naproxen suspension*	5–7	Every 8–12 hours	125 mg per 5 ml

*Only approved for select ages/indications; consult manufacturer's product labeling.

Description

Table 3-14 Topical Analgesia*

Use	Agent	Onset (minutes)
Un-intact skin	• LET (lidocaine 4%, epinephrine 0.1%, tetracaine 0.5%)—apply with cotton ball, not gauze. Use 1–3 ml (1 ml per cm to maximum 3 ml). 90–95% effective on face/scalp, 50% on limbs/torso. • EMLA (2.5% prilocaine, 2.5% lidocaine) may be used on un-intact skin if LET unavailable (less effective on un-intact skin). Use ≤ 1 g per 10 cm^2.	20–30 45–60
Intact skin	• EMLA (See un-intact skin above)	45–60

	• LMX4 or 5 (4–5% liposomal lidocaine formerly ELA-Max)–use ≤ 1 g per 10 cm^2 • Synera–(lido/tetracaine) apply patch to vascular access site or needle stick (only if older than 3 years) • Topicaine (4–5% lidocaine gel)–apply < 0.3–0.4 g per 10 cm^2	30 20–30 30–60
Needle-free injection (pre-IV)	• *J-tip*: Buffered lidocaine (0.25 ml of 1% buffered lidocaine or alternate dosing) via compressed CO_2 • Zingo: 0.5 mg lidocaine delivered via helium-powered device	3 3
Iontophoresis	• 1 ml of lidocaine 2% with 1:100,000 epinephrine added to drug electrode. Apply 1 milliampere (mA) to site and slowly increase until tingling sensation gone to a total dose of 30 mA. Place ground electrode onto major muscle of child or parent.	10–15

Description

*Healthcare workers are advised to review package inserts, mixture components, side effects, contraindications, indications, and dosing (especially maximum total dose per age/size) prior to using these agents.

Table 3-15 Analgesia and Sedation

Agent *Trade name*	Dose	Route	Onset (minutes)	Duration (hours)	Comments and select properties*
Diazepam *Valium*	***Sedative***: Younger than 6 months: not recommended 6 months–6 years: < 0.5 mg/kg Older than 12 years: 0.12–0.8 mg/kg OR 0.04–0.20 mg/kg ***Status epilepticus:*** 0.2–0.5 mg/kg OR 6 months–5 years: 0.2–0.5 mg/kg Older than 5 years: 1 mg	 PO IV/IM PR IV	< 1	1–2	↓ Respirations, ↓ BP
Etomidate *Amidate*	0.1–0.4 mg/kg	IV	< 1	< 0.25	Administer over 1 minute, causes myoclonus, vomiting
Fentanyl *Sublimaze*	1–3 mcg/kg 1–1.5 mcg/kg	IV Intranasal (use with atomizer)	2–3	0.5	↓ Respirations, ↓ BP, bradycardia, rare chest wall rigidity (due to rapid administration)
Flumazenil *Romazicon*	0.01 mg/kg (maximum dose of 0.05 mg/kg up to max of 1 mg)	IV	< 1	1	Reverses benzodiazepines (e.g., lorazepam, midazolam, diazepam)
Ketamine *Ketalar*	1–2 mg/kg 4 mg/kg 5–10 mg/kg	IV IM PO	< 1 5 30	0.25 0.5–1 1–2	Elevated BP, ↑ intracranial/ocular pressure, rare

					laryngospasm
Methohexital	20 mg	PR	15	0.5	↓ Respirations, ↓ BP
Midazolam *Versed*	0.10 mg/kg 0.10–0.15 mg/kg 0.2–0.3 mg/kg 0.5 mg/kg	IV IM Intranasal PO/PR	2 10–15 10–15 15–30	0.5 0.75 1 1–1.5	↓ Respirations, ↓ BP Start IV dose at 0.05–0.10 mg/kg with slow titration to max of 0.4–0.5 mg/kg
Morphine	0.1 mg/kg	IV	< 5	3–4	↓ Respirations, ↓ BP
Naloxone *Narcan*	0.01–0.1 mg/kg	IV, IM, SC	< 1	< 1	Reverses narcotics, erratic absorption SC, use low dose first
Nitrous oxide	30%	Inhaled	1–2	< 0.1	Patient holds mask to self-titrate
Propofol *Diprivan*	1–2 mg/kg (Max 1st dose 40 mg)	IV	< 1	< 0.25	Pain on IV site, respiratory depression, apnea, hypotension; don't use if allergy to egg yolk, lecithin, soybean oil, glycerol, EDTA (infuse 0.1–0.3 mg/kg/minute); not recommended for younger than 3 years old

Thiopental *Pentothal*	3–5 mg/kg 25	IV PR	< 1 5	0.1–0.5 0.5–1.0	Slow IV at 1 mg/kg every 1–2 minutes; causes histamine release, ↓ respiration, ↓ BP
Dexmedetomidine *Precedex*	Loading 0.5–1.0 mcg/kg Maintenance 0.3–2.0 mcg/kg/hour	IV	< 5	2–3	Hypotension, bradycardia, and cardiac arrest

*Only those thoroughly familiar with pediatric airway management, appropriate monitoring, and medication action and side effects should administer these agents.

Description

4 ■ ANAPHYLAXIS

Table 4-1 Management of Anaphylaxis

Airway	Assess and support the airway. Administer 100% oxygen. Consider early intubation if airway edema is suspected.		
Cardiac	Apply cardiac monitor and pulse oximeter; assess vitals frequently. Initiate chest compressions if cardiovascular arrest occurs.		
Skin	Remove the inciting allergen, if possible. Apply ice to bite, sting sites.		
Drugs	**Dose**	**Route**	**Indications and Detail**
Epinephrine	0.01 mg/kg (max of 0.5 mg) (Conc. 1:1,000) Immediately and then every 5–15 minutes as necessary	IM	First line of treatment. Inject IM into anterolateral thigh, NOT subcutaneously.
	0.1–1 mcg/kg/minute (to a maximum of 10 mcg/minute)	IV*	IV epinephrine infusion if persistent shock exists despite IM epinephrine and fluid resuscitation See IV drip, Table A-2
Other vasopressors	Consider norepinephrine or vasopressin if IV fluids and epinephrine drip fail to resolve hypotension.		
Normal saline	20 ml/kg Give as quickly as possible	IV Intraosseous access if IV access is not readily available.	Hypotension (repeat as needed)
Methylprednisolone *(Solumedrol)* *or* Dexamethasone	1–2 mg/kg (max 120 mg) 0.6 mg/kg (max 10 mg)	IV IV/PO	Second-line agent**
Diphenhydramine	1 mg/kg	PO/IV/IM	Second-line agent**

Diphenhydramine (*Benadryl*)	1 mg/kg (max 50 mg)	PO/IV/IM	Second-line agent[a] Relieve the cutaneous symptoms
or			
Cetirizine	2.5–10 mg	PO	Onset of action is faster for cetirizine than Benadryl

Famotidine *or* Ranitidine	0.5 mg/kg (max 20 mg) 1 mg/kg (max 50 mg)	IV IV	H2 blocker Second-line agent** Combined effect of H1 and H2 antagonist is superior to H1 alone in treating cutaneous manifestations
Glucagon	20–30 mcg/kg bolus* (max 1 mg), followed by continuous infusion at 5–15 mcg/minute	IV *Administer bolus slowly over 5 minutes as rapid administration can induce vomiting	Consider for patients on β blockers when anaphylaxis is refractory to IV epinephrine and fluid
Albuterol	2.5–5 mg every 15 minutes	Nebulized/ Metered-dose inhaler (2–6 inhalations)	Bronchospasm refractory to epinephrine
Racemic epinephrine	Currently not recommended. Anecdotal evidence that it may decrease oropharyngeal edema and make airway management less difficult in anaphylaxis		
Patient positioning	Place adults and adolescents in recumbent position; place young children in position of comfort; place pregnant patient on left side.		
Observation	Per expert opinion observe all for 4–8 hours. Consider longer observation/admission if severe or refractory symptoms or with a history of asthma or risk factors for severe anaphylaxis.		
Follow-up	Prescribe epinephrine auto-injector [e.g., Twinject (0.15 mg) if 15 to $<$ 30 kg, or Twinject (0.3 mg) if $\geq$ 30 kg, each device has two doses OR EpiPen (0.3 mg) if $\geq$ 30 kg or EpiPen Jr (0.15 mg) if 15 to $<$30 kg, each as single dose or 2-Pak to all with serious symptoms]. Educate patient, patient provider, and family on the use of auto-injector Provide anaphylaxis action plan Outpatient allergy-immunology referral		

*Monitor closely, as life-threatening complications (e.g., ischemia, arrhythmias) can occur.

**Efficacy of the second-line agents has not been proven.

Modified from Lieberman P, Nicklas RA, Randolph C, et al. Anaphylaxis—a practice parameter update 2015. *Ann Allergy Asthma Immunol*. 2015;115(5):341-384; Campbell RL, Li JTC, Nicklas RA, et al. Emergency department diagnosis and treatment of anaphylaxis: a practice parameter. *Ann Allergy Asthma Immunol*. 2014;113:599-608.

Description

HEREDITARY ANGIOEDEMA

Table 4-2 Hereditary Angioedema

A rare genetic condition with autosomal dominant inheritance. Affected individuals have either a reduced level (type I) or functional deficiency (type II) of C1 esterase inhibitor (C1-INH) or excessive bradykinin due to an increased factor XII activity (type III). It causes recurrent painful episodes of swelling, typically in the face, hands, feet, or genitals. May also occur in the airways and intestinal tract. Manifestations include abdominal pain, nausea, vomiting, diarrhea, and possible life-threatening airway obstruction. Trauma, stress, infections, surgery, and drugs (e.g., estrogens) are typical precipitants.
Acute management: (1) If (there is) isolated extremity (or) truncal edema, a wait and see approach is appropriate. Alternatively, increase Danazol by 2.5–5 mg/kg/day in those already taking this agent to abort an attack. Tranexamic acid (not FDA approved) is another prophylactic agent. (2) First-line agent for severe attacks is C1-INH concentrate (Cinryze), 10–20 units/kg IV (if <50 kg), 1,000 units (if 50–100 kg), or 1,500 units IV (if >100 kg). (This agent is not FDA approved in children.) Recombinant C1 inhibitor (Ruconest) and bradykinin B2-receptor antagonist (Icatibant) are other available options. Ecallantide (Kalbitor)—30 mg (3 doses of 10 mg each)—given at three separate sites subcutaneously is approved in children > 12 years. Discuss appropriate use and dosing of these drugs in children with pediatric allergist or hematologist. If previously mentioned medicines are unavailable or contraindicated, consider fresh frozen plasma (FFP) (may worsen attacks). Consider intubation if progressive laryngeal edema; epinephrine (dosing mentioned previously) administered IM (or IV if life-threatening) may or may not be effective. However, steroids and antihistamines are ineffective for hereditary angioedema.

Description

Modified from Cicardi M, Aberer W, Banerji A, et al. Classification, diagnosis, and approach to treatment for angioedema: consensus report from the Hereditary Angioedema International Working Group. *Allergy*. 2014;69: 602-616.

5 ■ BRIEF RESOLVED UNEXPLAINED EVENT (BRUE)

This term [formerly *apparent life-threatening event (ALTE*)] describes a sudden, brief (<1 minute in duration), unexplained but now resolved event in infants younger than 1 year with a normal physical examination.[1]

DIAGNOSIS OF BRUE

Includes one or more of the following criteria that lasted for less than 1 minute in an infant with no other explanation for the event and whose physical examination is reassuring:

1. Cyanosis or pallor
2. Absent, decreased, or irregular breathing
3. Marked change in tone (hyper- or hypotonia)
4. Altered level of responsiveness

- If the criteria are met, obtain an appropriate history and physical exam.
- Diagnosis of BRUE can only be made when there is no explanation for a qualifying event after a complete history and physical.

BRUE RISK CLASSIFICATION

Infants are categorized into two groups:

LOW-RISK PATIENTS

1. Age > 60 days
2. Gestational age > 32 weeks and postconception age > 45 weeks
3. Occurrence of only 1 BRUE (no prior BRUE ever and not occurring in clusters)
4. Duration of BRUE < 1 minute
5. No cardiopulmonary resuscitation by a trained medical provider
6. No concerning historical features
7. No concerning physical examination findings

HIGH-RISK PATIENTS

1. Patients who do not meet criteria as low risk by default are considered high risk.
2. History and physical examination suggest the need for further investigation, monitoring, and/or treatment.[1]

MANAGEMENT RECOMMENDATIONS

LOW-RISK PATIENTS

- **Should** educate caregivers about BRUE and ensure timely follow-up.
- **Should not**:
  - Obtain laboratory studies, CBC, comprehensive metabolic panel, CSF, blood cultures, ammonia, blood gases, urine organic acids, plasma amino acids, or acylcarnitines.
  - Obtain chest X-ray, echocardiogram, or EEG.
  - Obtain viral respiratory test, urinalysis, blood glucose, serum bicarbonate, serum lactic acid, or neuroimaging; admit the patient to the hospital solely for cardiorespiratory monitoring.
  - Initiate home cardiorespiratory monitoring.
  - Prescribe acid suppression therapy or antiepileptic medications.
- **May consider** obtaining pertussis testing and 12-lead ECG; monitoring the patient with continuous pulse oximetry and serial observations (1–4 hours)

HIGH-RISK PATIENTS

- Common etiologies in these infants include gastroesophageal reflux, seizures, child abuse, bronchiolitis, and pertussis.
- Less common etiologies are inborn errors of metabolism, arrhythmias, increased intracranial pressure, toxic ingestions, and craniofacial anomalies and syndromes.
- Evaluate the patient accordingly.
- Admit for further evaluation and management; however, no guidelines exist for management of high-risk infants.

REFERENCES

1. Tieder JS, Bonkowsky JL, Etzel RA, et al. Brief resolved unexplained events (formerly apparent life-threatening events) and evaluation of lower-risk infants: executive summary. *Pediatrics.* 2016;137.
2. Kondamudi N, Virji M. *Brief Resolved Unexplained Event (BRUE)*. Treasure Island: StatPearls; 2019.
3. Colombo M, Katz ES, Bosco A, Melzi ML, Nosetti L. Brief resolved unexplained events: retrospective validation of diagnostic criteria and risk stratification. *Pediatr Pulmonol*. 2019;54(1):61-65.

6 ■ BIOLOGIC, CHEMICAL, AND RADIATION EXPOSURES

Visit www.cdc.gov for updates/information regarding biologic/chemical exposures. Visit https://orise.orau.gov/reacts/ or call (865) 576-1005 regarding radiation exposure. Contact the Centers for Disease Control and Prevention (CDC) for further information regarding biologic, chemical, and radiation exposures. CDC Bioterrorism Preparedness and Response Center: (770) 488-7100.

General rules—Gown, gloves, and high-efficiency particulate air (HEPA) filter masks protect against most biologic agents, soap/water removes most biologic agents from skin, and hypochlorite (0.1%) bleach removes most contaminants from objects.

BIOLOGIC

Exposure to biologic agents can be due to various dispersal techniques, such as contaminated water and aerosol sprays. Symptoms can appear from days to weeks after exposure. There are three categories based on ease of dissemination, morbidity and mortality, panic potential, and level of public health requirements.

CATEGORY A (HIGHEST PRIORITY)

- ***Bacillus anthracis* (Anthrax):** It is a spore-forming organism found in soil normally transmitted by handling contaminated animals or animal products. Symptoms begin 1 to 60 days after exposure. Cutaneous signs include pruritic macule or papule, edema, painless ulceration, and eschar. Lymphangitis or painful lymphadenopathy can occur. Gastrointestinal symptoms and signs include abdominal pain, vomiting, hematemesis, or bowel perforation. Inhalation signs include cough, chest pain, fever, chills, hemorrhagic mediastinitis, pleural effusions, respiratory failure, or shock. Diagnosis may include PCR testing of skin lesions or serum for anthrax lethal factor toxin. Gram-positive rods in a typical "jointed bamboo rods appearance" in culture or short chains of two to four cells in direct clinical samples (unspun peripheral blood smear, CSF, or vesicular fluid) are highly suggestive of anthrax. Post-exposure chemoprophylaxis for penicillin-resistant strains or prior to susceptibility results is for 60 days after exposure with one of the following:

Medication	Dose	Maximum dose	Interval
In penicillin-resistant strains or before susceptibility results:			
Ciprofloxacin	30 mg/kg/day	500 mg/dose	Divided every 12 hours
Doxycycline		100 mg/dose	
<45 kg	4.4 mg/kg/day		Divided every 12 hours
>45 kg	100 mg/dose		Divided every 12 hours
Clindamycin	30 mg/kg/day	900 mg/dose	Divided every 8 hours
Levofloxacin		250 mg/dose	
<50 kg	16 mg/kg/day		Divided every 12 hours
>50 kg	500 mg/day		Every 24 hours
In penicillin-susceptible strains:			
Amoxicillin	75 mg/kg/day	1,000 mg/day	Divided every 8 hours
Pen VK	50–75 mg/kg/day		Divided every 6–8 hours

Description

A three-dose anthrax vaccine adsorbed (AVA) BioThrax is recommended for an adult post exposure but it is currently not FDA approved for children younger than 18 years. However, it will be available to children older than 6 weeks as an investigational vaccine through an expedited process at the time of an event and should be given at 0, 2, and 4 weeks in addition to the chemoprophylaxis. In children younger than 6 weeks, chemoprophylaxis should be provided, but the vaccine should be delayed until the infant is older than 6 weeks of age.

Treatment of confirmed cases of cutaneous anthrax without systemic signs includes a single oral antimicrobial agent (same antimicrobials and doses as given in the previous table) for 7 to 10 days in a naturally acquired infection, and for 60 days if following bioterrorism. Treat inhalational, gastrointestinal, or other systemic involvement without meningitis with two parenteral antimicrobials as follows:

Treatment of Anthrax (Systemic Without Meningitis)

Medication	Dose	Maximum dose	Interval	Route
Bactericidal agent (one of the following):				
Ciprofloxacin	30 mg/kg/day	400 mg/dose	Divided every 8 hours	IV
Meropenem	60 mg/kg/day	2,000 mg/dose	Divided every 8 hours	IV

Levofloxacin				
<50 kg	20 mg/kg/day	250 mg/dose	Divided every 12 hours	IV
>50 kg	500 mg/day		Every 24 hours	IV
Imipenem/ Cilastatin	100 mg/kg/day	1,000 mg/dose	Divided every 6 hours	IV
Vancomycin	60 mg/kg/day		Divided every 8 hours	IV
OR for penicillin-susceptible strains:				
Ampicillin	200 mg/kg/day	3,000 mg/dose	Divided every 6 hours	IV
Penicillin G	400,000 units/ kg/day	4 mU/dose	Divided every 4 hours	IV
PLUS one of the following protein synthesis inhibitors:				
Clindamycin	40 mg/kg/day	900 mg/dose	Divided every 8 hours	IV
Linezolid	30 mg/kg/day	600 mg/dose	Divided every 8 hours (<12 years) Divided every 12 hours (>12 years)	IV
Rifampin	20 mg/kg/day	300 mg/dose	Divided every 12 hours	IV

Data from Bradley JS, Peacock G, Krug SE, et al. Pediatric anthrax clinical management. *Pediatrics*. 2014;133(5):e1411-e1436. doi:10.1542/peds.2014-0563.

Description

Treat children who have systemic anthrax with meningoencephalitis with a bactericidal fluoroquinolone (e.g., ciprofloxacin or levofloxacin) PLUS a beta lactam (e.g., meropenem) PLUS a protein synthesis inhibitor (e.g., linezolid, clindamycin). Antitoxin (AIG or raxibacumab) is recommended for all systemic diseases. Consider steroids for all cases with cerebral edema or meningoencephalitis.

- ***Clostridium botulinum* (Botulism):** A neurotoxin that causes neuroparalysis with three main presentations, which include infant, foodborne, and wound botulism. Symptoms can

begin from 6 hours up to 10 days following exposure. Signs for infants and children include constipation, diminished gag reflex, weak neck muscles, or respiratory failure. Adults have weak jaw clench, difficulty speaking and swallowing, drooping eyelids, diplopia, descending proximal to distal muscle weakness, or respiratory failure. Botulism differs from other flaccid paralysis in the following ways: (a) symmetry, (b) first manifests with cranial nerve palsies, (c) descending paralysis, and (d) absence of sensory nerve dysfunction. Laboratory confirmation is done by demonstrating the presence of botulinum toxin in serum, stool, or food, or by microbiologic culture. However, it is not advised to wait for laboratory results but rather to treat based on clinical findings. Treatment includes supportive care. There is an antitoxin (botulinum antitoxin or BabyBIG) that can be given to halt the paralysis and reduce the risk of complications from botulism, but it does not reverse paralysis.

- ***Yersinia pestis* (Plague):** The plague is transmitted to humans by a rat flea bite, and there are three types: bubonic, pneumonic, and septicemic with pneumonic being the most severe and the only one with human-to-human transmission. Symptoms begin from 1 to 10 days following exposure. Signs include tender and enlarged lymph nodes called buboes, fever, chills, myalgia, pulmonary edema, abdominal pain, sepsis, or pneumonia. Diagnosis includes PCR testing, formalin-fixed tissues by hematoxylin and eosin stain (H&E, gram), or silver impregnation and Giemsa stains. Treatment in children includes streptomycin 15 mg/kg two times per day IM (max 2 g/day), gentamycin 2.5 mg/kg/dose every 8 hours IV/IM, levofloxacin 8 mg/kg/dose every 12 hours (max 250 mg/dose) IV or PO, ciprofloxacin 20 mg/kg two times per day (max 500 mg/dose) PO, or doxycycline 200 mg everyday (> 45 kg) or 2.2 mg/kg two times per day (max of 100 mg every day) for < 45 kg IV or PO. Post-exposure chemoprophylaxis in children for 7 days with ciprofloxacin 20 mg/kg two times per day (max 1 g) PO, or doxycycline PO 200 mg everyday or 2.2 mg/kg two times per day (max of 200 mg) if < 45 kg.
- ***Variola major* (Smallpox):** Symptoms begin from 7 to 19 days after exposure. Signs include fever, myalgia, or lesions that progress from macules and papules all the same stage on face and extremities to vesicles and umbilicated pustules. Diagnosis includes samples from vesicle fluid or skin samples by PCR of variola DNA or by electron microscopy. Treatment is supportive care with antibiotics reserved only for secondary bacterial infection. There is a vaccine that may be effective if given within 3 days to help decrease the incidence of disease and decrease the incidence of death. The FDA has approved three antivirals (tecovirimat, cidofovir, and brincidofovir) but they have not been tested on people with smallpox.
- ***Francisella tularensis* (Tularemia):** This bacterium can be spread by ticks, deerflies, or contact with an infected animal, as well as by breathing in contaminated dust or drinking contaminated water. Symptoms begin from 2 to 14 days. Signs include fever, sepsis, pneumonia, necrotizing lymphadenitis, skin ulcer with corresponding lymph node involvement, or conjunctivitis with ulcers. Diagnosis includes direct examination of secretions, exudates, or biopsy specimens using gram stain, direct fluorescent antibody, or immunohistochemical stains. Treatment with antibiotics for 10 to 21 days with streptomycin 15 mg/kg IM two times per day (max of 2 g/day), *or* gentamicin 2.5 mg/kg IM/IV every 8 hours everyday *or* doxycycline 2.2 mg/kg two times per day (maximum of 100 mg/dose) or ciprofloxacin 15 mg/kg two times per day (maximum of 400 mg/dose). Ciprofloxacin,

however, is not currently approved by the FDA for treatment of human beings for tularemia.

- **Viral Hemorrhagic Fever (Marburg, Ebola, Lassa Virus):** Caused by families of the RNA virus, all of these viruses can show signs of fever, bleeding, facial and chest flushing, petechiae, edema, hypotension, vomiting, and headache, leading to multiple organ failures and hypovolemic shock due to bleeding diathesis or circulatory compromise.
    - Symptoms begin for Lassa in 1 to 3 weeks after exposure and can be detected by enzyme-linked immunosorbent assay (ELISA) testing for Lassa antigen, IgM and IgG, or PCR testing. Treatment with ribavirin seems to be effective if given early on in clinical illness. Symptoms for Marburg begin 2 to 10 days after exposure and can be detected by ELISA testing or PCR. There is no treatment except supportive care. Ebola symptoms begin 2 to 21 days after exposure and can be detected by ELISA or PCR. There is no cure, and treatment includes supportive care.

CATEGORY B (SECOND-HIGHEST PRIORITY)

- ***Brucella* (Brucellosis):** This can be contracted by consumption of undercooked meat or unpasteurized milk. Symptoms begin 5 days to 6 months after exposure. Signs include fever, foul-smelling sweat (described as similar to wet hay), arthralgia, night sweat, vomiting, diarrhea, abdominal pain, enlarged liver, liver abscess, enlarged spleen, arthritis, optic neuritis, or endocarditis. Diagnosis can be done by PCR or microagglutination. Treatment includes antibiotics for 6 weeks with doxycycline 100 mg two times per day or if children are younger than 8 years of age then trimethoprim 5 mg/kg, sulfamethoxazole 25 mg/kg (TMP-SMZ) two times per day.
- ***Clostridium perfringens* Epsilon Toxin:** Toxin types B and D bind to endothelial cells of the brain capillary vessels and pass though the blood-brain barrier. Symptoms begin 6 to 24 hours after exposure. It causes devastating neurological signs and there is no cure.
- ***Coxiella burnetii* (Q Fever):** Can be contracted via inhalations from spore-like variants, contact with animal-infected secretions, and can also be tick-borne. Symptoms begin 2 to 3 weeks after exposure. Signs include flu-like symptoms, upper respiratory infection, cough, confusion, vomiting, or diarrhea. It can progress to atypical pneumonia with respiratory distress. It can also cause granulomatous hepatitis as well as retinal vasculitis. Diagnosis includes PCR testing or indirect immunofluorescence antibody using *burnetii* antigens. Treatment is most effective if started within the first 3 days of symptoms. Antibiotics include doxycycline 100 mg bid for 14 days or if younger than 8 years of age then TMP-SMZ 8–12 mg/kg/day (max 320 mg/day trimethoprim).
- **Ricin:** This is a toxin from the castor oil plant and found in the beans. A dose as small as the size of a few grains of table salt can kill a human. Symptoms begin 4 to 10 hours after ingestion, 4 to 8 hours after inhalation, and within 12 hours following injection. Signs include abdominal pain, vomiting, diarrhea, fever, necrotizing pneumonia, pulmonary edema, or shock. Diagnosis by ELISA. Treatment includes charcoal lavage and supportive care.
- ***Staphylococcus aureus* Enterotoxin B:** This is a toxin that can be administered by food or water or inhaled as an aerosol. Symptoms from 4 to 10 hours after exposure. Signs include fever, headache, pulmonary edema, vomiting, diarrhea, intestinal cramping, or toxic shock syndrome with high fever, hypotension, rash, and peeling of skin. Diagnosis includes ELISA or PCR testing. Treatment includes supportive care because there is no cure.

- **Alpha Viruses (Viral Encephalitis—Venezuelan, Eastern, and Western Equine):** These are mosquito-borne viral pathogens that cause progressive central nervous system disorders. Venezuelan equine presents with symptoms 1 to 6 days after exposure as compared to Eastern and Western equine, which are between 5 and 14 days. Signs include flu-like symptoms, fever, headache, vomiting, confusion, seizures, or focal neurological deficits. Diagnosis includes serology testing with specific IgM antibodies in serum or CSF. Treatment includes supportive care because there is no cure. About 33% of Eastern equine is fatal compared to 15% of Western equine.

CATEGORY C (THIRD-HIGHEST PRIORITY)

- ***Flavivirus* (Yellow Fever):** This is a mosquito-borne disease. Symptoms begin 3 to 6 days after exposure. Signs include fever, headache, dizziness, jaundice, hemorrhage, or shock. Diagnosis is done by ELISA. Treatment includes supportive care because there is no cure.

CHEMICAL WEAPONS

- **Blistering Agents**
  - **Mustard Gas/Lewisite:** Can cause skin erythema or vesicles, eye inflammation, or respiratory inflammation with delayed blistering up to 12 hours later. Decontaminate with soap and water for skin contamination, but if eye contact with the gas, then irrigate with water immediately for most effectiveness. Treatment for mustard gas is supportive care. Treatment for lewisite includes supportive care as well as dimercaprol 3–4 mg/kg IM every 4–6 hours for systemic effects in severe cases.
- **Blood Agents**
  - **Cyanide:** a colorless gas with a faint, bitter almond smell. It inhibits cytochrome oxidase causing cellular anoxia and lactic acidosis. Symptoms can begin 1 to 20 minutes after exposure. Signs include convulsions, cyanosis, fatigue, headache, hypotension, loss of consciousness, metabolic acidosis, palpitations, vomiting, or death. Treatment includes 100% oxygen and hydroxocobalamin 70 mg/kg IV (max 5 g) or cyanide antidote kit. The cyanide antidote kit includes amyl nitrite, which is inhaled for 30 seconds per minute for 3 minutes, sodium nitrate 10 ml (300 mg) IV, and sodium thiosulfate 1.65 mg/kg (max 12.5 g or 50 ml).
- **Nerve Agents:**
  - **Cyclosarin (GF), Sarin, Soman, Tabun, VX:** Organic chemicals (organophosphates) that disrupt nerve transfer messages to organs, are easily vaporized, can enter though the respiratory system, and can be absorbed through the skin. Most are colorless and tasteless with a slight fruity odor, except for VX, which has a faint fishy odor. Symptoms begin within minutes. Signs include bronchial constriction, cramps, diarrhea, increased secretions, miosis, respiratory arrest, tremors, sweating, paralysis, or loss of consciousness. Decontaminate by removing clothes, irrigating skin with soapy water, and irrigating eyes and wounds with sterile water. Treatment includes atropine 0.05 mg/kg IV/IM (max 2 mg) every 2 to 5 minutes to control bronchial secretions or bronchospasms. Give pralidoxime 25 mg/kg IV/IM (max 1 g IV or 2 g IM) with or after atropine, can repeat within 30 to 60 minutes up to a total of 45 mg/kg, and then every 12 hours up to two doses. If seizures, then give benzodiazepines. There is a nerve agent antidote kit called DuoDote, which is 2 mg atropine and 500 mg pralidoxime per auto injector, convulsive antidote nerve agent (CANA) with diazepam 10 mg auto injector.

RADIATION

Decontamination should be done as soon as possible with removal of clothing, irrigation of wounds with normal saline, irrigation of eyes with sterile water, and irrigation of skin with warm water and soap.

Cutaneous radiation syndrome occurs when exposed to high radiation with symptoms 12 to 20 days after irradiation. Symptoms include blistering, erythema, desquamation, and ulceration. Treat the area as if it was a thermal burn.

Acute radiation syndrome can occur after whole-body exposure from a minimum dose of 1 gray (Gy) to a fatal dose of greater than 10 Gy. There are four states of acute radiation. The first phase is called prodrome, which occurs within minutes to days following exposure with symptoms that include nausea, vomiting, diarrhea, anorexia, abdominal cramping, and dehydration. The next stage is the latent stage in which the patient feels healthy for a few hours to weeks. The manifest illness stage is the third stage and can last from hours to months. There are also three syndromes. In the hematopoietic syndrome, the person develops pancytopenia, infections, and hemorrhage. In the gastrointestinal syndrome, the person develops pancytopenia, but the GI tract cells are drying thus leading to infection, dehydration, and electrolyte imbalance. The cardiovascular/central nervous system syndrome symptoms include confusion, vomiting, diarrhea, and loss of consciousness. The last stage ranges from recovery to death. Often death occurs a few months after hematopoietic syndrome, within 2 weeks of gastrointestinal syndrome, and within 3 days of cardiovascular/central nervous system syndrome.

Treatment includes contact precautions, isolation, antibiotics, platelet transfusion, growth factors transfusion, hydration, and parenteral nutrition.

Potassium iodide (KI) should be administered within 6 hours after exposure to radioactive iodine. The use of KI reduces the risk of thyroid cancer after the release of radioactive iodine only.

Daily Potassium Iodide (KI) Dose for Radiation Exposure

Population	***Predicted thyroid exposure (rad)***	***Daily KI dose***
Adults > 40 years	> 500	130 mg
Adults > 18 to 40 years	≥ 10	130 mg
Pregnancy or lactating	≥ 5	130 mg

> 12 to 18 years (if ≥70 kg, treat as adult)	≥ 5	65 mg
> 3 to 12 years	≥ 5	65 mg
> 1 month to 3 years (dilute in milk, formula, H_2O)	≥ 5	32 mg
< 1 month	≥ 5	16 mg

Description

Data from www.fda.gov/Drugs/EmergencyPreparedness/BioterrorismandDrugPreparedness and www.cdc.gov

Table 7-1 Fluid Resuscitation in Burn Victims

• Intravenous fluid resuscitation required if ≥ 10% total BSA burns. • Partial- and full-thickness (not erythema) are used to calculate the total BSA.	
Pediatric burn fluid resuscitation formula	
Parkland formula	• LR* 4 ml/kg/% BSA** burn in first 24 hours (from time of burn) + maintenance fluid, with 1/2 over first 8 hours, and 1/2 over subsequent 16 hours
Cincinnati (young children)	• 4 ml/kg/%TBSA*** burn +1,500 ml/m^2 total BSA of LR. 1/2 over first 8 hours, and 1/2 over next 16 hours • First 8 hours add 50 mEq/l of sodium bicarbonate. Second 8 hours only LR. Third 8 hours of first 24 hours only, add 12.5 g of 25 albumin/l of crystalloid • D_5W as needed
Cincinnati (older children)	• 4 ml/kg/%TBSA burn + 1,500 ml/m^2 total BSA of LR. 1/2 over first 8 hours, and 1/2 over next 16 hours; no albumin • D_5W as needed
Galveston	• 5,000 ml/m^2 BSA burn + 2,000 ml/m^2 total BSA of LR. 12.5 g of 25% albumin/l of crystalloid. • D_5W as needed • 1/2 over first 8 hours, and 1/2 over next 16 hours.
Use 5% dextrose in maintenance fluids in children < 30 kg (See Table 13.18 for maintenance rate)	
Adult (teenager) burn fluid resuscitation formula	
Parkland formula	• 4 ml/kg/%TBSA burn of LR 1/2 over first 8 hours, and 1/2 over next 16 hours • No colloid or glucose
Modified Brooke	• 3 ml/kg/%TBSA burn of LR. 1/2 over first 8 hours, and 1/2 over next 16 hours • No colloid or glucose

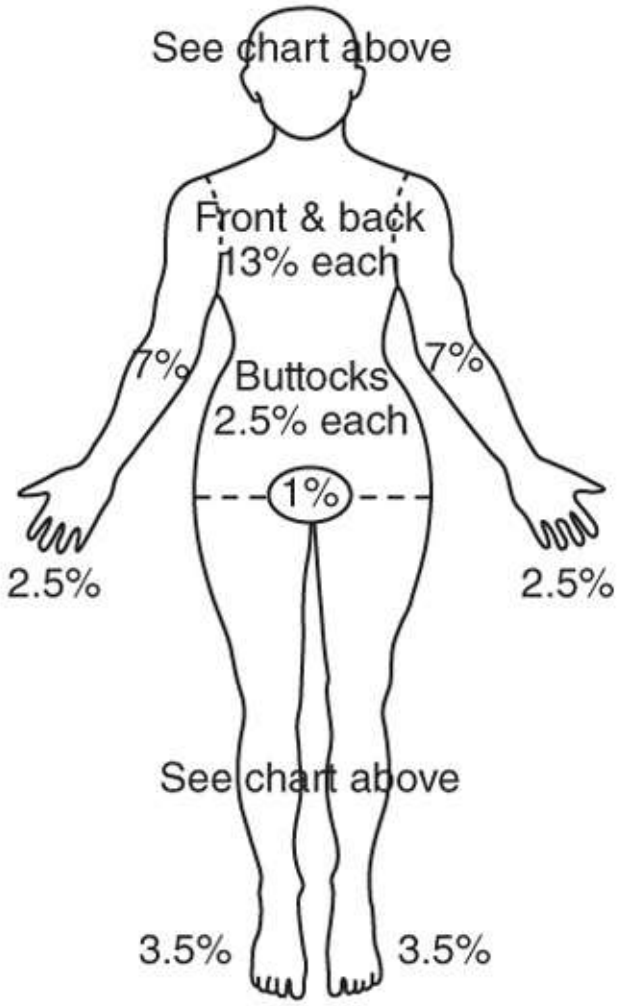
Description

*LR—Ringer's lactate solution. **BSA—body surface area. ***%TBSA—Percent total body surface area.

Table 7-2 Estimation of Burns in Children as a Percentage of Body Surface Area (BSA)*

Age in years	<1	1	5	10	15
Head (%)	19	17	13	11	9
Neck (%)	2	2	2	2	2
Trunk (anterior or posterior) (%)	13	13	13	13	13
One buttock (%)	2.5	2.5	2.5	2.5	2.5
Genitalia and perineum (%)	1	1	1	1	1
One forearm (3) or upper arm (4) (%)	3–4	3–4	3–4	3–4	3–4
One hand (2.5) or foot (3.5) (%)	2.5–3.5	2.5–3.5	2.5–3.5	2.5–3.5	2.5–3.5
One thigh (%)	5.5	6.5	8	8.5	9
One leg (below knee) (%)	5	5	5.5	6	6.5

* Entire palm of the individual, regardless of age, can be used to estimate 1% of the BSA.



Burns Admission Criteria
5–10% TBSA partial thickness burns
2–5% full thickness burn
Circumferential burn
Inhalation burn
High-voltage injury
Associated medical conditions or suspected abuse
Burn Center Referral Criteria
Partial-thickness burns ≥ 10% BSA
≥ 2% full thickness burns in any age group
Burns to face, hands, feet, genitalia, perineum, or major joints
Chemical burns
High-voltage burn
Inhalational injury
Concomitant major trauma
Preexisting medical disorders that could complicate management, prolong recovery, or affect mortality
Inadequate support or suspected abuse

Asymptomatic children with exposure to common household current (120–240 V) require no

treatment and no observation if there are no burns and no symptoms upon ED arrival.

Modified from American College of Surgeons. Chapter 14: Guidelines for trauma centers caring for burn patients. In: *Resources for Optimal Care of the Injured Patient*. Chicago, IL: American College of Surgeons; 2014:100-106; Jamshidi R, Sato TT. Initial assessment and management of thermal burn injuries in children. *Pediatr Rev*. 2013;34(9): 395-404.

Description

8 ■ CARDIOVASCULAR DISORDERS

ENDOCARDITIS PROPHYLAXIS

Table 8-1 Cardiac Conditions Requiring Infective Endocarditis (IE Prophylaxis)[1–3]

- Prior infectious endocarditis or any prosthetic cardiac valve
- Congenital heart disease (CHD)—only CHD categories below require prophylaxis:
  - Unrepaired CHD including those who have had shunts for palliation
  - Repaired CHD with residual defects at or adjacent to prosthetic patch or device
  - First 6-month post-op: Completely repaired CHD defects with prosthetic graft or device
- Post-cardiac transplantation with valve regurgitation

Description

[1]Prophylaxis only required before dental procedures or if invasive respiratory tract procedure with incision or biopsy of respiratory mucosa. [2]Prophylaxis is no longer recommended prior to GU or GI procedures. [3]See Table 18-1 for antibiotic regimens. Modified from Wilson W, Taubert KA, Gewitz M, et.al. Prevention of infective endocarditis: guidelines from the American Heart Association: a guideline from the American Heart Association Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee, Council on Cardiovascular Disease in the Young, and the Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anesthesia, and the Quality of Care and Outcomes Research Interdisciplinary Working Group. *Circulation*. 2007;116(15):1736-1754; Nishimura RA, Otto CM, Bonow RO, et al. 2017 AHA/ACC focused update of the 2014 AHA/ACC guideline for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association task force on clinical practice guidelines. *Circulation*. 2017;135(25):e1159-e1195.

ECG EVALUATION

Table 8-2 Normal ECG Values

Age	P-R interval[1]	QRS interval[1]	QRS axis (mean)	QTc[2]
0–7 days	0.08–0.12	0.04–0.08	80–160 (125)	0.34–0.54
1–4 weeks	0.08–0.12	0.04–0.07	60–160 (110)	0.30–0.50
1–3 months	0.08–0.12	0.04–0.08	40–120 (80)	0.32–0.47
3–6 months	0.08–0.12	0.04–0.08	20–80 (65)	0.35–0.46
6–12 months	0.09–0.13	0.04–0.08	20–100 (65)	0.31–0.49
1–3 years	0.10–0.14	0.04–0.08	20–100 (55)	0.34–0.49
3–8 years	0.11–0.16	0.05–0.09	40–80 (60)	< 0.45
8–16 years	0.12–0.17	0.05–0.09	20–80 (65)	< 0.45

[1]Seconds. [2]QTc = QT interval/(square root of RR interval).

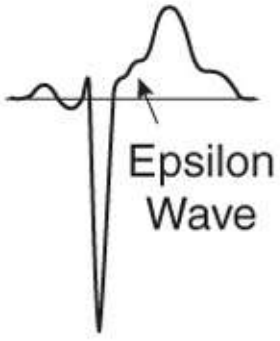
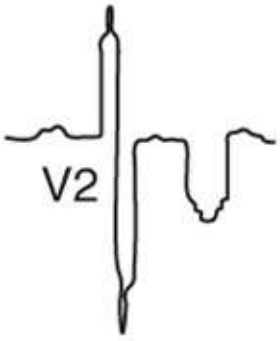
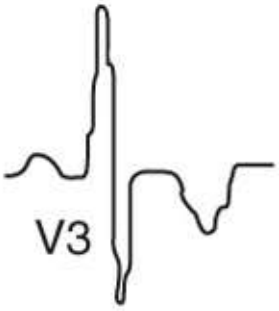
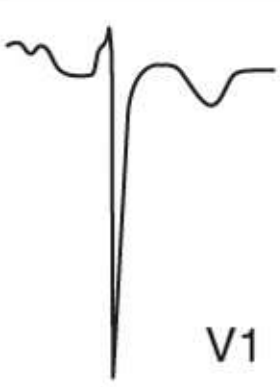
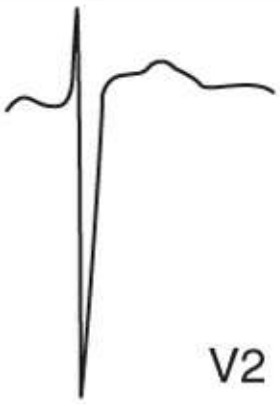
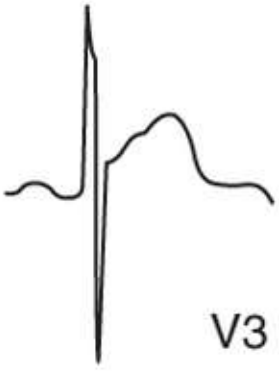
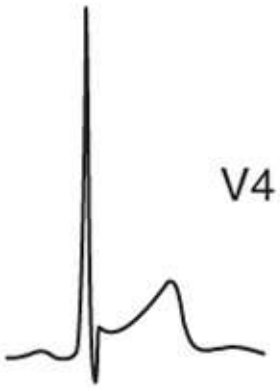
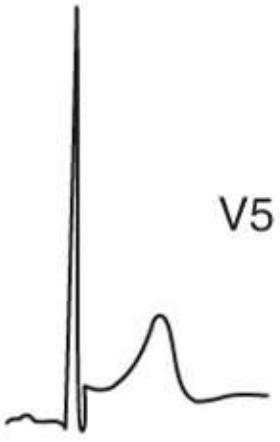
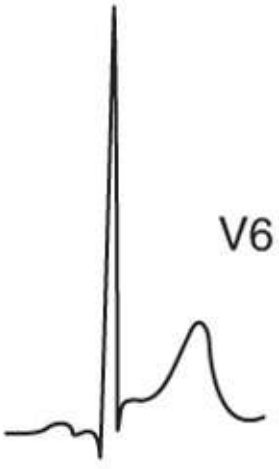
Description

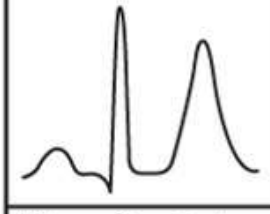
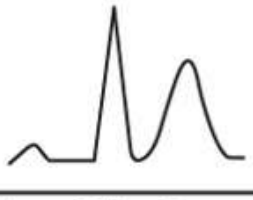
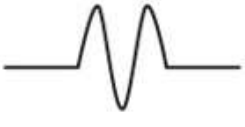
Table 8-3 ECG Diagnosis of Chamber Enlargement (Hypertrophy)

Right ventricular hypertrophy (RVH) • R in V1 > 20 mm (> 25 mm < 1 month) • S in V6 > 6 mm (> 12 mm < 1 month) • Upright T in V3R, R in V1 after 5 days • QR pattern in V3R, V1	**Biventricular hypertrophy** • RVH and (S in V1 or R in V6) exceeding mean for age • LVH and (R in V1 or S in V6) exceeding mean for age
Left ventricular hypertrophy (LVH) • R in V6 > 25 mm (> 21 mm < 1 year) • S in V1 > 30 mm (> 20 mm < 1 year) • R in V6 + S in V1 > 60 mm (use V5 if R in V5 > R in V6) • Abnormal R/S ratio • S in V1 > 2 × R in V5	**Right atrial enlargement** Peak P value > 3 mm (< 6 months), > 2.5 mm (≥ 6 months)
	Left atrial enlargement • P in II > 0.09 seconds • P in V1 with late negative deflection > 0.04 seconds and > 1 mm deep

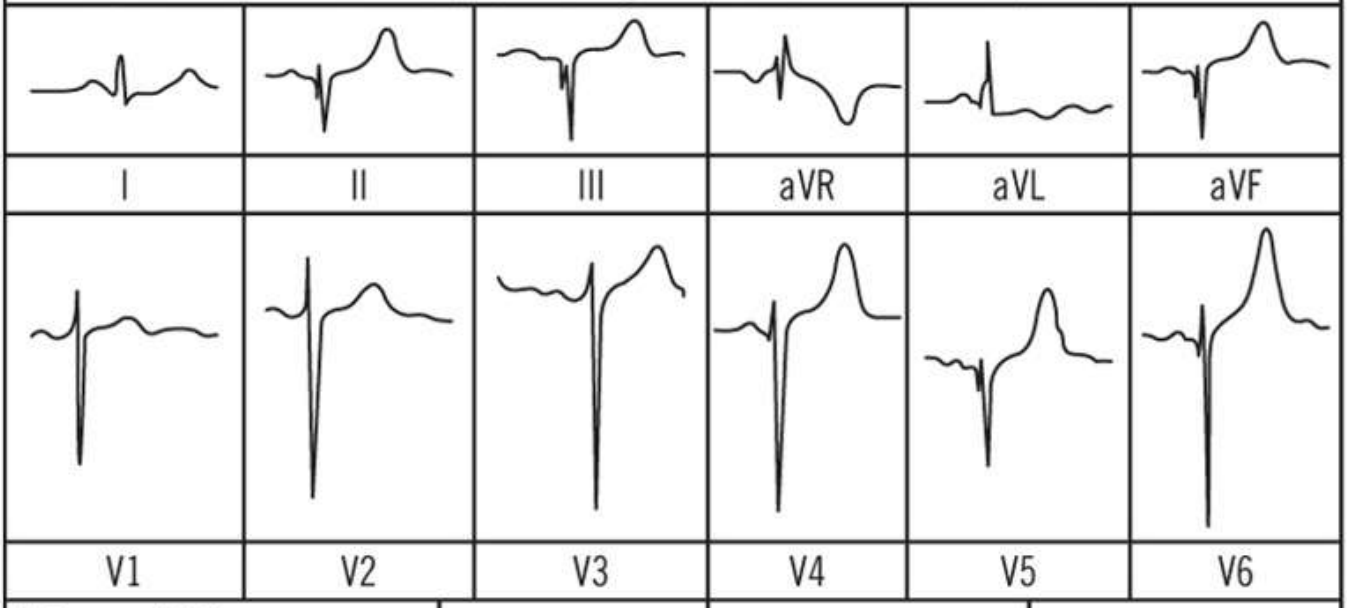
Description

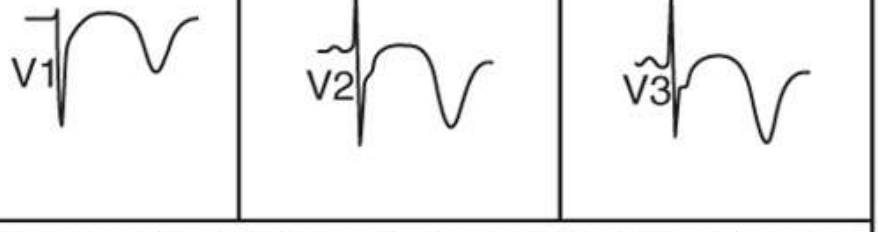
Table 8-4 ECG Features of Disorders Associated with or Mistaken for Disease States[1]

Disorder	ECG abnormality[1]		
Arrhythmogenic right ventricular cardiomyopathy—Right bundle branch block (RBBB), or in absence of RBBB—QRS > 110 ms in leads V1–V3 with T wave inversion in V2 and V3, LBBB ectopic beats. Epsilon wave[2]			
Benign early repolarization— Criteria include (1) widespread ST elevation (90% < 2 mm in precordial leads, and < 0.5 mm in limb leads) with precordial > limb leads; (2) J point elevation; (3) concave initial upsloping of ST segment; (4) notching/irregular contour of J point; (5) prominent concordant T waves; (6) stability of ECG over time			
			
Conduction defects	Sinoatrial block, AV blocks, bradyarrhythmias		

Drugs and toxins	See specific drug or toxin in the "Toxicology" section.		
Hyperkalemia—*Early* narrow or peaked T waves, short QT interval, *later* widened QRS with ↓ P wave height, then loss of P waves, AV block, sine wave pattern, asystole			
	K^+ > 6 mEq/l tall T wave	K^+ > 7.5 mEq ↑ PR, ↑ QRS	K^+ > 9 mEq/l, no P, sinusoidal
Hypocalcemia—Prolonged QT (see pages 44	Prolongs QT by lengthening ST segment, also ↓ T wave voltage, flat T waves, terminal T wave inversion, or deeply		

QT (see pages 44 (prolonged QT syndrome) and 47)	voltage, flat T waves, terminal T wave inversion, or deeply inverted T waves (if severe), rare ST elevation
Hypokalemia—ST depression, flat T waves, and prominent U wave (arrow); prolonged QT	
Hypertrophic cardiomyopathy (idiopathic subaortic stenosis): Nonspecific ST-T wave abnormalities; left ventricular hypertrophy. QRS complexes largest in midprecordial leads; Q waves in inferior (II, III, aVF) or precordial (V2 to V6) leads, or both.	



Intracranial hemorrhage—May cause deep, wide T waves, bradycardia, prolonged QT interval, minor ST elevation (<3 mm), U waves	
Ischemia (including arteritis, Kawasaki aneurysm occlusion, or anomalous coronary artery)	With anomalous coronary arteries, resting ECG is often normal. Focal ST segment elevation or depression, Q waves, T wave inversion. Reciprocal changes.
Kawasaki disease—Most with Kawasaki's have ECG evidence of carditis.	The most common ECG findings are elevated ST-T segments, elevated Q/R ratio (55% each), followed by a prolonged QT interval (35%), elevated P waves, diminished R waves (V1), prolonged PR intervals and flat T waves. After coronary artery formation, classic myocardial ischemic findings can occur. • ECG findings are not part of current criteria in the diagnosis of Kawasaki disease • Echocardiogram is recommended when Kawasaki disease is considered

Modified from McCrindle BW, Rowley AH, Newburger JW, et al. Diagnosis, treatment, and long-term management of Kawasaki disease: a scientific statement for health professionals from the American Heart Association. *Circulation*. 2017;135(17):e927-e999.

Lyme Disease—Carditis occurs in 16%. Most are older than 10 years, have arthralgias or cardiopulmonary symptoms (pain, dyspnea, syncope)

The most common ECG findings in order of frequency are 1st degree AV block, then 2nd or 3rd degree AV block (usually transient), prolonged QT, and then ST-T wave changes.

Modified from: Costello JM, Alexander ME, Greco KM, et al. Lyme carditis in children: presentation, predictive factors, and clinical course. *Pediatrics*. 2009;123(5):e835-e841.

Myocarditis—Patients may have ECG evidence of both myocarditis and pericarditis.

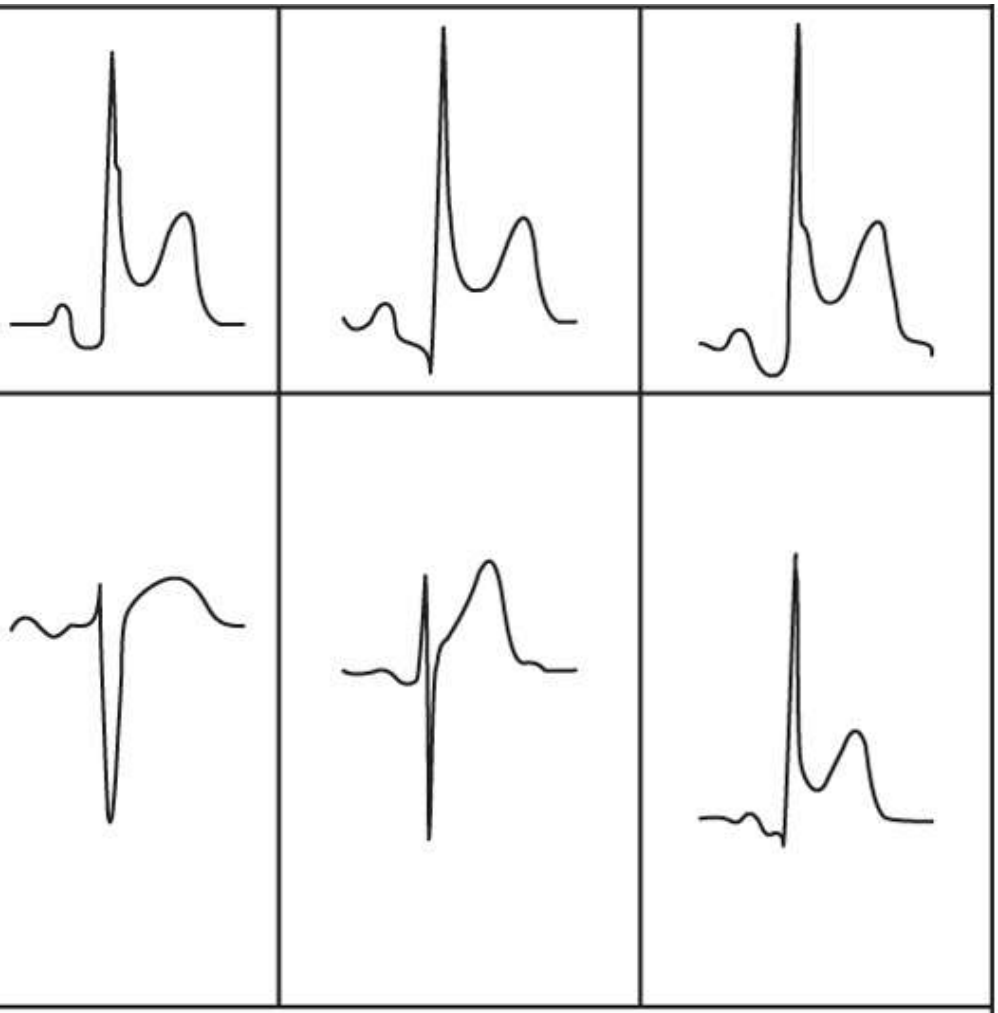
In one study, 100% of patients with myocarditis had abnormal ECG, 73% had elevated CK, and 54% had elevated troponin. 90% had cardiomegaly, 15% pulmonary edema, and 5% an infiltrate. Shortness of breath occurred in 69%, vomiting in 48%, poor feeding in 40%, + URI 39%.

Source: Durani Y, Egan M, Baffa J, et al. Pediatric myocarditis: presenting clinical characteristics. *Am J Emerg Med*. 2009;27(8):942-947.

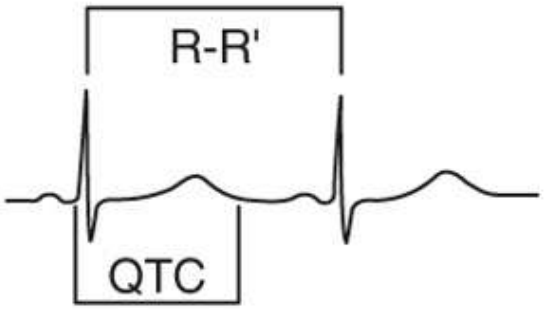
Sinus tachycardia is most common, with frequent nonspecific ST-T wave changes, occasional ischemic changes, pathologic Q waves, and variable AV blocks.

Most common ECG findings (in myocarditis)	*Frequency*
Sinus tachycardia	46%
Ventricular hypertrophy	41%
ST wave abnormality	32%
T wave abnormality	31%
Bundle branch	10%
Arrhythmia	7%
AV block	5%
Prolonged QT interval	5%

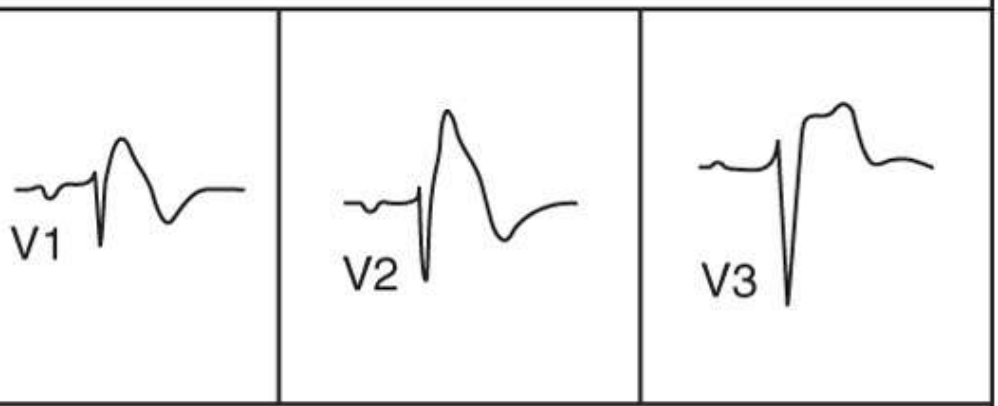
Pericarditis—(1) Diffuse ST elevation. (2) ST depression in aVR ± II and V1. ST segment is typically concave upward + ≤ 5 mm height. Q waves are rare. PR segment depression is common inferior + lateral.
(3) Sequence: (a) initial ST, (b) ST returns to baseline, (c) T waves flip ↓ and T wave amplitude is usually ≤ 5 mm, (d) T waves normalize.
(4) Height of ST segment/T wave > 0.25 in V5, V6, or I



Prolonged QT syndrome—QTc interval > 0.46–0.50 milliseconds, may need stress testing to uncover prolongation of QT.
See www.qtdrugs.org for causes.



Sudden unexpected death syndrome (SUDS) or Brugada syndrome—RBBB with ST segment elevation in V1 to V3 or incomplete RBBB with ST segment elevation in V1 and V2



Wolff-Parkinson-White syndrome—Delta wave, wide QRS, short PR interval, wide complex AFib/SVT

[1]The list is not all inclusive and only describes common ECG findings for diseases. [2]Epsilon wave = terminal notch in QRS complex.

Description

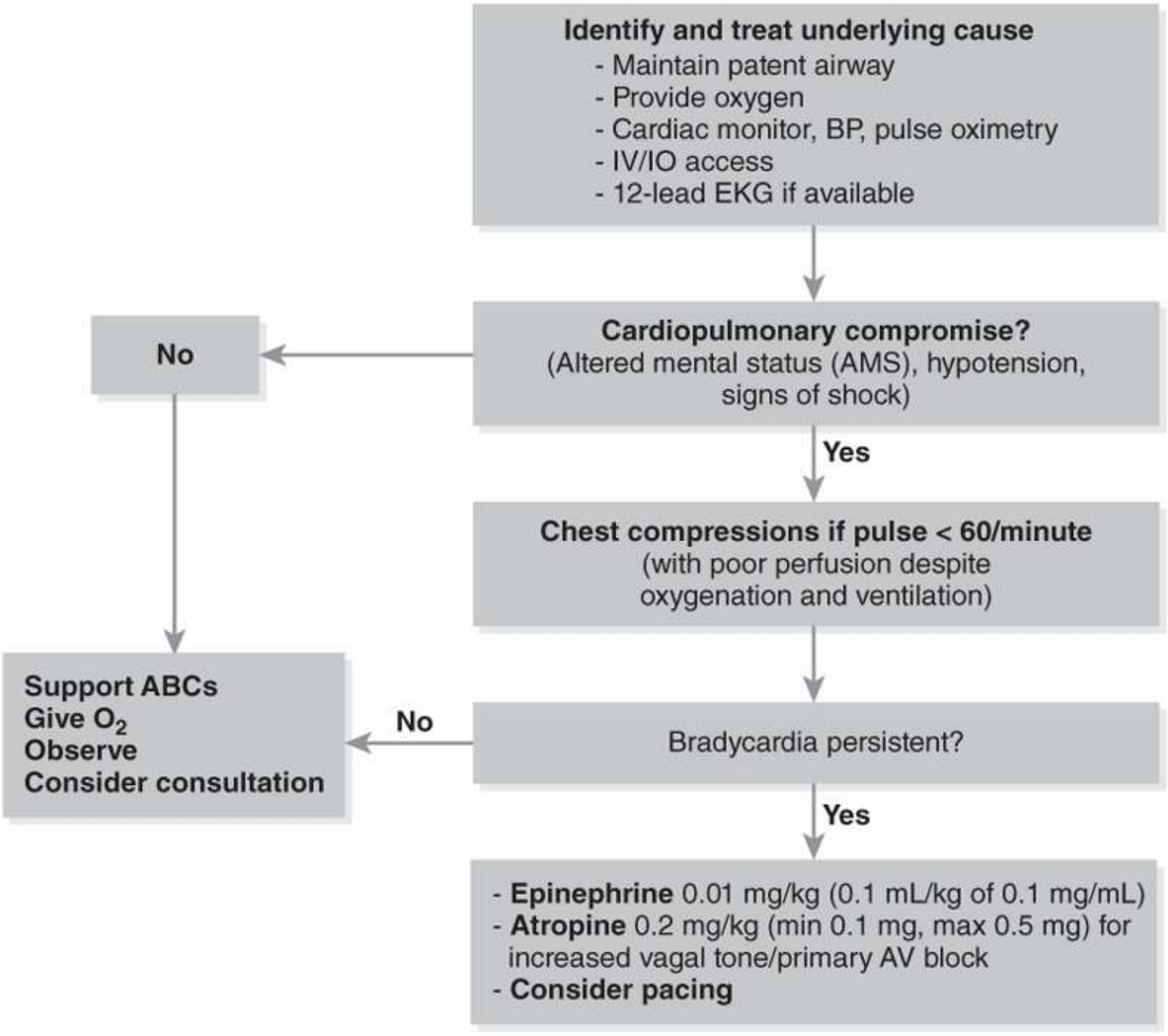


Figure 8-1 Symptomatic Bradycardia[1]

[1]Shock—identify and treat possible causes: Hypovolemia, hypoxia, hydrogen ion (acidosis), hypo/hyperkalemia, hypoglycemia, hypothermia, toxins, tamponade (cardiac), tension pneumothorax, thrombosis (heart/lung), trauma (blood loss or increased intracranial pressure, or tamponade/pneumothorax).

Table 8-5 Differentiation of Sinus Tachycardia from Supraventricular Tachycardia

	Sinus tachycardia	Supraventricular tachycardia
History	Volume loss (dehydration, bleed), drugs, other stressor	Often vague and nondescript, if prolonged—CHF or shock

Heart rate < 1 year	< 220	≥ 220
Heart rate > 1 year	< 180–200	> 180–200
QRS width	Narrow for age	Narrow in 90%
P waves	Upright leads I, aVF	Rare, negative in II, III, aVF
HR and R-R variability	Beat-beat (R-R varies), responds to stimulation	No variability, no response to stimulation
HR changes	Slow increase or decrease	Abrupt onset and termination

Description

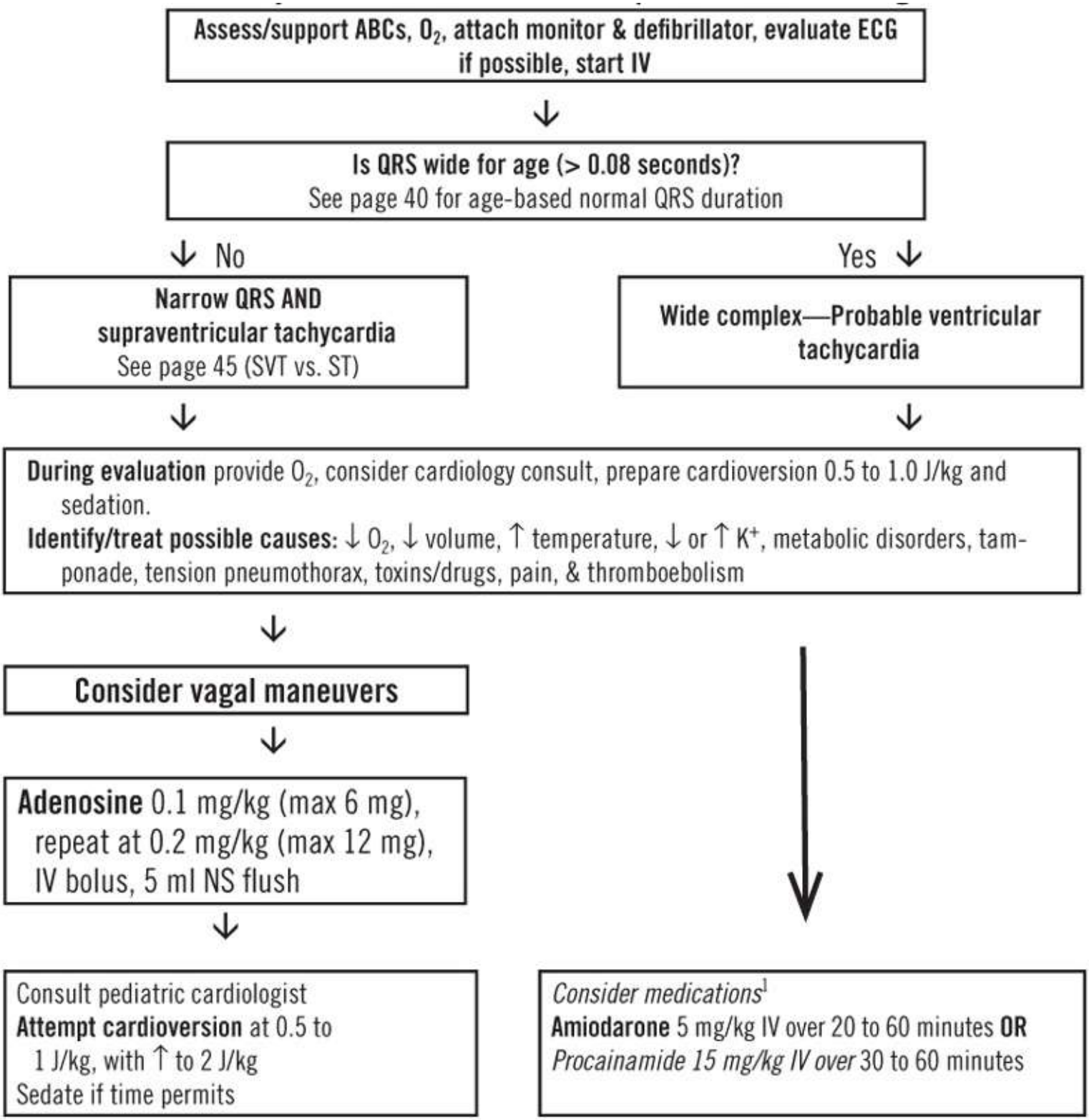
Table 8-6 Wide Supraventricular Tachycardia (Aberrancy) vs. Ventricular Tachycardia[1]

	Supraventricular Tachycardia	**Ventricular Tachycardia**
History	Wolff Parkinson White (WPW) in up to 30% in infancy[2]	70% structural cardiac disease
Symptoms and BP	Not a useful differentiator	Not a useful differentiator
Heart rate	> 220 infant, > 180 child	> 120
P waves	Retrograde P waves possible	Dissociation of P and QRS
Other features	Features found useful in differentiating adult VT (*absence of RS in all precordial leads, QRS concordance in precordial leads, QRS ≥ 0.12–0.14 ms*) vs. SVT (*triphasic QRS with RBBB in V1 or V6*) have not been studied in children	

Description

[1]During management, generally assume wide complex tachyarrhythmia is ventricular tachycardia. [2]Ebstein's anomaly esp. associated with WPW in 10–30%.

Table 8-7 Stable Tachycardia with a Pulse and Adequate Perfusion Management



[1]Consider $MgSO_4$ 25 mg/kg IV over 15 minutes if torsades. *Source: Circulation*. 2005;112:I-167.

Description

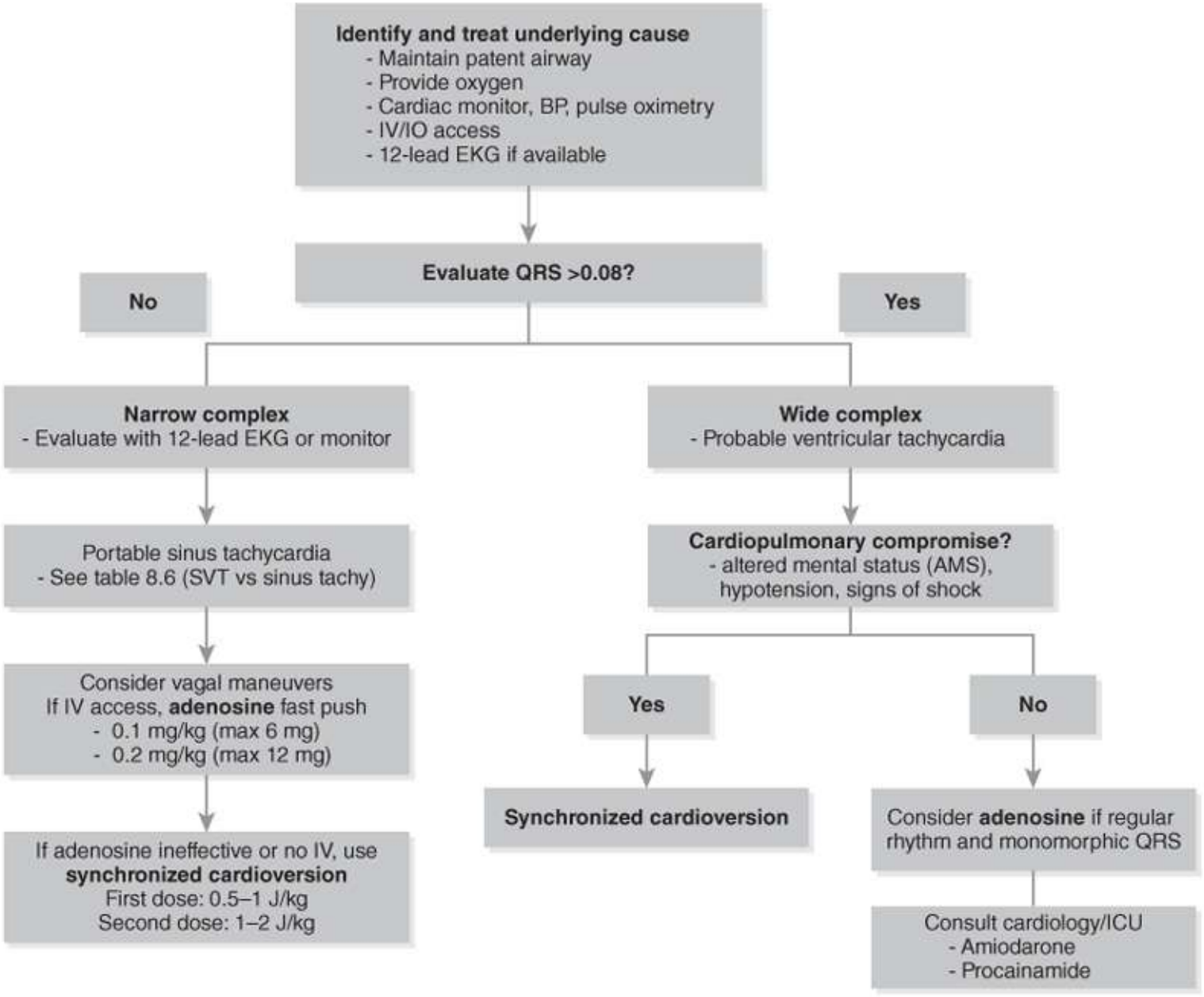


Figure 8-2 Unstable Tachycardia Management[1, 2]

[1]See Table 2-11 for pulseless VF/VT, PEA management. *Source*: *PALS Card 2015*.
[2]Shock—identify and treat possible causes: Hypovolemia, hypoxia, hydrogen ion (acidosis), hypo/hyperkalemia, hypoglycemia, hypothermia, toxins, tamponade (cardiac), tension pneumothorax, thrombosis (heart/lung), trauma (blood loss or increased intracranial pressure, or tamponade/pneumothorax.
Modified from 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care, Circulation 2005; 112: I-167.

OTHER RHYTHM/ECG DISTURBANCES

Atrial flutter: Atrial rate of 250–350 beats/minute with variable but regular ventricular rate depending on degree of AV block (sawtooth pattern). Nearly always seen in children with congenital heart disease, especially after cardiac surgery. Can develop in newborns with normal cardiac anatomy. Treat if unstable with synchronized cardioversion—initially use 0.5 J/kg doubling to 1 J/kg, then 2 J/kg if needed. Digoxin, procainamide, and amiodarone are used in hemodynamically stable patients.

Atrial fibrillation: Atrial rate of > 300–600 with irregularly irregular ventricular rates often > 100–150 beats/minute. As with a flutter, most infants have structural heart disease. Management of unstable patients requires synchronized cardioversion. If stable, anticoagulation is usually required before converting rhythm.

Prolonged QT interval: (1) Inherited form may be associated with deafness, or (2) acquired due to class I antiarrhythmics (e.g., quinidine, procainamide), amiodarone, phenothiazines, lithium, cyclic antidepressants, ↓ K^+, ↓ Ca^{2+}, ↓ Mg^{2+}, myocarditis, liver disease, weight loss. Children with prolonged QTc may present with syncope or seizures [QTc = QT interval/(square root of RR interval)]. Treat by correcting underlying disorder or discontinuing drug. See Table 8-2 for age-based normal QTc intervals.

Torsades de pointes: Polymorphic VT with morphology swinging from negative to positive direction in 1 lead. Etiology: see ↑ QT mentioned previously. Treatment: Correct underlying disease, $MgSO_4$ 25–50 mg/kg slow IV, overdrive pacing, isoproterenol, lidocaine, phenytoin.

ANTIARRHYTHMIC AGENTS

Adenosine—Endogenous purine nucleoside used to treat SVT.

Dose—0.1 mg/kg IV push (max 6 mg), may double and repeat at 0.2 mg/kg (max 12 mg). If unsuccessful or hypotension, then synchronized cardioversion. Reduce dose 75% if carbamazepine/dipyridamole use or heart transplant (Thajudeen A, Stecker EC, Shehata M. Arrhythmias after heart transplantation: mechanisms and management. *J Am Heart Assoc*. 2012;1(2):e001461).

Contraindications—Sick sinus syndrome, second- or third-degree AV block, current use of digoxin and verapamil (may precipitate VFib), asthma (may precipitate bronchospasm especially if using theophylline), carbamazepine/*Tegretol* use (may increase degree of heart block), denervated heart (post-transplant)

Select Side Effects—Flushing, palpitations, chest pain, bradycardia, heart block, headache, dyspnea, bronchoconstriction in asthmatics

Amiodarone—Class III antiarrhythmic with adrenergic inhibition, ↑ action potential/refractory period, ↓ AV conduction/sinus node function used for ventricular fibrillation, ventricular tachycardia, SVT, atrial fib/flutter.

Dose—(pulseless VF/VT) 5 mg/kg rapid IV/IO bolus (max 300 mg). (VT/SVT with pulse) 5 mg/kg IV/IO over 20–60 minutes (max 300 mg). May repeat up to maximum dose of 15 mg/kg/day. IV maintenance dose 5 mcg/kg/minute (max 15 mcg/kg/minute)

Contraindications—Sinus node disease, bradycardia, second- or third-degree AV block, age ≤ 30 days causes gasping syndrome: respiratory distress, acidosis, cardiac arrest

Select Side Effects—↓ HR resistant to atropine (may need isoproterenol or pacer), ↓ BP, cardiac arrest, Torsades de pointes (↑ QT), ARDS/pneumonitis, hepatitis

Digoxin—Cardiac glycoside with inotropic and AV blocking effects. Obtain cardiology consult before administering this agent.

Total digitalizing dose (TDD) is given over 16–24 hours: 1/2 of dose initially IV, followed by 1/4 dose at both 8 and 16 hours. Oral doses are 20% greater, with maintenance dose 12.5% of TDD every 12 hours starting 12 hours after TDD complete.

Table 8-8 Unstable Tachycardia Management

Age	Total digitalizing dose IV	Maintenance (IV) daily dose
Premature neonate	15–25 mcg/kg	Maintenance dose is 20–30% of loading dose for premature neonate, and 25–35% of loading dose for others (divide above dose every 12 hours)
Term neonate	20–30 mcg/kg	
1–24 months	30–50 mcg/kg	
2–5 years	25–35 mcg/kg	
5–10 years	15–30 mcg/kg (max 1.5 mg)	

Description

Contraindications—Ventricular dysrhythmias (esp. VF). In patients receiving digoxin, cardioversion or calcium infusion might precipitate ventricular fibrillation.

Select Side Effects—Atrial and supraventricular arrhythmias with or without block, bradycardia, vomiting, diarrhea, headache, confusion, and visual changes.

Esmolol—β1 selective blocker with short half-life (2 minutes). Used in SVT, hypertensive emergency/urgency. Consider cardiology or ICU consultation prior to use.

Dose—100–500 mcg/kg IV over 5 minutes with initial maintenance infusion of 50 mcg/kg/minutes. May increase infusion 50 mcg/kg/minutes every 5 minutes to maximum of 200 mcg/kg/minute (0.2 mg/kg/minute).

Contraindications—Sinus bradycardia, or heart block, CHF, cardiogenic shock

Select Side Effects—Low blood pressure, bradycardia, confusion, vomiting, bronchoconstriction

Lidocaine—Class IB antiarrhythmic. Used in shock-resistant VF, pulseless VT

Dose—1 mg/kg IV/IO or 2–3 mg/kg ET. Second bolus of 0.5–1.0 mg/kg IV/IO (2–10 × higher for ET) if needed. Infusion: 20–50 mcg/kg/minute

Contraindications—Amide anesthetic allergy, AV, SA, intraventricular heart block

Select Side Effects—↓ BP/HR, altered LOC, seizure, vomit, respiratory depression

Procainamide—Class IA antiarrhythmic with anticholinergic/anesthetic effects

Dose—15 mg/kg IV over ≥ 30 minutes. Infusion: 20–80 mcg/kg/minute (daily max 2,000 mg/24 hours)

Contraindications—Second- or third-degree heart block, Torsades de pointes, QT prolongation, myasthenia gravis, lupus, hypersensitivity to procaine

Select Side Effects—↓ BP, ↑ or ↓ HR, QT/QRS widening, confusion, vomiting, neutropenia, thrombocytopenia, anemia, ↑ LFTs, lupus-like syndrome

Verapamil—Calcium channel blocker with negative inotropic and chronotropic effect

Dose—0.1 mg/kg IV (max 5 mg). Repeat 0.2 mg/kg (max 10 mg) in 30 minutes if no effect. When used, needs expert consultation, continuous ECG, and IV calcium available.

Contraindications—Avoid in infancy as associated with hypotension and cardiac arrest. Other contraindications include sinus bradycardia, heart block, shock, ventricular tachycardia, wide complex SVT/AFib/Aflutter due to bypass tract.

Select Side Effects—↓ BP/HR, heart block, CHF, seizures, respiratory insufficiency in muscular dystrophy, ↑ LFTs, GI upset, constipation

Table 8-9 Select Serious Causes of Chest Pain in Children

Ischemia from arteritis (Kawasaki's), coronary artery anomalies, HTN, ↓ O_2 *Structural anomalies* (e.g., aortic stenosis), pulmonic stenosis, cardiomyopathy (HCM, dilated) *Pulmonary* (emboli, pneumothorax)		*Arrhythmias* (↓ or ↑ HR) ↓ BP with ↓ coronary perfusion *Infectious* (pericarditis, myocarditis, endocarditis) Aortic dissection Sickle cell (chest syndrome) * Life-threatening conditions in only 1–6% of pediatric chest pain		
Chest pain etiologies at a pediatric ED	Musculoskeletal Respiratory Idiopathic	25–64% 13–21% 2–21%	Psychogenic Trauma GI or cardiac	9–13% 5% 3–5% each

Modified from Steven M. Selbst et. Al., Pediatric Chest Pain: A Prospective Study, Pediatrics. 1988;82:319. Cerebral Blood Flow Abnormalities in Children With Sydenham's Chorea: A SPECT Study, Clin Pediatr. 2004;43:241.

Description

Table 8-10 Most Common Congenital Defects Diagnosed at Different Ages[1]

0–6 Days		7–13 Days		14–28 Days	
D-Transposition of great arteries	19%	Coarctation—aorta	16%	VSD	16%
Hypoplastic LH	14%	VSD	14%	Coarctation—aorta	12%
Tetralogy of Fallot	8%	Hypoplastic LH	8%	Tetralogy of Fallot	7%
Coarctation—aorta	7%	D-Transposition of great arteries	7%	D-Transposition of great arteries	7%
VSD	3%	Tetralogy of Fallot	7%	Patent ductus	5%
Other defects	49%	Other defects	48%	Other defects	53%

[1]LH—left heart; VSD—ventricular septal defect.

Data from Marino BS, Bird GL, Wernovsky G. Diagnosis and management of the newborn with suspected congenital heart disease. *Clin Perinatol*. 2001;28(1):91-136.

Data from Flanagan MF, Fyler DC. Cardiac disease. In Avery GB, Fletcher MA, MacDonald M, eds. *Neonatology: Pathophysiology and Management of the Newborn*. Philadelphia, PA: J.B. Lippincott; 1994:524; with permission.

Description

Table 8-11 Pulse Oximetry in Congenital Heart Disease (CHD)

Beyond first 24 hours of life, pulse oximetry can be used to screen for CHD

- < 90% SpO_2 in right hand or foot = positive screen (ECHO)
- 90–94% SpO_2 in right hand or foot OR > 3% difference → repeat screen in 1 hour (max 3 times)
- ≥ 95% in right hand or foot AND ≤ 3% difference → negative screen

Description

Adapted from Kemper AR, Mahle WT, Martin GR, et al. Strategies for implementing screening for critical congenital heart disease. *Pediatrics*. 2011;128:e1259.

Table 8-12 Hyperoxia Test in Cyanotic CHD*

1. Obtain arterial blood gas (ABG) on room air.
2. Place patient on 100% oxygen for 10 minutes.
3. Repeat ABG:

- Cyanotic heart disease usually PaO_2 < 50 mm Hg following 10 minutes of 100% O_2 (see disorders and hyperoxia test results, which follows).
- Those with lung disease usually can raise their PaO_2 > 100 mm Hg.

Description

*Useful if echocardiography unavailable.

Table 8-13 Lesions with Ductal Dependent Systemic (S) or Pulmonary (P) Flow[1]

Tetralogy of fallot (P), Ebstein's anomaly (P), critical PS (P), tricuspid atresia (P), pulmonic valve atresia (P)	Hypoplastic left heart (S), interrupted aortic arch (S), critical coarctation of aorta (S), critical AS (S), d-TGA (P)

Description

[1]Mostly disorders with failed hyperoxia test or shock in first 3 weeks of life are often responsive to prostaglandin E1 (see dose Table A-2).

Table 8-14 Specific Cardiac/Noncardiac Disorders and Hyperoxia Test Results[1,2]

Disorders	PaO_2 (%sat) FiO_2 21%	PaO_2 (%sat) FiO_2 100%	$PaCO_2$
No disease	> 70 (> 95%)	> 300 (100%)	35
Lung or neurologic disease	50 (85%)	> 150 (100%)	50
d-TGA ± VSD, tricuspid atresia + PS or atresia, critical PS, tetralogy of fallot	< 40 (< 75%)	< 50 (< 85%)	35
Truncus arteriosus, TAPVR, hypoplastic left heart, single ventricle	40–60 (75–93%)	< 150 (< 100%)	35
Persistent pulmonary HTN of newborn, LV outflow tract obstruct (AA hypoplasia, interrupted AA, critical coarctation, AS)	Pre 70 (95%)[3] Post < 40 (< 75%)	Variable	35–50
d-TGA + (coarctation of aorta or interrupted aortic arch) or + pulmonary HTN	Pre < 40 (< 75%) Post > 50 (< 90%)	Variable	35–50

[1]A failed hyperoxia test indicates ductal dependent systemic or pulmonary blood flow. [2]TGA—transposition of great arteries; PS—pulmonary stenosis; TAPVR—total anomalous pulmonary venous return; HTN—hypertension; AA—aortic arch; AS—aortic stenosis. [3]Defect is (pre) preductal or (post) post-ductal.

Modified from Alex R. Kemper, William T. Mahle, Gerard R. Martin, W. Carl Cooley, Praveen Kumar, W. Robert Morrow, Kellie Kelm, Gail D. Pearson, Jill Glidewell, Scott D. Grosse and R. Rodney Howell. Strategies for Implementing Screening for Critical Congenital Heart Disease. *Pediatrics* November 2011; 128 (5): e1259-e1267. DOI: https://doi.org/10.1542/peds.2011-1317

Description

Table 8-15 Chest Radiography in Acyanotic CHD

Normal pulmonary flow	PS, MS or MR, AS, coarctation of the aorta
↑ Pulmonary flow	ASD, VSD, PDA, left to right shunts with pulmonary HTN, AV canal

Description

Table 8-16 Chest Radiography in Cyanotic CHD

↓ Pulmonary flow	Severe PS, pulmonary atresia, tetralogy of fallot (normal/boot-shaped heart), TGA with PS, tricuspid atresia, Ebstein's anomaly (massive heart), Eisenmenger's complex
↑ Pulmonary flow	TAPVR (Snowman sign—late finding, supracardiac venous return via dilated right and left superior vena cava), hypoplastic LH, TGA (egg-shaped heart tilted on its side with a narrow mediastinum "egg on a string") ± VSD, truncus arteriosus

Description

ACYANOTIC HEART DISEASE

Cardiac lesions with flow of blood from high pressure left to right side of the heart.

Examples—(1) *Atrial septal defect* often asymptomatic until adulthood and can cause right atrial enlargement (RAE) and SVTs. (2) *Ventricular septal defects* (VSD) if small may cause loud holosystolic murmur at left sternal border. If moderate, CHF may develop after first few weeks as normal newborn pulmonary resistance drops, decreasing RV pressure, and increasing the left to right shunt. RVH > LVH ± left atrial enlargement (LAE) may be evident on ECG. (3) *Patent ductus arteriosus*—Early systolic/diastolic murmur at second, third left intercostal (IC) space, later becomes machinery type and radiates to the back. Progressive CHF may develop while ECG may show LVH if PDA is large.

Management of CHF—Elevate head of bed, O_2, furosemide (*Lasix*) 1 mg/kg IV, morphine 0.05 mg/kg IV, dopamine/dobutamine if shock, vasodilator if ↑ BP or vasoconstriction (e.g., nitroprusside), treat cause (e.g., prostaglandin E1 [PGE1; dose on Table A-2] if ductal dependent lesion—hypoplastic left heart, coarctation, interrupted aortic arch, TGA).

CYANOTIC HEART DISEASE WITH DECREASED PULMONARY FLOW

Obstruction of flow at the right side of the heart so there is less flow to the lungs

Example—Tetralogy of Fallot: VSD, RV outflow obstruction, RVH, overriding aorta—Acute shunting leads to ↑ RR, ↑ cyanosis, ↓ murmur, stroke, or death. Precipitants: crying, defecating, exercise, ↓ systemic vascular resistance (SVR), ↓ LV pressure, and RV outflow spasm.

Acute management of hypercyanotic "Tet spell"—O_2, knee-chest position (↓ venous return), morphine 0.1 mg/kg IV (↓ outflow spasm), NS 10–20 ml/kg IV (SVR), phenylephrine (see dose on Table A-2, goal = ↑ SVR 20%), prostaglandin E1 (see dose on Table A-2) ± propranolol or esmolol (consult cardiology for these drugs). Use caution as they lead to ↓ BP/HR especially in neonates.

CYANOTIC HEART DISEASE WITH INCREASED PULMONARY FLOW

Example— (1) *d-Transposition of great arteries*: Aorta arises from RV and pulmonary artery from LV. Mixing of blood is via foramen ovale, patent ductus arteriosus ± VSD. Patients have cyanosis/CHF. CXR-cardiomegaly (egg on a string appearance). (2) *Total anomalous pulmonary venous return (TAPVR)*: All blood (systemic and pulmonary) returns to right atrium. ASD or patent foramen ovale must be present. CXR shows cardiomegaly and increased pulmonary vascular flow (Snowman sign).

Acute management—Treat as CHF, prostaglandin E1 for TGA and TAPVR patients with *infra*diaphragmatic venous return connection abnormalities (may worsen in patients with TAPVR) and abnormal *supra*diaphragmatic connections (see dose on Table A-2).

LEFT VENTRICULAR OUTFLOW OBSTRUCTION

Most common disorders presenting at ≤ 28 days old are hypoplastic left heart (HPLV) (51%), coarctation (CoA) (34%), and interrupted aortic arch (IAA) (13%).

Modified from: Rosenberg NM, Walker AR, Bechtel K, et al. Conscious sedation in the pediatric emergency department. *Pediatr Emerg Care*. 1998;14(6):436-439.

Table 8-17 Physiologic Murmurs

Murmur	Age	Location	Timing	Cause
Still's	3–6 years	Apex	Systole	Turbulent LV outflow
Pulmonary ejection	8–14 years	2nd left intercostal space (ICS)	Systole	RV outflow tract turbulence
Supraclavicular	4–14 years	Above clavicle	Systole	Brachiocephalic branching
Venous hum[1]	3–6 years	Base of neck	Entire	Venous return
Straight back pectus	All	Apex	Systole	RV filling with inspiration
Hemic exertion	All	Apex, left ICS	Systole	Rapid LV ejection
Neonatal pulmonary ejection	< 6 months	Right second ICS	Systole	Underdeveloped pulmonary arteries

[1]Venous hums decrease with supine position, turning head, and expiration.

Description

PHYSIOLOGIC MURMURS

Murmur evaluation: Murmurs should be of concern if CHD, failure to thrive, frequent infections, asthma, chest pain, or syncope. Heart disease also is suggested if: (1) murmur is grade ≥ 3, holosystolic, diastolic, harsh/blowing, increased in upright position; (2) cyanosis or CHF; or (3) abnormal ECG, CXR, or blood pressure.

Table 8-18 Evaluation and Etiology of Pediatric Syncope

Evaluation (primarily based on clinical presentation)	ECG, pregnancy test females > 11–12; Hb, glucose, electrolytes, Holter if arrhythmia, CT head (abnormal neuro exam), CT chest (dissection, PE), ECHO (valvular heart disease)			
Etiology of syncope in infants and children presenting to a pediatric ED	Vasovagal Orthostasis Atypical seizure	50% 20% 7%	Head trauma Migraine Miscellaneous	5% 5% 13%

Modified from Pratt JL, Fleisher GR. Syncope in children and adolescents. *Pediatr Emerg Care*. 1989;5:80-82.

Description

Table 8-19 Features Associated with Life-Threatening Cause of Syncope*

• Family history of cardiomyopathy or sudden death (HCM, prolonged QT) • Syncope during exercise or while supine (HCM, aortic + pulmonic stenosis, pulmonary hypertension) • Syncope + chest pain or palpitations (HCM, ischemia, aortic stenosis) • Congenital deafness (long QT)	• Abnormal ECG, examples Table 8-4 • Abnormal cardiac examination • Recurrent syncope • Fall directly onto face (rapid onset) • CHD • Drugs with cardiac effects • Marfanoid appearance or collagen vascular disease in family

Description

*The largest ED study to date of pediatric syncope found two or more of the following historical features to have 100% sensitivity for cardiac disease: (1) syncope with exercise, (2) chest pain preceding syncope during exercise, (3) no prodrome, and (4) palpitations preceding syncope. Modified from Hurst D, Hirsh DA, Oster ME, et al. Syncope in the Pediatric Emergency Department—can we predict cardiac disease based on history alone?. *J Emerg Med.* 2015;49(1):1-7.

Table 8-20 Causes of Sudden Death in Young Athletes[1–3]

Cause	% of Total
Hypertrophic cardiomyopathy (HCM)	26%

Commotio cordis	20%
Coronary artery anomaly	14%
Left ventricular hypertrophy, not diagnostic of HCM	8%
Myocarditis	5%
Asthma, ruptured aortic aneurysm, arrhythmogenic right ventricular cardiomyopathy, tunneled (bridged) coronary artery, atherosclerotic coronary artery disease, dilated cardiomyopathy, myxomatous mitral valve, heat stroke, drug abuse, long Q-T, cardiac sarcoid, ruptured cerebral artery, trauma involving structural cardiac injury	≤ 1–3% each

Description

[1]A history (especially family), exam, and ECG detects many disorders causing sudden death. A resting (± exercise) ECG in young adults and adolescents is standard in Europe while the American Heart Association does not endorse routine ECGs. An available automated external defibrillator at training/sport sites may save lives. [2]See ECG examples, Table 8-4. [3] The NCAA recommends screening all athletes for the sickle-cell trait due to death from exertional rhabdomyolysis (death within hours, days); for all strenuous exertion, ensure adequate rest, hydration, and recovery periods, and stop the workout if muscle cramping, swelling, weakness, inability to catch breath, or excess fatigue occurs.

Overall high school athlete risk is 1:50,000–80,000, with higher risk in males, African Americans, basketball athletes.

Adapted from Harmon KG, Drezner JA, Wilson MG, et al. Incidence of sudden cardiac death in athletes: a state-of-the-art review. *Heart*. 2014;100(16):1227-1234.

Data from Maron BJ. Sudden death in young athletes. *N Engl J Med*. 2003;349(11):1064-1075. doi:10.1056/nejmra022783

9 ■ DERMATOLOGY

Table 9-1 Rash Patterns and Etiology[1]

Description	
Acneiform	Acne vulgaris, drugs (steroid, Li, INH), Cushing's, chloracne
Acrodermatitis (extremity)	Papular acrodermatitis, smallpox, atopic dermatitis (infantile), tinea pedis, dyshidrotic eczema, poststreptococcal desquamation, Rocky Mountain Spotted Fever, drug rash
Clothing covered	Contact dermatitis, miliaria, psoriasis (summer), folliculitis
Flexural creases	Atopic dermatitis (childhood), infantile seborrheic dermatitis, intertrigo, candidiasis, tinea cruris, ichthyosis, inverse psoriasis
Linear Christmas tree distribution	Pityriasis rosea, secondary syphilis, drug reaction, guttate psoriasis, atopic dermatitis
Sun exposed	Phototoxic drug rash, photocontact dermatitis, lupus, viral exanthem, porphyria, xeroderma pigmentosum

[1]Vesiculobullous, petechial/purpuric, eczematous, papulosquamous rashes, see pages 60–65. Evaluation of patients with a petechial rash, see Table 18-7.

NEWBORN RASHES

Rash	Characteristics	Distribution	Course/ Treatment
Erythema toxicum	Erythematous papules and sterile pustules surrounded by erythematous halo	Over entire body surface area, palms and soles spared, occurs in first few days of life	Self-limited
Transient neonatal pustular melanosis	Flaccid and superficial pustules, which disrupt easily, on a nonerythematous base, progress to hyperpigmented macules	Lesions may be present at birth, involves all areas including palms, soles, and genitalia	No treatment needed
Infantile acropustulosis	Intensely pruritic, discrete erythematous papules that become vesiculopustular within 24 hours and subsequently crust	Dense lesions over palms and soles and sides of feet, waxes (7–14 days) and wanes (2–4 months), may continue up to 2 years	Topical steroids and oral antihistamines

Description

Eosinophilic pustular folliculitis	Polymorphous eruption with pruritic vesiculopustules, coalesce to form exudative and crusted plaques	Mainly on scalp and face, but also on trunk and extremity Intermittent	High potency steroid cream
Miliaria	Tiny fragile, clear (crystallina) vesicles over healthy skin to pruritic erythematous papules (rubra)	In intertriginous areas, face, scalp, and trunk	Benign
Milia	1–2 mm white cysts	Forehead, cheeks, nose and upper lip, starting by days 4–5, resolves by 2 months	Self-limited
Transient benign vascular phenomena	Acrocyanosis Cutis marmorata Harlequin color change	Blue, purple discoloration due to cold Reticulated cyanosis/ marbling of skin, symmetrically involving the trunk and extremity Dependent part becomes bright red in contrast to pale upper half	Benign

SCALING DERMATITIDES

	Characteristics	Distribution	Treatment
Irritant contact dermatitis	Lesions have erythema, oozing, weeping, and formation of microvesicles within epidermis	Over convex surfaces of perineum, lower abdomen, buttocks, and thighs sparing intertriginous areas	Removal of stimulus and temporary treatment with topical steroids and barrier pastes
Seborrheic dermatitis	Salmon-colored patches with greasy yellow scales	In intertriginous areas, diaper area, axilla, and scalp	Mild keratolytics, emollients, low potency steroids, antifungal shampoo

Description

CUTANEOUS FUNGAL INFECTIONS

Rash		Characteristics	Treatment
Tinea versicolor (*Malassezia globosa*)		Reddish brown to hypopigmented macules covered with fine scales, enlarge to coalesce to form confluent patches No pruritus, area does not tan with exposure to sun	Antifungal shampoo, topical antifungal agents, oral antifungal if diffuse
Dermatophytoses (*Trichophyton, Microsporum, Epidermophyton*)	Tinea capitis	"Black dot ringworm", circular patches of alopecia with hair broken close to follicle or diffuse scaling with minimal hair loss	Oral griseofulvin, terbinafine, itraconazole with antifungal shampoo
	Kerion	Severe inflammatory response producing a boggy granulomatous mass often studded with small pustules	As above
	Tinea corporis	Elevated scaly plaque that spread centrifugally and clears centrally to form annular lesions	Topical antifungals
	Tinea unguium	Numerous white patches on the surface of the nail or thick, brittle, yellow nail that may separate from nail bed	Oral antifungals
Candida	Bright red with sharp borders, satellite red papules and pustules	In skin creases and areas of skin that are constantly moist or occluded	Topical antifungals

Description

SELECT SERIOUS DISEASES CAUSING RASHES IN THE

NEWBORN PERIOD INCLUDE:

Disease	Characteristics	Treatment
Congenital syphilis	Erythematous maculopapular or vesiculobullous lesions followed by desquamation involving hands and feet with mucous patches, persistent rhinitis, and condylomatous lesions also present. Systemic disease will manifest as lymphadenopathy, pneumonitis, nephritis, enteritis, pancreatitis, meningitis, or osteochondritis	Penicillin
Acrodermatitis enteropathica	Erythematous dry, scaly patches, and plaques may evolve into crusted, vesiculobullous, erosive lesions involving perioral, acral, and intertriginous areas, associated with diarrhea and hair loss	PO or IV Zinc
Herpes simplex	Presents at 5–11 days of life with small clustered pustules and vesicles that get denuded. May occur at site of trauma	Acyclovir

Description

CHILDHOOD EXANTHEMS

Exanthems are eruptions of the skin associated with systemic illness.

Disease	Measles 1st disease	Scarlet fever 2nd disease	Rubella 3rd disease	Erythema infectiosum 5th disease	Roseola infantum 6th disease
Etiology	Paramyxovirus	Streptococcus pyogenes	Rubivirus	Parvovirus	Human herpes virus 6 and 7
Infectivity	Several days before to 4 days after rash	Until fever present, up to 24 hours of antibiotics	7 days before to 7 days after	Start at exposure to 4–14 days after	For 1–2 days after fever subsides
Morphology	Erythematous confluent maculopapular rash	Generalized erythematous, sandpaper, lasts 5–6 days	Rose-pink maculopapular	Slapped cheek, lacy reticular, worsens with sunlight	Rose-pink maculopapular, rash appears after fever falls
Distribution	Begins at hairline, spreads inferiorly	Begins on face and upper trunk, spreads inferiorly	Spreads inferiorly	Erythematous cheek Reticular extremities	Neck and trunk
Incubation period	8–12 days	2–5 days	14–21 days	4–21 days	10–15 days
Associated symptoms	Koplik spots, cough, coryza, conjunctivitis, Forchheimer spots	Pastia's lines, strawberry tongue, exudative pharyngitis, abdominal pain, rheumatic fever, circumoral pallor, Forchheimer spots	Tender occipital and posterior auricular Lymph Nodes (LN), arthralgia, Forchheimer spots	Lymphadenopathy absent, rash waxes and wanes over weeks, arthritis, aplastic crisis	LN-pathy, febrile seizure may occur, Nagayama spots

Koplik spot: Clustered, white lesions on the buccal mucosa opposite the lower first and second molars.

Forchheimer spots: Fleeting small, red spots (petechiae) on the soft palate.

Pastia lines: Pink or red lines formed of confluent petechiae in skin creases.

Nagayama spots: Erythematous papules on the soft palate and uvula.

Description

Enteroviruses: More than 30 exanthems are associated with coxsackievirus/echoviruses. Rash = maculopapular, scarlatiniform, vesicular, or urticarial (e.g., hand-foot-mouth—fever, malaise, then vesicles in mouth, on palms, feet, lasts 3 to 6 days, reoccurs).

PAPULOSQUAMOUS AND ECZEMATOUS RASHES

ATOPIC DERMATITIS (AD)

Incessant pruritus is the only symptom of AD, characterized by intermittent flares and remission.

Essential features are pruritus, eczema (acute, subacute, chronic) with distribution on face, neck, and extensor involvement in infants and children and flexural involvement in any age, with sparing of groin and axilla, chronic relapsing history.

Diagnosis is supported by early age of onset, strong family and/or personal history of atopy or immunoglobulin E (IgE) reactivity, and xerosis.

Associated with:

1. Atypical vascular response (e.g., facial pallor)
2. Keratosis pilaris/pityriasis alba/hyper-linear palms/ichthyosis
3. Ocular and periorbital changes
4. Other findings (e.g., perioral changes or periauricular lesions, perifollicular accentuation/lichenification/prurigo)

No reliable biomarker exists for diagnosis, but IgE level can be helpful.

Treatment

Nonpharmacological Management

1. Petrolatum, Aquaphor, or newer agents such as Atopiclair, and Mimyx can reduce the severity of the disease, and are best when applied soon after bathing. There is strong evidence that application of moisturizers/emollients lubricate and soften the skin, occlusive agents retard evaporation, and humectants attract and hold water.
2. Hypoallergenic, neutral to low pH, fragrance-free soaps are recommended. Limit use of soaps.
3. Use of wet wraps with or without topical steroids is recommended in moderate to severe AD, especially during flares.

Pharmacological Treatment

1. **Topical corticosteroids (TCS):** Mid- to high-potency TCS appropriate for acute flare-ups; however, least potent TCS may be used for long-term management to reduce adverse effects. Use with caution on thin skin like the face, neck, and skin folds. Once daily application may be as effective as twice daily application.
2. **Immunomodulators:** Topical calcineurin inhibitors (TCI). Used if there is recalcitrance to steroids, long-term use of or atrophy of skin from steroids, or if required for sensitive skin, like the face, anogenital area, and skin folds. For children younger than 2 years, off-label use of tacrolimus 0.03% or 1% pimecrolimus can be recommended. Proactive use as maintenance therapy 2 to 3 times a week is recommended to reduce the need for a topical corticosteroid.

3. **Topical antibiotics and antiseptic:** In moderate to severe AD with signs of secondary infection, bleach baths and intranasal mupirocin may be recommended.
4. **Targeted biologic treatments:** Dupilumab (anti IL-4Rα monoclonal antibody).
5. **Topical phosphodiesterase inhibitor:** Crisaborole 2% for mild to moderate AD in adults and children older than 2 years of age.
6. **Other:** Probiotics, UV-A and UV-B can be tried. Oral antibiotics if secondary infection.
7. **Hydroxyzine/Benadryl:** For itching. Use humidifier to prevent excessive drying.

CONTACT DERMATITIS CAUSED BY IRRITANTS OR ALLERGENS

Diaper dermatitis (irritant): Patchy or confluent erythema in areas of occlusion and friction (convex surfaces). Spares inguinal folds. Blistering and erosion may occur. Consider candida if red, pustular or papular lesions involving convex and concave surface.

Management: (a) Keep area dry. (b) Desitin or Bepanthen applied topically. (c) Occlusive barrier (e.g., zinc oxide ointment or Orlando butt balm (mix zinc oxide 30 g, Aquaphor 20 g, Burow's solution 10 ml) after diaper change. (d) Topical antifungal if secondary fungal infection. (e) Low potency steroids can be used in recalcitrant cases. (f) Oral Mycostatin. (g) If breastfeeding treat mom's Candida.

Allergic dermatitis: Exhibits initial eczematous reaction with red papules or vesicles overlying area of edema (e.g., linear streaks for poison ivy, oak, sumac).

Management: Remove offending agent, Burow's solution, cool compresses, topical or brief systemic steroids.

Table 9-2 Other Papulosquamous and Eczematous Rashes

Disorder	Skin lesions	Treatment
Dyshidrotic eczema	Scaling vesicles, blisters, fissures Feet > hands, lateral digits, hyperhidrosis ± localized atopic dermatitis	High-dose topical steroids ± oral steroids first, cold compress. Calcineurin inhibitors, psoralen, PUVA, stress-reduction therapy have also been tried
Eczema herpeticum	Herpes clusters at site of atopic dermatitis	If young patient or moderate involvement, IV acyclovir. If well appearing and older, PO acyclovir
Exfoliative dermatitis	General erythema and scaling with exfoliation head to toe, fluid loss, bullae, and sepsis, plus Nikolsky's sign	Mainstay of treatment aimed at maintaining skin hydration, avoid scratching, applying topical steroids, avoiding precipitating factors and treating underlying cause; compresses with Burow's

		solution or potassium permanganate also effective
Pityriasis rosea	Papules, scales Starts with a herald patch, erupts over 2–21 days over lines of cleavage of skin, Christmas tree pattern on back *(if African American, may spare trunk)*	Self-limiting, with a duration of 6–8 weeks Supportive care for pruritus
Psoriasis	Round or oval red plaques with silvery scales Scalp, trunk, extensor extremities, or areas of trauma; nail pitting, dystrophy, and fissuring of palms and soles may be present	Topical and systemic medication (MTX/cyclosporine), biologic agent, phototherapy, UV therapy, Psoralen, stress reduction, moisturizers, salicylic acid, urea, and climatotherapy
Seborrheic dermatitis	Mild patchy scaling to thick adherent scaling, intermittent active phases with burning, itching and scaling in winter and early spring with remission in summer, over oil-bearing areas of head and neck	Antifungal gels, calcineurin inhibitors, sulfur or sulfonamide combinations, or propylene glycol, low-potency shampoos containing salicylic acid, tar, selenium, sulfur, or zinc can be used. Selenium sulfide (2.5%), ketoconazole, and ciclopirox shampoos may help by reducing *Malassezia* yeast scalp reservoirs
Syphilis (secondary)	Diffuse/localized, maculopapular, nonpruritic, bilaterally symmetrical, with nontender LN-pathy, associated with constitutional symptoms and pain in bone and fatigue	Penicillin drug of choice Doxycycline is the next best alternative
Tinea	Begins as erythematous scaly plaque, with central resolution giving it an annular appearance	Topical antifungals (azoles and allylamines) Systemic antifungals if severe

Description

Table 9-3 Vesiculopustular Rashes[1]

Rash	Skin lesions/distribution	Management

Impetigo	Nonbullous: Honey-colored crust with moist erythematous base Bullous: Fragile, thin-roofed, flaccid, and transparent bullae with clear, yellow fluid that turns cloudy and dark yellow, on rupture there is no crusting, with a collarette of scales around the periphery over face, extremity, elbow, and trunk	Topical and systemic steroids
Staphylococcal scalded skin syndrome (SSSS)	Macular erythema with dermal exfoliation, generalized sunburn, circumoral erythema, periorifice crusting, Nikolsky's sign, sterile bullae affecting total body with sparing of mucosa	Fluid hydration, topical wound care, and antibiotics to treat infection
Herpes simplex	Vesicular lesions on the oral mucosa and tongue, which later rupture and coalesce and leave ulcerated plaques, with tender lymphadenopathy	Acyclovir
Herpes zoster	Self-limited grouped vesicular lesions covering one or two adjacent dermatomes	Wet dressing, Burow's solution, calamine lotion, pain medications, antiviral treatment. Tricyclic antidepressants (TCA), gabapentin, pregabalin, narcotic or non-narcotic pain meds can be used for post-herpetic neuralgia
Erythema multiforme	Papules, wheals, target lesions involving entire surface of the body. No mucosal involvement in minor. > 2 mucosal involvement in Stevens-Johnson syndrome	Oral antihistamines, analgesics, local skin care, and soothing mouthwashes, topical steroids, meticulous wound care and use of Burow's or Domeboro solution dressings, remove offending drug, treat infection
Toxic epidermal necrolysis	Widespread erythema, necrosis, and bullous detachment of the epidermis and mucous membranes, resulting in exfoliation and possible sepsis and/or death	Withdrawal of offending agent, isolation, fluid and electrolyte balance, nutritional support, protective dressing, pain management

Description

[1]Other conditions that may mimic or have vesicular lesions—scabies (more often papular, excoriated, or scaling). Threadlike burrows are seen in the classic form, dyshidrosis, ID reaction, insect bites, molluscum contagiosum (simulates vesicles), coxsackievirus (hand, foot, mouth).

Table 9-4 Petechial and Purpuric Rashes[1–3]

Rash	Skin lesions	Treatment
Idiopathic thrombocytopenic purpura (and thrombotic thrombocytopenic purpura [TTP])	Petechiae, ecchymosis, hematomas on exposed sites, bony prominences, and mucosa	Mild: no treatment Moderate to severe: +/– intravenous IG (IVIG), +/– steroids
Henoch-Schönlein purpura	Petechiae, purpura typically symmetrical in dependent body areas +/– joint pain, abdominal pain, +/– renal involvement	Adequate hydration, treat pain, steroids/immunosuppressive drugs if complications
Acute leukemia	Petechiae, purpura, (generalized or localized), adenopathy, hepatosplenomegaly, sternal tenderness	Treat as per protocol
Aplastic anemia	Petechiae, purpura, ecchymosis, generalized or at sites of injury	Supportive care, immunosuppressive therapy, or HCT
DIC	Generalized petechiae (tend to be palpable with *meningococcemia*), purpura, areas of skin necrosis	Replacement of platelets, cryoprecipitates, and/or fresh frozen plasma
Factor deficiency (e.g., hemophilia)	Easy bruising, abnormal bleeding under the skin and mucous membrane +/– involvement of muscle and joints	Replacement of factor

Description

[1]See “Bleeding Disorders,” pages 120–123, and “Evaluation of Patients with Petechiae,” Table 18-7. [2] Other purpuric rashes: vasculitis, *Rickettsia* (RMSF), histiocytosis X, scurvy, trauma, medicines (steroids, thiazides), dysproteinemias, Kaposi’s sarcoma, pyogenic granuloma. [3]See etiology and differential for fever and petechiae, Table 18-8.

Eichenfield LF, Tom WL, Chamlin SL, et al. Guidelines of care for the management of atopic dermatitis: section 1. Diagnosis and assessment of atopic dermatitis. *J Am Acad Dermatol*. 2014;70(2):338-351.

Table 10-1 Developmental Milestones

	Milestones			
Age	**Social**	**Language**	**Fine motor**	**Gross motor**
2 months	Social smile	Coos, gurgling sounds	Follows object 180 degrees	Holds head up
4 months	Spontaneous smile	Turns to voice, laughs	Brings objects to midline	Rolls front to back
6 months	Knows familiar faces	Babbles	Passes object from one hand to the other	Sits independently
9 months	Stranger anxiety	Says "mama/dada" nonspecifically	Uses immature pincer	Crawls, pulls to stand
12 months	Separation anxiety	Follows one-step command with gesture, 3 words	Uses mature pincer	Walks
18 months	Independence	Says 10–25 words	Builds four-cube tower	Runs stiffly, walks up stairs with assistance
2 years	Parallel play	Says 2–3-word sentences	Displays handedness	Runs
3 years	Cooperative play	States first name, follows command with 2–3 steps	Builds eight-cube tower, undresses	Rides tricycle
4 years	Cooperative play	Tells stories	Uses scissors	Hops and stands on one foot up to 2 seconds
5 years	Wants to please and be like friends	Speaks clearly	Can print some letters and numbers	Stands on one foot more than 10 seconds

Description

Table 10-2 Weight, Height, Head Circumference—5th, 50th, and 95th Percentiles

Age	Males			Females		
	Height (cm)	Weight (kg)	Head circum. (cm)	Height (cm)	Weight (kg)	Head circum. (cm)
1 month	51.4–55.9–59.7	—	—	50.8–54.3–58.4	—	—
3 months	58.3–61.9–66.6	5.35–6.95–8.45	39.7–41.7–43.1	56.7–61.0–64.8	5.40–6.30–7.75	39.0–40.3–42.6
6 months	64.8–68.2–71.9	7.00–8.39–10.70	42.4–44.0–46.8	63.3–66.7–70.9	6.58–7.55–8.96	40.8–42.6–45.0
9 months	67.9–72.6–76.6	8.05–9.30–10.89	43.6–45.4–47.4	66.8–71.0–75.5	7.40–8.73–10.45	42.6–44.3–46.2
12 months	72.9–77.3–82.9	8.90–10.55–12.35	44.7–47.0–49.4	70.0–76.2–80.5	8.28–9.80–11.57	43.5–45.6–48.0
18 months	77.8–83.7–90.2	9.98–11.91–15.45	45.5–48.0–50.1	76.1–81.6–87.5	9.15–10.95–13.50	44.0–46.5–49.2
2 years	83.0–89.1–95.5	10.95–12.93–15.77	46.4–49.0–51.2	82.4–88.0–94.4	10.25–12.36–15.08	45.0–47.8–49.9
3 years	90.5–96.7–103.3	12.47–14.95–18.00	—	89.1–95.7–102.9	11.75–14.40–18.03	—
4 years	96.9–104.2–111.8	13.75–17.01–21.00	—	95.7–103.2–110.2	13.72–16.44–20.87	—
5 years	103.1–111.1–118.8	15.76–19.16–24.10	—	101.9–109.9–117.2	14.60–18.48–25.65	—

Modified from Kuczmarski, R. J., 2000 CDC Growth Charts for the United States: Methods and Development. *Vital and Health Statistics*. May 2002;11(246).

Description

OTHER GROWTH MILESTONES

- *Dentition*—1st teeth to erupt: Lower central incisors (6–10 months), upper central incisors (8–12 months), lateral incisors (9–16 months), first molars (13–19 months), cuspids (16–23 months), 2nd molars (23–33 months). Most children have a full set of primary teeth by 3 years. Permanent teeth begin to erupt at 6 years, continues until 12 years.
- *Fontanelle*—Posterior fontanelle closes by 1–2 months. Anterior fontanelle, closes at 9–18 months.
- *Sinuses*—The ethmoid and maxillary sinuses are aerated at birth, while the sphenoid sinus becomes aerated by 5 years. Frontal sinus appears at 7–8 years with complete development in adolescence.
- *Menarche*—Median age at menarche for US girls is 12.43 years. Primary amenorrhea: No menarche and has no secondary sex characteristics at 14 years OR no menarche but has secondary sex characteristics at 16 years.

11 ■ ENDOCRINOLOGY

ADRENAL CRISIS (INSUFFICIENCY)

Presentation: Fever, vomiting, altered mental status, ↓ BP, shock, ↓ Na^+, ↑ K^+, ↓ glucose, ↑ eosinophils.

Associated with chronic steroid use or unidentified adrenal disease [e.g., Addison's, congenital enzyme defects (e.g., congenital adrenal hyperplasia with ambiguous genitalia)].

Laboratory assessment may reveal hyponatremia with or without hyperkalemia, metabolic acidosis, and hypoglycemia.

The table that follows lists the common steroid preparations and their potency relative to hydrocortisone. Hydrocortisone is the least potent preparation commonly prescribed. A hydrocortisone dose of 20 mg is roughly equivalent in potency to a prednisone dose of 5 mg. Note that cortisol and hydrocortisone should be considered to have equivalent potencies.

Glucocorticoid	Approximate equivalent dose (mg)	Physiologic dose ($mg/m^2/day$)
Hydrocortisone	20	6–12
Prednisone/Prednisolone	5	1.5–3
Methylprednisolone	4	1.2–2.4
Dexamethasone	0.75	0.2–0.4

Description

ADRENAL CRISIS THERAPY

- Assess hydration, BP, and blood glucose. If possible, draw and store blood sample [glucose, electrolytes, creatinine, ACTH, cortisol, aldosterone, and plasma renin activity (low aldosterone and high plasma renin seen in primary adrenal insufficiency)] for later steroid-level analyses.
- 20 ml/kg normal saline bolus IV to correct shock (may repeat as needed).[1]
- Dextrose 2 ml/kg of 25% dextrose in water ($D_{25}W$) or 4 ml/kg 10% dextrose in water ($D_{10}W$) IV should correct hypoglycemia.[2]
- Patients with suspected adrenal crisis should undergo immediate treatment with a parenteral injection of 100 mg (older than 2 years of age), or 50 mg (younger than 2 years of age) hydrocortisone, after which, appropriate fluid resuscitation should be administered,

as well as 200 mg (50–100 mg/m^2 for children) of hydrocortisone/24 hours (by way of continuous IV therapy or 6-hourly injection). If hydrocortisone is unavailable, prednisolone may be used. Dexamethasone is least-preferred, as its onset of action is slow.

- Antibiotics if suspicion of sepsis (e.g., ceftriaxone 50 mg/kg).
- Exert caution if associated hypothyroidism is treated, as thyroxine increases cortisol clearance.

INSULIN GUIDELINES

- All dosing should be coordinated with the patient's endocrinologist if available.
- Basal/maintenance insulin (typical total daily requirements):
  - Prepubertal: 0.7 units/kg/day
  - Midpubertal: 1 unit/kg/day
  - Late pubertal: > 1–2 units/kg/day
    **If *newly* diagnosed, initial dosing is usually 60–70% of these values

Insulin regimens:

- **Basal-bolus concept:** (i.e., a pump or intermediate-acting/long-acting insulin/basal analog once or twice daily and rapid-acting or regular boluses with meals and snacks) has the best ability of mimicking physiologic insulin profile.
- **Different therapeutic strategies:**
  - Glucose and meal-adjusted regime: 30–45% of total daily insulin given as basal insulin, the rest given preprandial with rapid-acting/regular insulin adjusted for meal, glycemia, and activity.
  - Less intensive regime:
    - Three times daily: Mix of short/rapid + intermediate before breakfast, rapid/regular before afternoon snack or dinner, intermediate-acting before bed
    - Two times daily: Mix of short/rapid/intermediate before breakfast and the main evening meal
    - Prandial insulin: adjusted by glucose and carbohydrate content, extra injections when needed
  - Fixed insulin dose regime: limited flexibility, more challenging.
  - Insulin pump regimes are gaining popularity with a fixed or variable basal rate and adjusted bolus doses with meals.
  - Sensor augmented therapies: Continuous glucose monitoring (CGM) used with pump therapy or MDI (pen/syringe), well tolerated in children, but use decreased with time in different studies. Intermittently viewed CGM (iCGM) is being increasingly used in children older than 4 years in countries where it is available.

Table 11-1 Insulin Preparations

Insulin[1]	Preparation	Onset (hours)	Peak (hours)	Duration (hours)	
Ultra-rapid acting analog	Faster aspart	0.1–0.2	1–3	3–5	Better intended to match the time-action profile of prandial insulin. Useful for pumps and closed-loop approaches.
Rapid-acting analog (quicker effect than regular insulin to treat hyperglycemia)	Aspart, glulisine, lispro	0.15–0.35	1–3	3–5	Give immediately before meals (in exception of cases such as infants and toddlers who are reluctant to eat, give after food). Most often used as prandial or snack boluses in combination with longer-acting insulins (see basal-bolus regimens). Most often used in insulin pumps.
Regular/Soluble (short acting) (identical to human insulin)	Short acting	0.5–1	2–4	5–8	Used either with intermediate-acting insulin in a twice daily regimen or as a premeal bolus injection in basal-bolus regimen (given 20–30 minutes before meals) together with intermediate-acting insulin 2 to 3 (or even 4) times daily or a basal analog given once or twice daily.
Intermediate	Isophane NPH	2–4	4–12	12–24	Suitable for twice daily regimens, tailored basal substitution and for pre-bed dosage in basal-bolus regimens.
Long	Detemir[2] 100 units/ml (Levemir)	1–2	6–12	20–24	Basal analogs have a more predictable insulin effect and less of a peak than NPH and allow basal dosing independent of meal time, once or twice a day. 30–45% of total daily dose.
	Glargine[2] (Lantus)	2–4	Prolonged	24	
	Glargine 300 units/ml[3]	2–6	Minimal peak	30–36	
	Degludec[4]	0.5–1.5	Minimal peak	> 42	

[1]Previous numbers and timing based on ***International Society for Pediatric and Adolescent Diabetes*** data and may not reflect true pediatric values. [2]Detemir and Glargine are not approved for use in children younger than 2 years old. [3]Approved for use in children less than 1-year-old to 5 years. [4]Approved for use in children as young as 1 year of age.

Data from Bangstad, H. J., Danne, T., Deeb, L., Jarosz-Chobot, P., Urakami, T., & Hanas, R. (2009). Insulin treatment in children and adolescents with diabetes. Pediatric diabetes, 10, 82-99.

Description

Premixed insulins (fixed ratio mixtures of pre meal and basal insulins) are used in some countries particularly for prepubertal children on twice daily regimens.

Recently, premixed insulins have also become available with rapid-acting analogs. Biphasic insulin aspart 30 (30% aspart and 70% aspart bound to NPH) given for three main meals combined with NPH at bedtime was equally efficient as premixed human insulin (70% NPH) given for morning and bedtime with regular insulin for lunch and dinner in adolescents.

Premixed insulins with regular (or rapid acting): NPH in different ratios, for example, 10:90, 15:85, 20:80, 25:75, 30:70, 40:60, and 50:50 are available in various countries from different manufacturers. Premixed insulins are suitable for use in a pen injector device.

Biosimilar: Glargine insulin LY2963016, a first biosimilar insulin, has been approved in several countries also for pediatric use. A biosimilar insulin lispro is under production.

DIABETIC KETOACIDOSIS (DKA), INTERNATIONAL SOCIETY FOR PEDIATRIC AND ADOLESCENT DIABETES GUIDELINES

Diagnosis requires all three criteria: glucose > 200, pH < 7.3, or bicarb < 15, ketosis (blood or urine).

Evaluate according to PALS guideline (including mental status, cardiorespiratory status, history of polyuria, polydipsia, weight loss, polyphagia, vomiting).

Check blood glucose and urine acetone (>3 mmol confirms ketoacidosis).

Use current weight for all calculations.

Assess for dehydration: Prolonged cap refill (>2 seconds) and abnormal skin turgor are considered most useful signs for predicting 5% dehydration. Weak pulses, hypotension, oliguria suggest >10% dehydration.

Evaluate mentation: If obtunded, secure airway (avoid intubation as far as possible); empty stomach if required.

Management

- Place oxygen if in shock
- CR monitor
- 2 IV lines (fluids + draw blood)
- Draw blood: POC glucose, blood glucose, blood gas, BMP, Ca, Mg, phosphorus, +/– CBC, urine hCG, HbA1c
- Fluids:
  - First hour: fluid resuscitation 10–20 ml/kg of 0.9 NS or RL over 1 to 2 hours (can repeat up to three times until circulation restored).
  - If intravenous/osseous access is not available, rehydrate with nasogastric tube, give same volume of fluid with normal saline (0.9%), half-strength Darrow's solution or oral rehydration solution (ORS) until perfusion improves. This can be done at a constant rate over 48 hours. If a nasogastric tube is not available, give ORS by oral sips at a rate of 5 ml/kg per hour.
  - Important: Shock must be adequately treated before proceeding. There should be good peripheral perfusion and adequate blood pressure.
  - At start of second hour: Rehydrate 0.9 NS+20 mEq/l K Phos + 20 mEq/l KCl or K acetate (if K < 5 mEq/l).
  - Hydrate with maintenance + replacement of deficit over 24 to 48 hours (approximately 1.5 to 2 times daily requirement).
  - When BG = 250–300 mg/dl (13.9–16.7 mmol/l): Change fluids to D5 0.45 NS + 20 K Phos + KCl (increases chloride load and metabolic acidosis) or K-Acetate (preferred) at same rate above.
  - If glucose 100, change dextrose to 10 or 12.5%.

When using two-bag method: Bag 1 has no glucose and bag 2 has 10% glucose.[3]

At BG > 350, 100% of the fluid should be fluid with no dextrose.

At 300 to 349, bag 2 will provide 25% of the fluid to achieve 2.5% solution.

At levels 250 to 299, bag 2 will provide 50% of the fluid to achieve 5% solution.

At levels 200 to 249, bag 2 will provide 75% of the fluid to achieve 7.5% solution.

At levels < 200, bag 2 will provide 100% of fluid to achieve 10% dextrose solution.

Insulin: Start insulin 0.05 to 0.1 units/kg/hour at least 1 hour after starting fluid replacement

(initial volume expansion) until resolution of DKA (pH > 7.30, serum bicarbonate > 15 mmol/l, beta-hydroxybutyrate (BOHB) < 1 mmol/l, closure of anion gap. Aim to decrease glucose at 100 ml/dl/hour or 5.6 mmol/l/hour and rise in pH at 0.03 units/hour.

When DKA resolves: Start oral fluids. Administer SC insulin 15 minutes before discontinuing IV insulin, check BG every hour until BG stable on SC insulin.

https://cdn.ymaws.com/www.ispad.org/resource/resmgr/Docs/ispad-lfac-pocketbook-final.pdf

If insulin cannot be given intravenously by a side drip or infusion pump, use deep subcutaneous or intramuscular insulin: Give 0.1 unit/kg of short-acting (regular, soluble) or rapid-acting insulin SC or IM into the upper arm, and repeat this dose every 1 to 2 hours.

Potassium: For a child being rehydrated with ORS, no added potassium is needed as ORS contains potassium. Serum potassium should be monitored every 6 hours or more frequently if indicated. If intravenous potassium is not available, potassium could be replaced by giving fruit juice, bananas, or coconut water orally.

Bicarbonate: Only administer if hyperkalemia or epinephrine-resistant shock or with cardiac dysfunction with a pH < 6.9 or severe hyperkalemia.

Monitoring: BG every 1 hour, electrolytes and BOHB every other hour. Ca, Mg, and phosphorous every 4 hours.

Discharge: When able to tolerate per os (P.O.), no vomiting, bicarbonate ≥ 17, normal electrolytes and appropriate follow-up scheduled.

COMPLICATIONS OF DIABETES AND THERAPY

Cerebral edema: Occurs 4 to 12 hours after the start of therapy; is the leading cause of death and morbidity in diabetic ketoacidosis (DKA) (https://www.chop.edu/clinical-pathway/diabetes-type1-with-dka-clinical-pathway).

Diagnosing Clinically Significant Cerebral Edema[4]

Presence of either of the following has a sensitivity of 92% for detecting cerebral edema in the setting of DKA:

1 Diagnostic criteria plus 2 major criteria *or*
1 Major criteria and 2 minor criteria

Diagnostic criteria	• Abnormal motor or verbal response to pain • Decorticate or decerebrate posture • Cranial nerve palsy (especially III, IV, and VI) • Abnormal neurogenic respiratory pattern (e.g., grunting, tachypnea, Cheyne-Stokes respiration, apneusis)
Major criteria	• Altered mentation/fluctuating level of consciousness (GCS ≤ 13) • Sustained heart rate deceleration (decline > 20 bpm) not attributable to improved intravascular volume or sleep state • Age-inappropriate incontinence

Minor criteria	• Vomiting • Headache • Lethargy or not easily arousable from sleep • Diastolic blood pressure > 90 mm Hg • Age younger than 5 years

Description

- Treat with mannitol, reduce fluids to 1× maintenance fluid, intubation. Target PCO_2 should approximate patient's baseline PCO_2 preintubation if patient was able to maintain normal ventilator response to acidosis (unless herniating).
  Hypertonic saline (3%) 5 ml/kg over 30 minutes may be an alternative to mannitol, especially if there is no initial response to mannitol.
- **Consider ICU:** Age younger than 2 years, pH < 7, shock, altered mental status, glucose > 1,000, Na > 160.

High risk of complications: In children younger than 3 years, very severe acidosis, pH < 7, low $PaCO_2$, elevated BUN, bicarbonate therapy, administration of insulin in the first hour, initial glucose > 1,000 mg/dl, Na > 160 (https://www.chop.edu/clinical-pathway/diabetes-type1-with-dka-clinical-pathway).

Hyperosmolar coma is rare in children and is associated with preexisting neurologic disorders. Blood glucose is typically > 600 mg/dl, serum osmolality is > 330, and ketosis is minimal or absent. The corrected sodium is usually high. Aggressive fluids management and management of underlying cause and treatment of complications (e.g., rhabdomyolysis, renal failure, electrolyte abnormalities, infections) are primary treatment modalities. Insulin boluses are not recommended. Use only when serum glucose concentration is no longer declining at the rate of < 3 mmol/l (approximately 50 mg/dl) per hour with fluid administration alone.

Sources: Carchman et al.[5] and Glaser.[6]

HYPOGLYCEMIA

Hypoglycemia is defined as a blood glucose <40–55 mg/dl (<30–45 mg/dl in neonate). Values of 55–70 mg/dl may indicate mild hypoglycemia (especially in diabetics). It is most commonly due to poor nutrition or overmedication with insulin, toxins (see Table 31-3), or hypoglycemic agents.

Table 11-2 Etiology of Hypoglycemia

Neonatal	Prematurity, SGA, infant of diabetic mother, birth asphyxia	
Decreased intake	Vomiting, malnutrition	
Decreased absorption	Diarrhea, malabsorption	
Glucose underproduction	Prematurity, SGA, malnutrition	
	Ketotic hypoglycemia	Ketonemia and ketonuria, high BOHB and normal plasma lactate
Inborn errors of metabolism	Glycogen storage disease	High plasma lactate and high BOHB
	Fatty acid oxidation defect	Low BOHB but elevated FFA
Hyperinsulinemia	Endogenous (high C-peptide level)/exogenous (low C-peptide level)	Low BOHB and FFA IGFBP-1 level decrease or remain stable with increased insulin
Endocrine disorder	Panhypopituitarism, GH deficiency, cortisol deficiency	Evaluate levels of specific hormones
Drug: ingestion/toxins/alcohol	Ethanol, salicylates, propranolol	Elevated level of medication present

Description

FFA—free fatty acid; BOHB—beta-hydroxybutyrate; GH—growth hormone; IGFBP—insulin-like growth factor-binding protein; SGA—small for gestational age.
Modified from Gandhi, Kajal. “Approach to hypoglycemia in infants and children.” Translational pediatrics 2017;6(4):408.

Symptoms: Sweating, dry mouth, nausea, trembling, flushing, hunger, anxiety, decreased concentration, fatigue, confusion, drowsiness, weakness, and lack of coordination.

Labs: Glucose, insulin and C-peptide, lactate, beta-hydroxybutyrate, FFA, IGFBP, GH, and cortisol level. Urine organic acids. May require PET scan with dihydroxyphenylalanine (DOPA) for evaluation of focal versus diffuse tumors or MRI for pituitary or hypothalamic abnormality.

Treatment: Treat if symptomatic or <45 in asymptomatic patients.

Table 11-3 Management of Hypoglycemia

Age	Dose and concentration	Other treatment[1]
0–30 days	5–10 ml/kg of $D_{10}W$ IV	Glucagon 0.02–0.03 mg/kg if < 20 kg, 1 mg if > 20 kg, administer IM, SC, or IV; Diazoxide IV if severe
1–24 months	2–4 ml/kg of $D_{25}W$ IV	
> 2 years	1–2 ml/kg of $D_{50}W$ IV	

Description

[1]Octreotide may be used IV if hyperinsulinemia or sulfonylurea overdose (Table 31-44).

In patients with DM

If normal mentation: treat with oral glucose.

If altered mentation and at home: SC glucagon can be used.

If in hospital: IV dextrose 25–50% can be used.

If hyperinsulinism: treat with frequent feeding, followed by diazoxide. Octreotide is the second line of medical therapy. Glucagon infusion at rates of 0.005–0.02 mg/kg/hour should be used as a temporary treatment in children with hyperinsulinism in whom adequate amounts of dextrose cannot be given.

Growth hormone and cortisol replacement are specific treatments for children with hypoglycemia and hypopituitarism or adrenal insufficiency.

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12 ■ ENVIRONMENTAL DISORDERS

HYPERTHERMIA

Table 12-1 Minor Heat Illness

- *Heat syncope*: Postural hypotension from vasodilation, volume depletion, and ↓ vascular tone.
  - Management: Rehydrate with salt containing fluids, remove from heat and evaluate for serious disease.
- *Heat cramps*: Painful, contractions of large muscle groups of the legs, abdomen, or arms in those who are sweating liberally and drinking hypotonic solutions (e.g., water).
  - Management: Replace fluids—Oral or IV rehydration. Do not use salt tablets.
- *Heat tetany*: Hyperventilation that may result in respiratory alkalosis, positive Chvostek sign, laryngospasm, or carpopedal spasm.
  - Management: Move to cooler environment. Persistent hyperventilation may require partial rebreather oxygen mask set below 5 l/minute.
- *Heat exhaustion*: Salt and water depletion causing orthostasis, and hyperthermia [usually < 104°F (40°C)]. *Mental status and neurologic exam are normal.* Lab: high hematocrit, electrolytes normal, sodium may be decreased in some.
  - Management: Initiate treatment with NS 10–20 ml/kg IV and continue to hydrate as needed.

Description

Table 12-2 Heatstroke

Clinical features	Risk factors
• Hyperpyrexia (temp. > 104–105.8°F) • Central nervous system dysfunction (seizures, altered mentation, decreased plantar responses, hemiplegia, ataxia) • Loss of sweating (variably present)	• Very young or old age • Drugs that limit sweating (anticholinergics, amphetamines, cocaine, antihypertensive agents)

Description

Complications of heatstroke: Rhabdomyolysis, hypoglycemia, renal or liver failure, ↓ or ↑ Na, ↓ Ca, ↓ phosphate, ↓ or ↑ K, and disseminated intravascular coagulation.

Table 12-3 Heatstroke Management

- Administer oxygen and protect airway if comatose or seizing. Check blood glucose, and treat hypoglycemia. Measure temperature with continuous rectal probe or Foley catheter temperature sensor that is accurate at high temperatures.
- Begin IV NS cautiously as pulmonary edema is common and the mean fluid requirement in heat stroke is > 20 ml/kg in the first 4 hours. Consider central venous pressure

monitoring to guide fluid resuscitation.

- Begin immediate cooling by: (1) *Evaporation*: spray with tepid water and direct fan at patient (leads to 0.1–0.3°C/minute temp. drop). For shivering, IV lorazepam 0.05–0.1 mg/kg IV. (2) *Ice water (or 60°F) tub immersion:* may complicate resuscitation and monitoring (leads to temperature drop ~ 0.16°C/minute). (3) *Ice packs (to neck, axilla, groin)*, *cooling blankets*, *peritoneal dialysis, and gastric lavage* with cold water are slow or unproven. (4) Avoid aspirin (contributes to hyperpyrexia). Avoid repeat acetaminophen doses (possible liver damage and ineffective in heatstroke).Stop the previous measures at temperatures of 100.4 to 101.3°F to avoid overcorrection.
- Most effective but invasive method is internal cooling. Cardiopulmonary bypass requires specialized institutions; gastric, rectal, and/or bladder lavage have not been shown to be more effective than evaporative cooling alone.
- Place a temperature-sensing Foley catheter to monitor urine output and temperature (see rhabdomyolysis, which follows).
- Obtain CBC, electrolytes, renal function, glucose, liver enzymes, LDH/CPK, PT, and PTT, arterial blood gas, and fibrin degradation products; ECG and CXR.
- Exclude other causes of fever: infection, malignant hyperthermia, hyperthyroidism, drugs, etc.

Description

Table 12-4 Other Heat-Related Disorders

- **Malignant hyperthermia (MH):** Autosomal dominant. Fever (late sign), hypercarbia, + muscle rigidity after anesthetics or succinylcholine. *Treatment*: Stop agent, correct hypercarbia, give loading bolus of dantrolene 2.5 mg/kg IV (max 10 mg/kg).

- **Neuroleptic malignant syndrome:** Similar to MH (with ***F***ever, ***E***ncephalopathy, ***V***itals unstable, ***E***levated enzymes, ***R***igid muscle) but due to antipsychotics (e.g., haloperidol, phenothiazines). *Treatment:* stop agent, cool patient—see heatstroke (see page 77) and administer bromocriptine 2.5–10 mg PO or NG three times per day. Benzodiazepines may be useful for agitation. Some experts recommend dantrolene 2.5 mg/kg IV (max 10 mg/kg) although this is more effective in malignant hyperthermia. Avoid phenothiazines.

- **Rhabdomyolysis:** Syndrome with release of contents into circulation due to tissue hypoxia, direct injury, exercise, enzyme defects, metabolic disease (DKA, ↓ K, ↓ Na, or ↓ phosphate, thyroid), toxins, infections, heatstroke. *Complications*: renal failure, ↓ K, ↑ or ↓ Ca, ↑ or ↓ phosphate, ↑ uric acid, compartment syndrome, DIC. *Treatment*: (1) IV NS to keep urine output > 2–3 ml/kg/hour, (2) alkalinize urine, (3) ± mannitol if poor urine output: 0.25–0.5 g/kg IV, + add 12.5 g to each L NS, (4) dialyze ↑ K, or uremia.

Description

HYPOTHERMIA

Table 12-5 Hypothermia

Severity	Temp. °F (°C)	Features
Mild	90–95 (32–35)	Shivering, vasoconstriction, + slurred speech at < 95°F
Moderate	82–90 (28–32)	At < 89°F altered mental status, mydriasis, shivering ceases, muscles are rigid, incoordination, bradypnea
Severe	≤82 (≤28) 79 (26) 77 (25) 68 (20)	Bradycardia in 50%, Osborne waves on ECG, voluntary motion stops, pupils are fixed and dilated Loss of consciousness, areflexia, no pain response No respirations, appear dead, pulmonary edema Asystole

Description

Table 12-6 Management of Hypothermia

- Evaluate for cause (e.g., sepsis, hypoglycemia, CNS disease, adrenal crisis).
- **Mild hypothermia** (<32°C): Administer humidified warmed O_2. Passive external rewarming (warm blankets, hot packs) and treatment of underlying disease is often the only treatment needed.
- **Moderate hypothermia** (29–32°C): Passive rewarming + active internal rewarming. Drugs and cardioversion for cardiac arrest may be ineffective. Warm humidified O_2 and warm IV fluids with gastric or peritoneal lavage if poor response to warm fluids/O_2 (<1°C/hour temperature rise). Perform CPR and ALS (e.g., defibrillation) as needed with meds at longer intervals.
- **Severe hypothermia** (≤29°C): (1) Warm humidified O_2, and warm IV fluids. (2) If no cardiac arrest, warmed peritoneal dialysis (41°C dialysate), or (3) pleural irrigation (41°C). (4) If core temp. <25°C consider venous–venous bypass or extracorporeal membrane oxygenation. (5) Consider open pleural lavage for direct cardiac rewarming if core temp <28°C after 1 hour bypass in an arrest rhythm. If signs of life, and no cardiac arrest, avoid CPR and ALS. If cardiac arrest, CPR and ALS are OK (only defibrillate once, consider withholding medications until temperature >29–30°C). (6) Do not treat atrial arrhythmias. (7) Use NS to treat ↓ BP. Use vasopressors cautiously as needed. (8)

Consider D_{10}/D_{25}, naloxone, hydrocortisone 1 mg/kg IV, antibiotics as needed.

Description

PIT VIPER (CROTALIDAE) BITE

- ***Emergency Treatment for Crotalid Envenomation***
  - Decrease movement, remove jewelry or clothing, and immobilize extremity at or below the level of the heart.
  - Avoid incision and drainage and tourniquets. Avoid early fasciotomy, and instead administer antivenin with close observation of response.
  - If snake is brought to the ED, treat with respect, decapitated snakes can bite reflexively for up to an hour.
  - Perform exam, measure envenomation site, and administer fluids, pressors prn.
  - If no signs of envenomation, clean wound, administer tetanus, and observe for a minimum of 6 hours. Consider antibiotics (e.g., Augmentin × 5 days).
  - If significant envenomation, obtain CBC, electrolytes, renal and liver function tests, PT, PTT, fibrinogen, urinalysis, ECG, and type and cross.
- ***Ovine–Crotalidae Polyvalent Immune Fab Antivenin (FabAV; CroFab)***
  Sheep derived and more potent than equine antivenin (AVCP), which is no longer available + less allergy (17% acute, 12% delayed). Allergy to FabAV, papaya, or papain is a relative contraindication.
  - Administer first dose of 4 to 6 vials (some double-dose if low BP, airway compromise).
  - Repeat 2 to 6 vials every hour until no progression.
  - Administer an additional 2 vials at 6, 12, and 18 hours if no progression.
  - Dilute FabAV to a total of 250 ml in NS (less if < 10 kg). Infuse IV over 1 hour.
  - The manufacturer, BTG International Inc., states, “Pediatric CroFab dose = adult dose” (https://www.crofab.com/Treatment-With-CroFab/Dosing-and-administration).
  - Polyvalent equine F(ab’)2 antivenin (ANAVIP) is approved by the FDA for adults and children.

Sources: National Highway Traffic Safety Administration. Crash Injury Research and Engineering Network (CIREN): an update. *Ann Emerg Med*. 2001;38:181-182; Goto CS, Feng SY. Crotalidae polyvalent immune Fab for the treatment of pediatric crotaline envenomation. *Pediatr Emerg Care*. 2009;25(4):273-279; quiz 280-282.

Table 12-7 Evaluation and Management of Crotalidae Envenomation

Grade	Features of *Crotalidae* Envenomation	Laboratory
None	± Fang marks, no pain, erythema or systemic symptoms.	None
Mild	Fang marks, mild pain/edema, ±vesicles, all within 10–15 cm of bite. No systemic symptoms.	No abnormalities
Moderate	Fang marks, all local signs extend beyond wound site. + systemic symptoms (vomiting, paresthesias), mild	Hemoconcentration, thrombocytopenia,

	coagulopathy (without bleeding).	hypofibrinogenemia
Severe	Fang marks, severe pain/edema, severe symptoms (↓ BP, respiratory distress), coagulopathy with bleeding.	Significant anemia, prolonged clotting time, metabolic acidosis

Description

CORAL SNAKE (ELAPIDAE) BITE

Southeast United States and Arizona. These snakes must bite and chew. Local effects + bite marks may be minimal. *Symptoms are systemic*: altered level of consciousness (LOC), descending flaccid paralysis, cranial nerve deficits, weakness/respiratory failure, and may be delayed 24 hours. Admit for respiratory or neurologic deterioration. All symptomatic patients require coral snake antivenin. *Dosing*: potentially associated with severe allergic reactions and should only be administered in a continuously monitored setting. Sonoran (Arizona) coral snake venom is less toxic, no deaths have been reported, and coral snake antivenin is ineffective.

SPECIAL SITUATIONS

Mojave rattlesnake: May cause muscle weakness, paralysis, or respiratory failure with few local symptoms. FabAV is effective.

Exotic snakes: Call 800-222-1222 for information regarding available antivenin.*Serum sickness* will develop in many receiving >5 vials of antivenin within 5–20 days causing joint pain, myalgias, and possibly rash. Warn patient and treat with diphenhydramine (Benadryl) 1 mg/kg orally every 4–6 hours and prednisone 1–2 mg/kg orally daily.

SPIDER BITES

Table 12-8 Salient Characteristics of Black Widow Spider Bites

Black widow spiders	Features of black widow bites
• Found in all of the United States, mostly South • Females ~ 5 cm with legs and 1.5 cm without legs • Only females are toxic • 1/5 have red hourglass on abdomen	• Mild to moderately painful bite. • In 1 hour, redness, swelling, and cramping at bite, which later spreads. • Often no local symptoms are appreciated. Pain is felt in the abdomen, flank, thighs, and chest and is described as cramping. • ↓ BP, shock, coma, respiratory failure.

Description

Table 12-9 Management of Black Widow Spider Bites

Management of black widow spider bites	
• Lorazepam (Ativan) 0.05–0.1 mg/kg IV • Consider *Latrodectus* antivenin. Dose: 1–2 vials IV in 50–100 ml NS Skin test prior to using • Allergy and serum sickness can occur • Calcium is ineffective	**Indications[1] for admission/antivenin** • Respiratory or cardiac symptoms • Severe cramping or pain despite lorazepam use • History of ↑ BP or cardiac disease

Description

[1] Controversial as no deaths have occurred in 30 years. Allen C. Arachnid envenomations. *Emerg Med Clin North Am*. 1992;10(2):269-298.

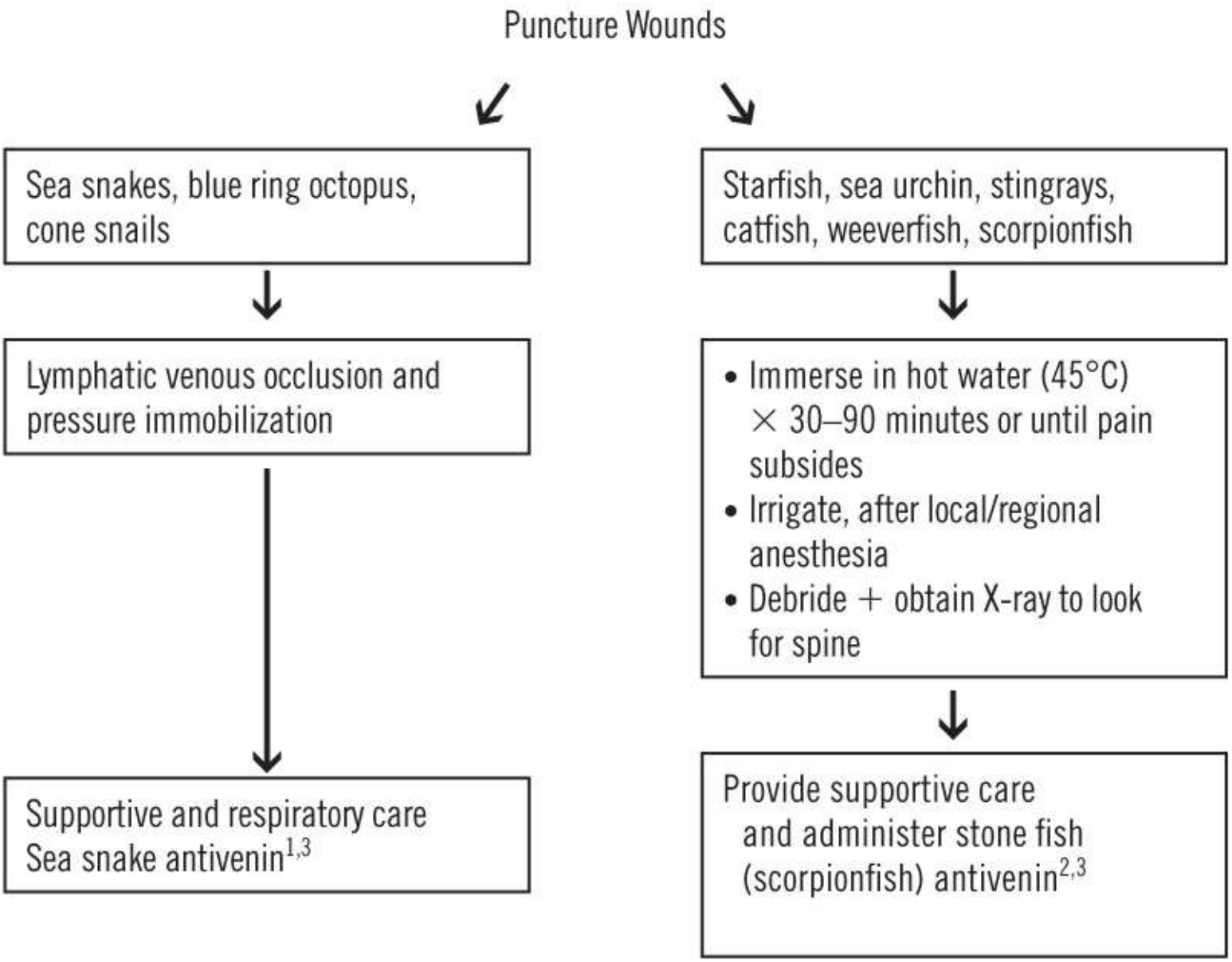
Table 12-10 Brown Recluse Spiders

Brown recluse spiders	Management
• Live mostly in the southern and midwestern United States. Bites are mild or painless. • Characterized by a brown violin-shaped mark on the cephalothorax. • Bites are often innocuous resulting in a delay in seeking care. • At first, lesions are red with central blister/pustule. • Later discoloration appears and pustule drains creating an ulcer. • Fever, chills, arthralgias, GI upset, DIC, or shock. • Hemoglobinuria (renal failure).	• Wound care, tetanus • Refer to surgeon for possible excision if > 2 cm and well-circumscribed border. • ± Hyperbaric oxygen (controversial). • Dapsone limited to adults with proven brown recluse bites. Dapsone not recommended in children due to risk of methemoglobinemia. • Antivenom not commercially available.

Description

MARINE ENVENOMATION

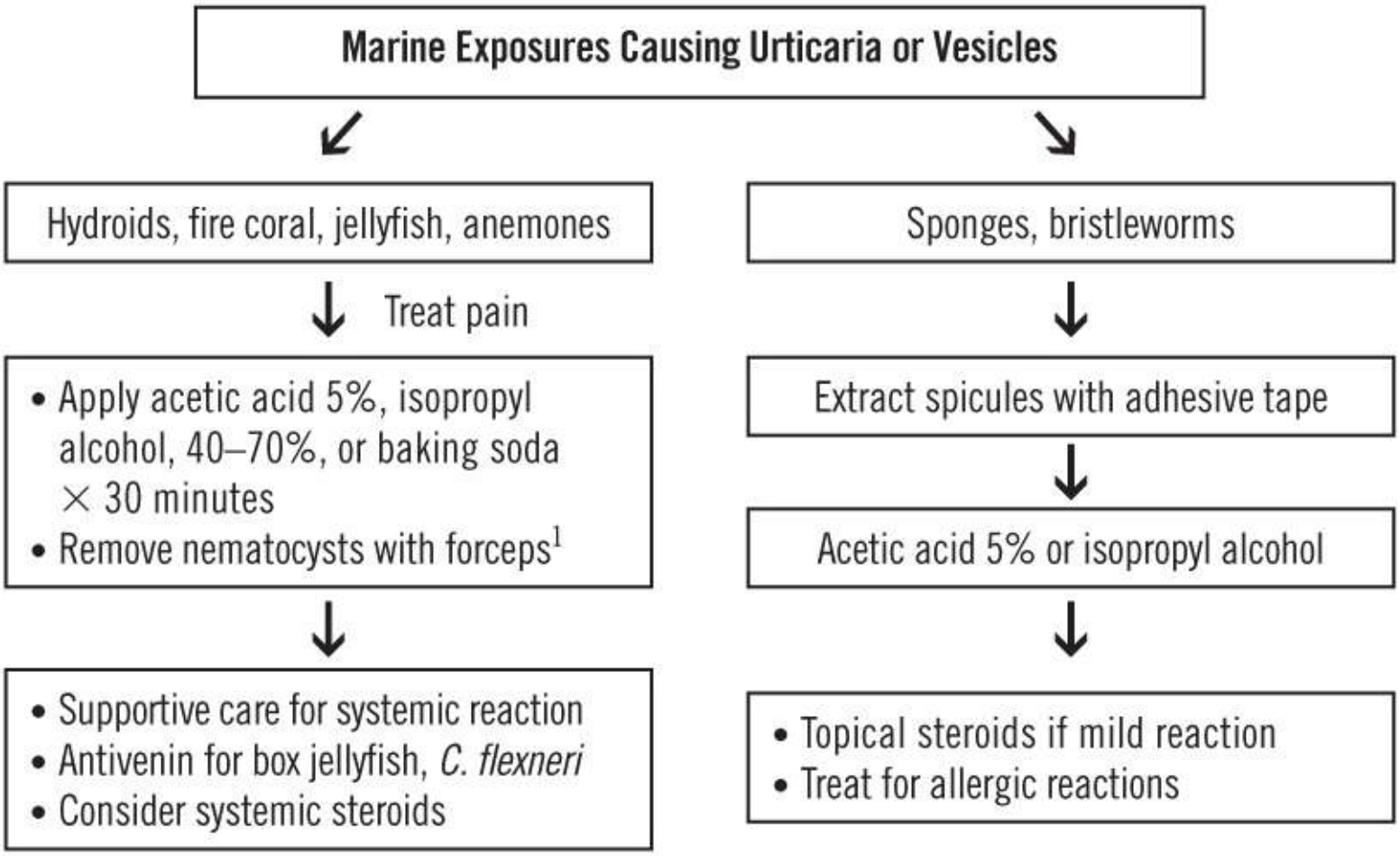
Table 12-11 Marine Puncture Wounds



[1]*Sea snakes*. Bites are painless, causing paralysis + muscle necrosis. Administer polyvalent sea snake antivenin (Commonwealth Serum Laboratories, Australia) within 36 hours. If unavailable, tiger snake and polyvalent Elapidae antivenin are effective. [2]*Stone fish (a type of scorpionfish).* Venom causes muscle toxicity, with paralysis of cardiac, skeletal, and involuntary muscles. Pain is immediate and intense. The wound is ischemic, cyanotic, and may lose tissue. Heat (45°C) partially inactivates venom. Follow package insert for antivenin (Commonwealth Serum Laboratories, Australia). [3]In the United States, call **(**619) 222-6363 or (415) 770-7171 for antivenin.

Description

Table 12-12 Marine Exposures Causing Urticaria or Vesicles



[1] Do not rinse in fresh water but may rinse in ocean water.

Description

MARINE INFECTIONS

- Organisms causing soft-tissue infection: *Aeromonas hydrophila, Bacteroides fragilis, Escherichia coli, Pseudomonas, Salmonella, Vibrio, Staphylococcus/Streptococcus* species*, Clostridium perfringens*.
- Irrigate, debride, explore, and obtain X-rays to exclude foreign bodies.
- Antibiotic agents for treating soft-tissue infection or prophylaxis:
  - *Parenteral agents:* Third-generation cephalosporin and/or an aminoglycoside.
  - *Oral agents:* Septra, cefuroxime, tetracycline if older than 8 to 12 years.

13 ■ FLUID AND ELECTROLYTES

ELECTROLYTE DISORDERS

Table 13-1 Formulas

Anion gap	• $Na^+ – (Cl– + HCO_3^–)$ *Normal* = 8–16 mEq/l
Osmolal gap	• Measured – calculated osmolality *Normal* = 0–10 mOsm/L
Calculated osmolalilty (285–295 mOsm/kg)	• (Na × 2) + (Glucose/18) + (BUN/2.8)

Description

BUN—blood urea nitrogen.

See pages 197–198 for an evaluation of organic acidurias and other metabolic disorders.

Table 13-2 Causes for the Increase in the Anion Gap, Normal Anion Gap, and Osmolal Gap

Causes of ↑ anion gap	**Causes of normal anion gap (hyperchloremic acidosis)**
Methanol, metformin ***U***remia ***D***iabetes ***P***araldehyde ***I***ron, INH ***L***actate ***E***thanol, ethylene glycol ***S***alicylates, starvation, seizure Toluene, cyanide, carbon monoxide, colchicine	***F***istula (biliary/pancreatic) ***U***retrogastric conduit ***S***aline administration ***E***ndocrine: Addison's, hyper-parathyroidism ***D***iarrhea ***C***arbonic anhydrase inhibitor ***A***mmonium chloride ***R***enal tubular acidosis ***S***pironolactone

Description

Causes of ↑ osmolal gap
Alcohols (methanol, ethylene glycol, isopropanol) Sugars (glycerol, mannitol) Ketones (acetone, diabetic ketoacidosis)

Description

Appropriate compensation during simple acid base disorder

Metabolic acidosis	$PCO_2 = 1.5 \times (HCO_3^–) + (8 \pm 2)$

Metabolic alkalosis	PCO_2 increases by 7 mm Hg for each 10 mEq/l increase in serum HCO_3^-
Respiratory acidosis	
Acute	(HCO_3^-) increases by 1 for each 10 mm Hg increase in PCO_2
Chronic	(HCO_3^-) increases by 3.5 for each 10 mm Hg increase in PCO_2
Respiratory alkalosis	
Acute	(HCO_3^-) falls by 2 for each 10 mm Hg decrease in PCO_2
Chronic	(HCO_3^-) falls by 4 for each 10 mm Hg decrease in PCO_2

Description

Normal pH 7.35–7.45
HCO_3 20–28 mEq/l
PCO_2 35–45 mm Hg

Interpreting acid base disturbance:

1. pH: <7.35 = acidosis, >7.45 = alkalosis
2. PCO_2: If pH and PCO_2 in opposite directions = respiratory disorder
   If pH and PCO_2 in same direction = metabolic disorder
3. HCO_3: High in metabolic alkalosis or compensated respiratory acidosis
   Low in metabolic acidosis or compensated respiratory alkalosis
4. Suspect mixed acid base disorder if:
   a. Normal pH with abnormal PCO_2 or HCO_3
   b. Inappropriate compensatory response (greater or lesser)
   c. Shift of both pH and HCO_3 toward acidosis or alkalosis

CALCIUM

Hypocalcemia: Total calcium < 8.5 mg/dl or ionized Ca^{+2} < 2.0 mEq/l (1.0 mmol/l)
Hypercalcemia: Total calcium > 10.5 mg/dl or ionized Ca^{+2} > 2.7 mEq/l (1.3 mmol/l)

Table 13-3 Hypoalbuminemia Correction

Hypoalbuminemia correction	• For each change in serum albumin of 1 g/dl ↑ or ↓, serum calcium changes 0.8 mg/dl in same direction.

Description

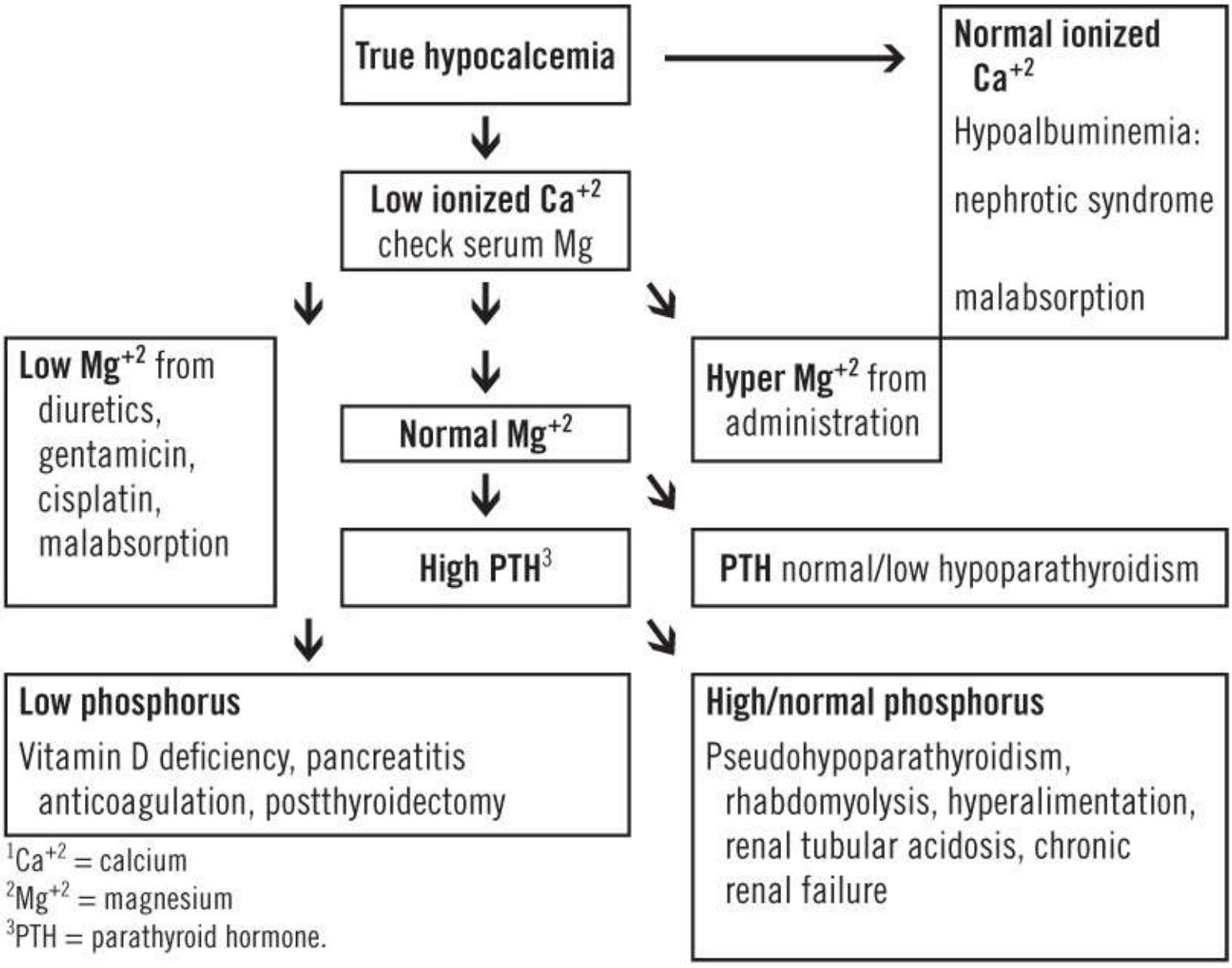
Table 13-4 Hypocalcemia—Clinical Features

Symptoms	Physical findings	Electrocardiogram
Paresthesia, fatigue, seizures, tetany, vomiting, weakness, laryngospasm	• Hyperactive reflexes • Chvostek-Trousseau (C-T) signs[1] • Low blood pressure • Congestive heart failure	• Prolonged QT, > 450 msec (especially Ca^{+2} < 6 mg/dl) • Bradycardia • Arrhythmias

Description

[1]C = muscle twitch with tap facial nerve. T = carpal spasm after forearm BP cuff up for 3 minutes.

Table 13-5 Hypocalcemia Etiology[1,2]



Description

Table 13-6 Drugs That Cause Hypocalcemia

• Cimetidine • Cisplatin • Citrate (transfusion) • Dilantin, phenobarbital • Gentamicin, tobramycin	• Glucagon • Glucocorticoids • Heparin • Loop diuretics (Lasix) • Magnesium sulfate	• Phosphates • Protamine • Norepinephrine • Na^+ nitroprusside • Theophylline

Description

Table 13-7 Hypocalcemia Treatment

Check serum electrolytes, BUN, creatinine, albumin, magnesium, arterial pH				
Drug	**Preparation**	**Elemental**	**Route**	**Drug dose (max. dose)[3]**
Ca gluconate	10% solution—100 mg/ml	9.8 mg/ml	IM, IV[1,2]	0.5–1 ml/kg (5–10 ml)
Ca chloride	10% solution—100 mg/ml	27 mg/ml	IV[1,2]	0.2–0.3 ml/kg (5–10 ml)
Ca gluconate	500, 650, 975, 1,000 mg		PO	100 mg/kg four times per day (500 mg/kg)
Calcium glubionate (calcionate)	1,800 mg/5 ml	115 mg/5 ml	PO	
Calcium carbonate (Oyster Cal, Caltrate, Tums)	400–1,177 mg	400 mg/1 g	PO	200–1,300 mg/day

[1]Administer IV calcium (Ca) slowly (over ≥ 5–10 minutes) while patient on cardiac monitor. IV calcium may cause hypotension, tissue necrosis, bradycardia, or digoxin toxicity. [2]Consider central administration to prevent tissue damage. Local infiltration of hyaluronidase reverses necrosis. [3]All are doses of salt (listed drug) and not of elemental calcium.

Description

Treatment

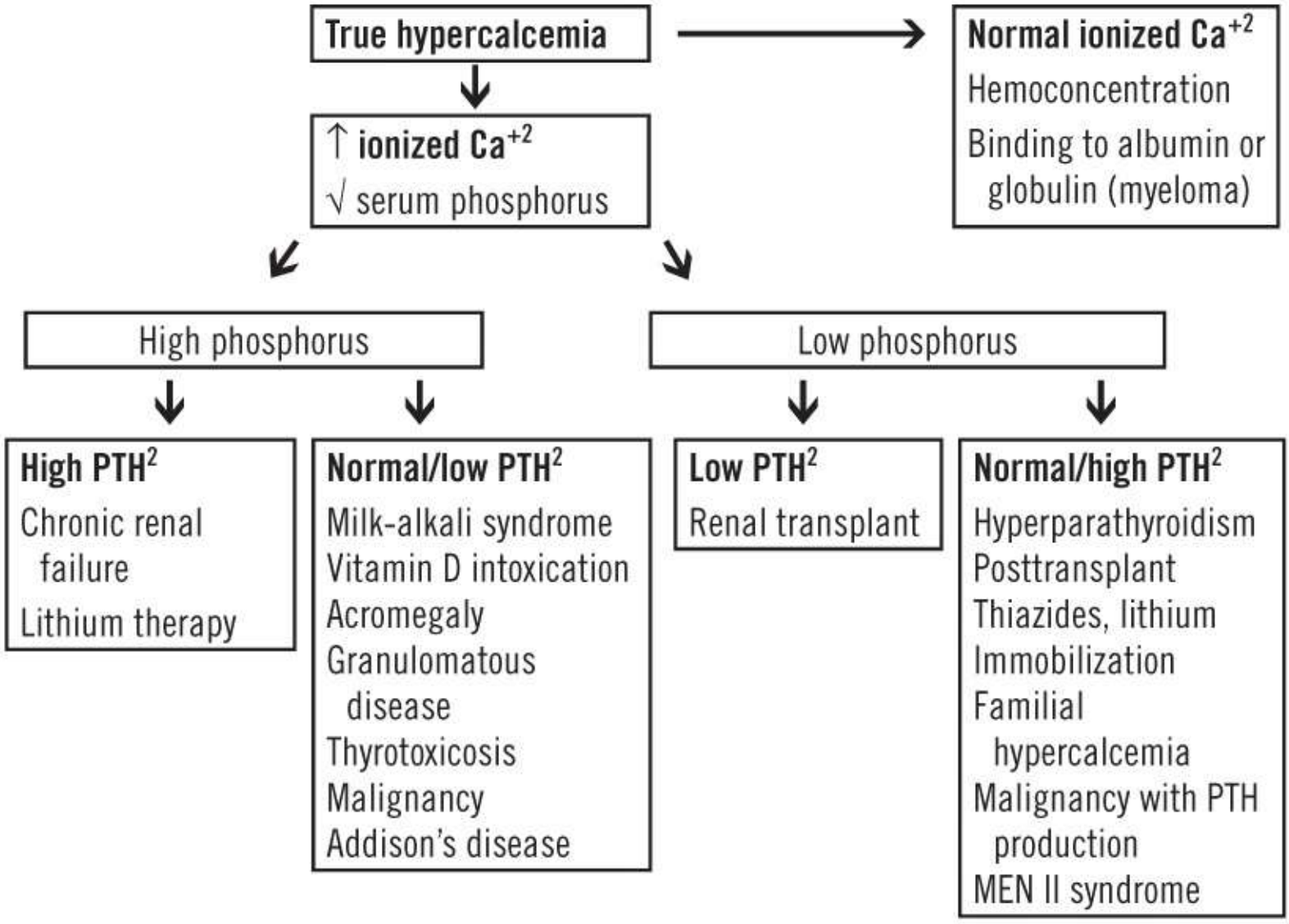
Symptomatic hypocalcemia should always be treated because it has serious neuronal and cardiac effects.
IV calcium indicated if seizures, if critically ill or preparing for surgery.
Switch to oral once symptoms improve.
Treat with magnesium if hypomagnesemia present.
Treat with phosphate-lowering drug if associated with hyperphosphatemia.
Do not completely treat if associated with rhabdomyolysis and pancreatitis.
Treat acidosis first before treating the hypocalcemia.
Diet should be high in calcium and low in phosphate (4:1). Patients with renal failure should be given a low-solute, low-phosphate formula (e.g., Similac 60/40)

Table 13-8 Hypercalcemia—Clinical Features

Clinical Features	
General	• Weakness, polydipsia, dehydration
Neurologic	• Confusion, irritability, hyporeflexia, headache
Skeletal	• Bone pain, fractures
Cardiac	• Hypertension, QT shortening, wide T wave, arrhythmia
GI	• Anorexia, weight loss, constipation, ulcer, pancreatitis
Urologic	• Polyuria, renal insufficiency, nephrolithiasis

Description

Table 13-9 Hypercalcemia[1]



$^{1}Ca^{+2}$ = calcium. ^{2}PTH = parathyroid hormone.

$^{1}Ca^{+2}$ = calcium. ^{2}PTH = parathyroid hormone.

Description

Table 13-10 Hypercalcemia Management

• Especially important for Ca^{+2} > 12 mg/dl, hypotension, or cardiac arrhythmias.
• IV NS 20 ml/kg with 30 mEq/l of potassium chloride with repeat boluses to keep urine output > 2–3 ml/kg/hour and increase calcium excretion.
• Furosemide 1–2 mg/kg can be used to promote urinary calcium excretion (after adequate hydration) but rarely necessary.
• Calcitonin SC (2–4 units/kg every 24 hours) or IV along with bisphosphonate acids like etidronate, ibandronate, risedronate, Clodronate, Alendronate, Pamidronate Zoledronic act by inhibiting bone resorption.
• Consider glucocorticoid steroid if sarcoid, vitamin A or D toxicity, or leukemia,

mithramycin, metastatic bone disease. Dialysis may also be useful.

Description

POTASSIUM

Etiology of Hypokalemia

Total body deficit (chronic)	Total body deficit (acute)	Shift ECF to ICF	Other
• Prolonged diuretic use • Inadequate K intake • Laxative use • Diuretics • Hyperhidrosis • Hypomagnesemia • RTA • Dengue	• DKA • Severe GI loss • Dialysis and diuretic treatment • Alcohol intoxication and overdose	• Alkalosis • Insulin use • Catecholamine use • Sympathomimetic use • Diuretic therapy • Alkalinization • Hyperthermia	• Mineralocorticoid excess • Renal disease, RTA, periodic hypokalemic paralysis • Increased aldosterone • Celiac disease

Acute decrease in pH will increase K^+ (a ↓ pH of 0.1 will ↑ K^+ 0.3–1.3 mEq/l).

Acute metabolic acid–base disorders cause most changes.

Description

Table 13-11 Hypokalemia (< 3.5 mEq/l)

- **Labs:** Electrolytes, blood gas, drug screen. ACTH, cortisol, renin, aldosterone, insulin, and C-peptide based on clinical suspicion of diagnosis.

Clinical features of hypokalemia	Treatment of hypokalemia
• Lethargy, confusion, weakness • Areflexia, difficult respirations • Autonomic instability, low BP	• Ensure good urine output first • If mild, replace orally only • Parenteral K^+ if severe hypokalemia (e.g., cardiac or neuromuscular symptoms or DKA) • Administer K^+ no faster than 0.5–1 mEq/kg/hour using ≤40 mEq/l (cautiously while continuously on cardiac monitor) unless life-threatening hypokalemia, give
ECG findings in hypokalemia	
• Examples Table 8-4, page 42 • K^+ ≤ 3 mEq/l: low-voltage QRS, flat T waves, ↓ ST segment, prominent P and	

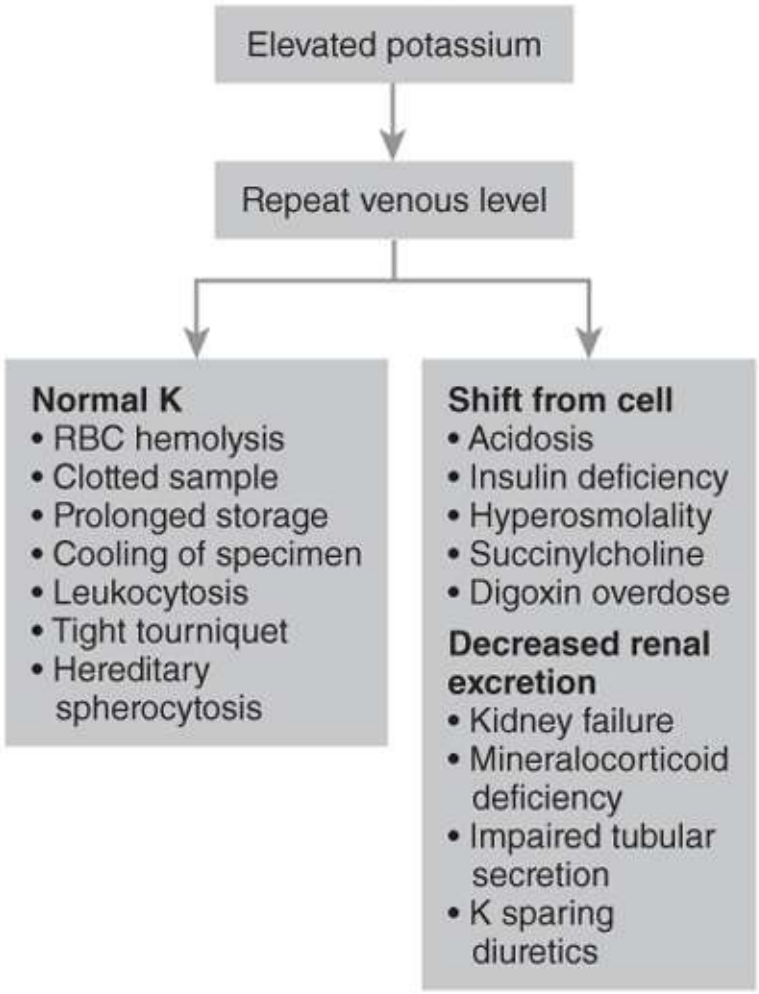
U waves. • $K^+ \leq 2.5$ mEq/l: prominent U waves • $K^+ \leq 2$ mEq/l: widened QRS	no more than 20 mEq/dose.

Description

Table 13-12 Hyperkalemia

Hyperkalemia: K > 5.5 in child and > 6 in newborn in nonhemolyzed sample.

Etiology



Clinical features

- Paresthesia, weakness
- Ascending paralysis sparing head, trunk, and respiration
- Life-threatening arrhythmias

Evaluation: Electrolytes, glucose, calcium, Mg, BUN, creatinine, osmolality, CBG, anion gap, CPK, ECG.

ECG changes:

- K^+ 5.0–6.0: peak T waves
- K^+ 6.0–6.5: ↓ PR and QT intervals
- K^+ 6.5–7.0: ↓ P, ↓ ST segments
- K^+ 7.0–7.5: ↑ intraventricular conduction
- K^+ 7.5–8.0: QRS widens, ST + T waves merge
- $K^+ > 8$: sine wave appearance

Treatment: Stop meds that increase potassium, low potassium diet, CR monitor

No ECG change/symptoms: Kayexalate 0.5–1.0 g/kg orally and rectally in 3–5 ml of 20% sorbitol

ECG change/symptoms: cardio protect with Ca gluconate 10% 100 mg/kg IV max of 2 g, slowly (lowers K 1.2 mEq/l in 4–6 hours)

Move K from ECF to ICF: Insulin + glucose (0.5–1.0 g/kg IV) + insulin (1 unit/3 g glucose IV)

Nebulized albuterol (2.5 mg in children < 25 kg, 5 mg in children > 25 kg)

Sodium bicarbonate: 1–2 mEq/kg IV, may repeat

Lower total body potassium

Diuretics: Furosemide 1 mg/kg IV

Kayexalate 1 g/kg orally/rectally (lowers K 1.2 mEq/l in 4–6 hours)

Hemodialysis

Description

SODIUM

Daily Na^+ requirements: In newborn, 1–2 mEq/kg/day, and in premature, 3–4 mEq/kg/day.

Serum Na is determined by water balance and not sodium concentration.

With change in sodium concentration, there is a change in osmolality, which influences ADH secretion, which leads to conservation or excretion of water.

Volume depletion takes precedence over osmolality in the influence of ADH, even if there is hyponatremia.

Hyponatremia (Serum Na < 135)

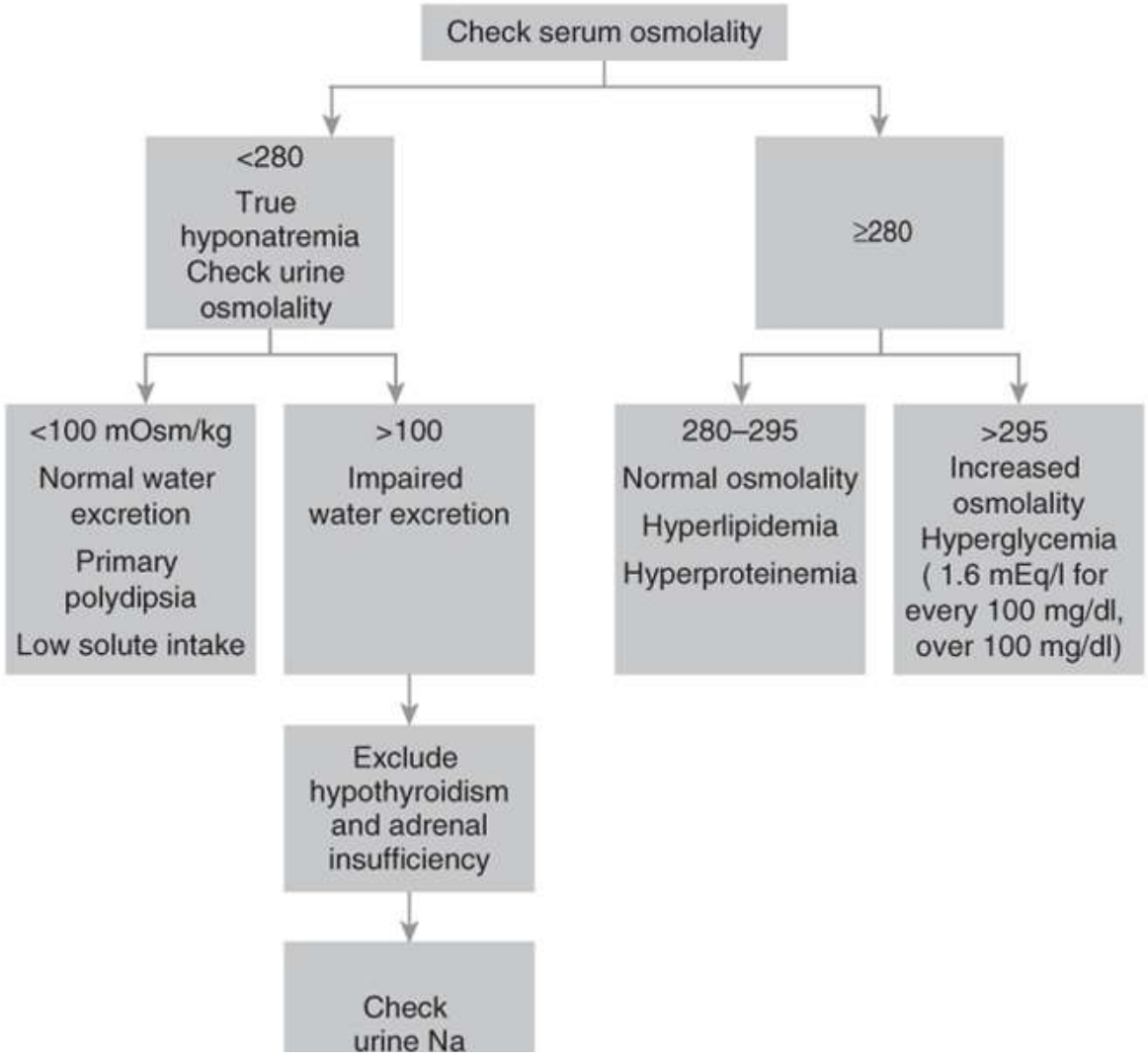
Table 13-13 Clinical Features of Hyponatremia

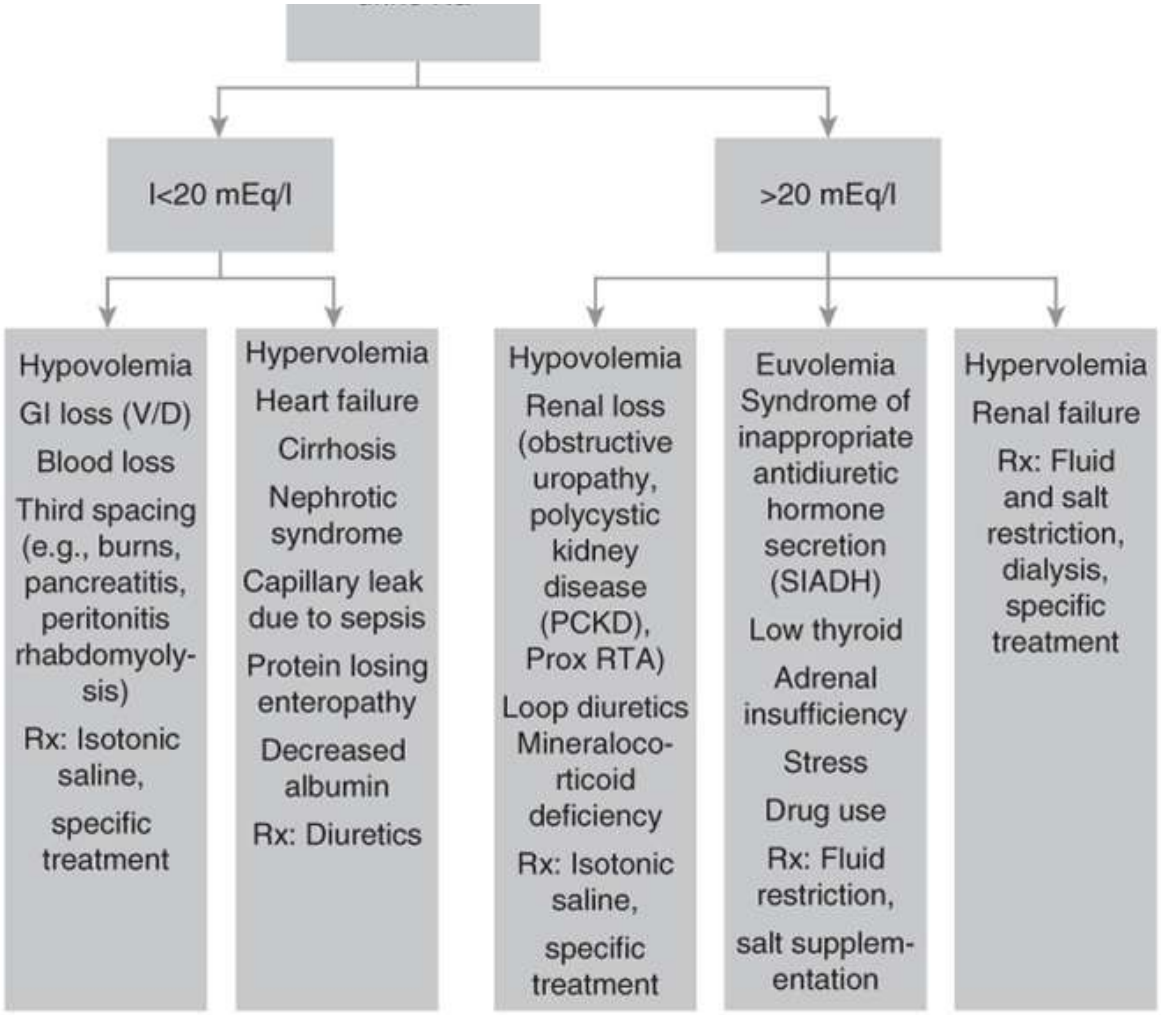
• Lethargy, apathy, confusion • Depressed reflexes, muscle cramps • Pseudobulbar palsies	• Cerebral edema • Seizures • Hypothermia

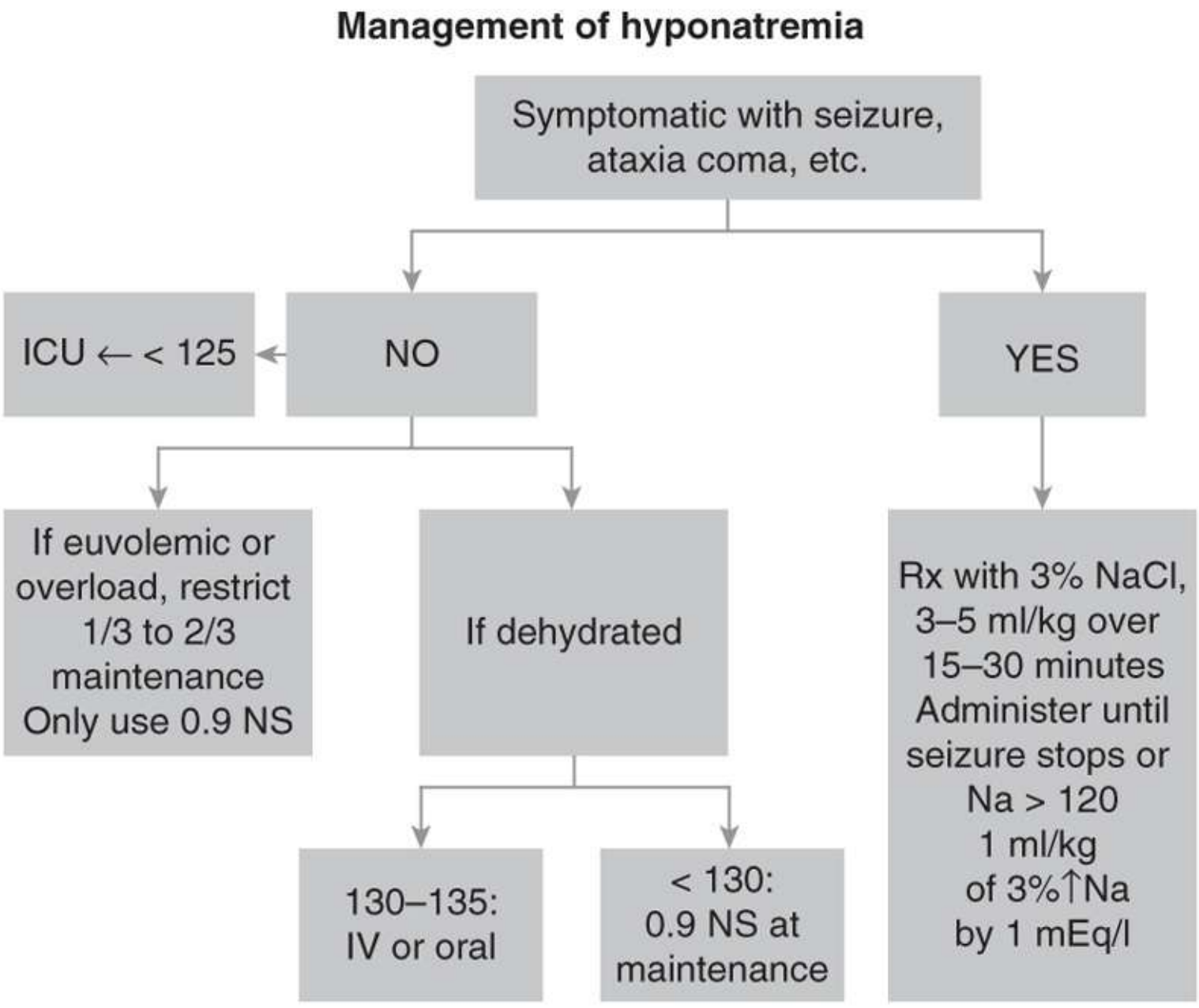
Description

Labs: Serum Na, electrolytes, blood sugar, BUN, serum osmolality, urine osmolality and specific gravity, urine Na, creatinine, blood gas.

Table 13-14 Algorithm for Evaluation of Hyponatremia




I<20 mEq/l
>20 mEq/l
Hypovolemia
GI loss (V/D)
Blood loss
Third spacing (e.g., burns, pancreatitis, peritonitis rhabdomyoly-sis)
Rx: Isotonic saline,
specific treatment
Hypervolemia
Heart failure
Cirrhosis
Nephrotic syndrome
Capillary leak due to sepsis
Protein losing enteropathy
Decreased albumin
Rx: Diuretics
Hypovolemia
Renal loss (obstructive uropathy, polycystic kidney disease (PCKD), Prox RTA)
Loop diuretics Mineraloco-rticoid deficiency
Rx: Isotonic saline,
specific treatment
Euvolemia
Syndrome of inappropriate antidiuretic hormone secretion (SIADH)
Low thyroid
Adrenal insufficiency
Stress
Drug use
Rx: Fluid restriction,
salt supplem-entation
Hypervolemia
Renal failure
Rx: Fluid and salt restriction, dialysis, specific treatment



Description

Rules:

1. Rate of correction not to exceed 8 mmol/l.
2. If fluid deficit, Rx with isotonic saline.
3. If hypervolemic, restrict fluids.
4. Fluid restriction is cornerstone for chronic hyponatremia.
5. Except for hypovolemic, hyponatremia treatment relies on decreasing free water intake +/– renal free water excretion.

Hypernatremia (Serum Na > 145)

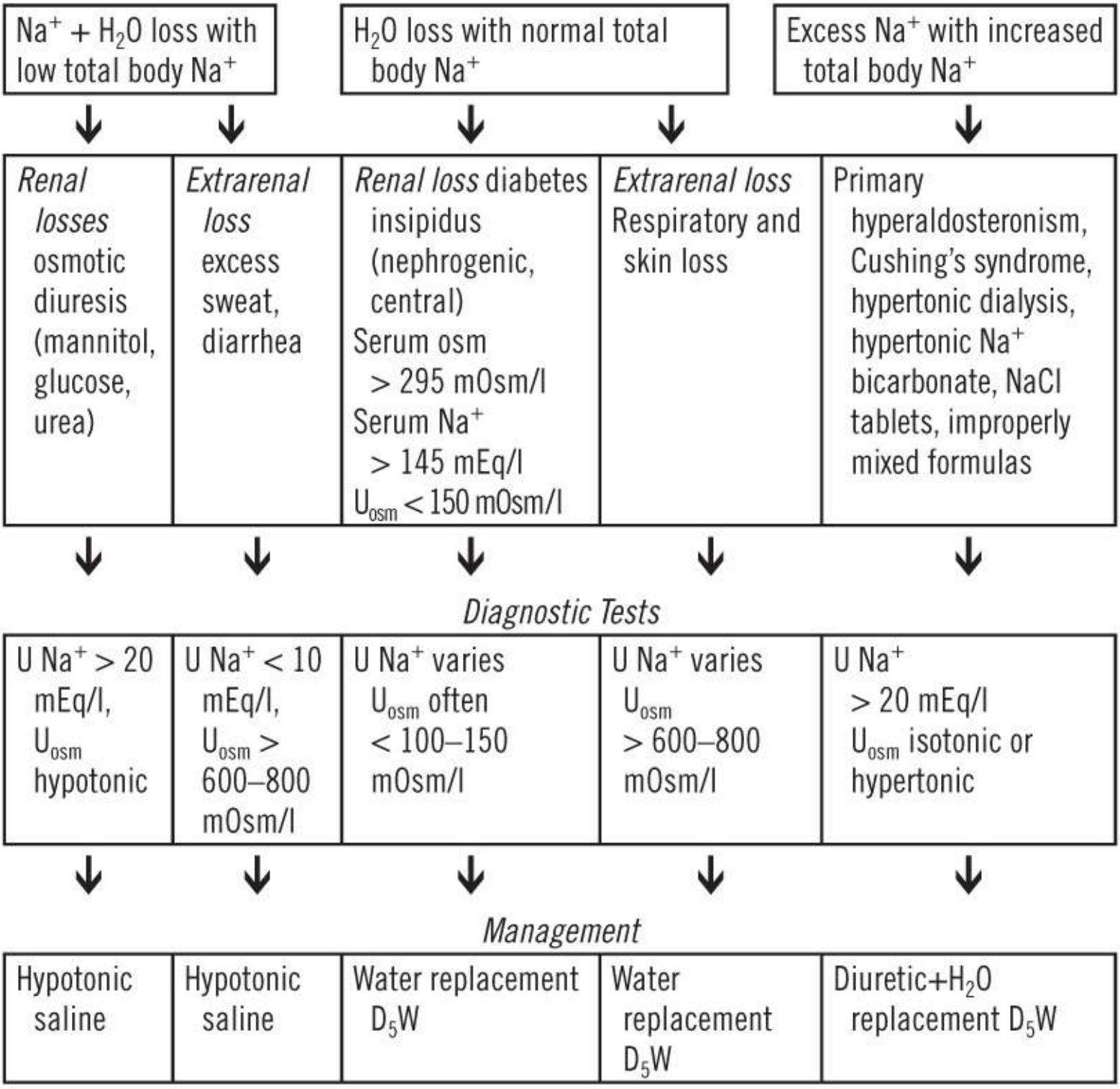
Table 13-15 Clinical Features of Hypernatremia

• Lethargy, irritability, coma • Seizures	• Doughy skin • Late preservation of intravascular

• Spasticity, hyperreflexia	volume (and vital signs)

Description

Table 13-16 Hypernatremia Etiology, Diagnosis, Management[1]



[1]U—urine, U_{osm}—urine osmolality.

Description

Management of Hypernatremia

Correct hypernatremia slowly over approximately 48 hours. Over-vigorous rehydration causes cerebral edema, seizures, coma, or death. Lower Na^+ no faster than 1–2 mEq/l/hour.

In hypernatremia with dehydration, first restore intravascular volume with isotonic fluid, normal saline preferred. Most patients do well with 3–4 ml/kg of water for each 1 mEq that the sodium level exceeds 145 mEq, with Na concentration of half normal saline at a rate of 20–30% greater than maintenance fluid. Patients with pure water loss may require a more hypotonic (0.2 NS) fluid.

With endogenous Na^+ overload, treatment consists of salt restriction and correction of the primary underlying disorder. If there is excess exogenous mineralocorticoid, restrict salt and modify replacement therapy.

Desmopressin (DDAVP) is indicated in children with diabetes insipidus. Intranasal DDAVP dose is 0.05–0.3 ml daily, bid.

DEHYDRATION

Dehydration is total water depletion with respect to sodium, and volume depletion is the decrease in the circulation volume. It is usually associated with metabolic acidosis (excess HCO_3 loss in stool with diarrhea, or urine with RTA, or glycogen depletion causing ketosis, or poor tissue perfusion causing lactic acidosis, or H+ ion retention from poor tissue perfusion). Sometimes there may be alkalosis from vomiting with loss of gastric contents containing chloride, sodium, and potassium causing hypochloremic, hypokalemic metabolic alkalosis.

Dehydration:

Mild (3–5%): Normal HR, pulse, capillary refill, BP, and respiration.

Moderate (6–10%): Listless, irritable, prolonged capillary refill, ↑ HR and RR, ↓ UO.

Severe (> 10%): Lethargy, altered mental status, ↑ HR and RR, sunken eyes, no tears, oliguria or anuria.

Table 13-17 Dehydration—Classification and Management

Classification	Isotonic	Hypotonic	Hypertonic[1]
Na^+ (mEq/l)	130–150	<130	>150
Cause	Usually GI[2] and ECF[3] fluid loss	Dilute fluid (water) replacement	Too dilute formula, ↑ Na^+ intake, ICF[3] > ECF[3] loss
Deficit	Na^+ = water loss	Na^+ > water loss	Water > Na^+ loss
BP	Depressed	Very depressed	May be preserved
RR	Increased	Increased	Minimal increase
Skin/Turgor	Dry/Poor	Clammy/Very poor	Doughy/Fair
Mentation	Lethargy	Coma or seizure	Irritable or seizure
Rehydrate[4]	Normal saline	Normal saline	D_5 1/2 NS with K^+
Unique feature *(exclude hypoglycemia in all patients)*	Most common. Oral rehydration is appropriate for children if <5–10% dehydration if able to take liquids PO.	Consider 3% NS if seizures, life-threatening symptoms (see page 94 for indication/dosing).	NS can paradoxically ↑ Na^+. Lower Na^+ < 2 mEq/l/hour or < 10 mEq/l/day. Too rapid Rx = congestive heart failure, CNS edema, renal damage. ±↓ Ca^{+2}

[1]4 ml/kg free water deficit for each 1 mEq/l Na > 145. [2]GI—gastrointestinal. [3]ICF—intracellular fluid; ECF—extracellular fluid. [4]Use NS to reverse shock in all cases.

Description

Dehydration—Further Management

Severe dehydration: Rapid correction with normal saline or Ringer's lactate 20 ml/kg over 20 minutes can repeat as needed (monitoring for improved HR, BP, urine output, perfusion, and mentation). Slow rate in patients with cardiac insufficiency, congestive heart failure, pulmonary edema, and diabetic ketoacidosis.

With isonatremic or hyponatremic dehydration, correct entire deficit over 24 hours.

Deficit is determined by degree of dehydration.

For second phase, the child requires 1/2 of remaining deficit and 1/3 of maintenance fluid over 8 hours.

Third phase consists of 1/2 of the deficit and 2/3 of maintenance fluid over 16 hours.

With hypernatremic dehydration, correct slowly over 48 hours; may need to correct over 72 to 84 hours if very severe hypernatremia.

Add potassium after the patient voids and normal renal function is documented.

Replacement (usually over 8 hours) is maintenance plus deficit volume plus ongoing losses, usually 1.25 to 1.5 times maintenance.

Do IV hydration if ill, patient needs to stay NPO, severe dehydration (> 10%), cannot take oral fluids, or serious lab abnormality.

Other treatment options:

(1) Intraosseous (if severely ill, see page 11); (2) Subcutaneous—recombinant human hyaluronidase (rHuPH$_2$0; Hylenex, Baxter International) increases subcutaneous fluid absorption 1.6- to 3.3-fold. Apply LMX or EMLA to skin; in 30 minutes insert 24–25 gauge angiocatheter or needle into mid-anterior thigh or interscapular; 1 ml (150 units) is injected SC through needle followed by continuous pump facilitated SC infusion of 20 ml/kg NS over 1 hour, may repeat (50% swell locally); OR (3) NG/feeding tube: 50 ml/kg Pedialyte over 3 hours.

Table 13-18 IV Maintenance Fluid Calculation

By Body Weight	4 ml/kg/hour (100 ml/kg/day) for 1st 10 kg, + 2 ml/kg/hour (50 ml/kg/day) for 2nd 10 kg, + 1 ml/kg/hour (25 ml/kg/day) for each kg above 20 kg
Maintenance Na^+ requirements = 2–3 mEq/100 ml maintenance fluid administered Maintenance K^+ requirements = 2 mEq/100 ml maintenance fluid administered	

Description

Some experts (not all) recommend isotonic saline (normal saline/NS) over hypotonic saline (e.g., 1/2 NS) with appropriate potassium, etc., for maintenance fluids to decrease iatrogenic hyponatremia.

Modified from MacLaren R, Bond CA, Martin SJ, Fike D. Clinical and economic outcomes of involving pharmacists in the direct care of critically ill patients with infections. *Crit Care Med*. 2008;36(12):3184-3189; Beck CE. Hypotonic versus isotonic maintenance intravenous fluid therapy in hospitalized children: a systematic review. *Clin Pediatr (Phila)*. 2007;46(9):764-770.

Table 13-19 Composition of Oral and Intravenous Solutions

Solution	Sodium (mEq/l)	Potassium (mEq/l)	Chloride (mEq/l)	Bicarbonate (mEq/l)[1]	Glucose (g/dl)
Extracellular fluid	142	4	103	27	~0.1
0.9 NS	154	0	154	0	0
D_5NS	154	0	154	0	5
5% albumin	130–160	0	130–160	0	0
Hypertonic 3% NS	513	0	513	0	0
0.45 NS	77	0	77	0	0
0.3 NS	51	0	51	0	0
0.2 NS	34	0	34	0	0
LR	130	4	109	28	0
Infant Carvajal's[2]	81	0	61	20	4.65
Child Carvajal's[2]	132	3.8	109	27	4.8
WHO solution[3]	90	20	80	—	2.0
Pedialyte	45	20	35	30	2.5
Rehydralyte	75	20	65	30	2.5
Resol	50	20	50	34	2.0
Ricelyte	50	25	45	10	3.0
Infalyte	50	20	40	—	2.0
Gatorade	28	2	—	—	2.1
Ginger ale	4	0.2	—	—	9.0
Coke/Pepsi	3/2	0.1/0.9	13.4/7.3	10.0/10.0	10.5/10.5
Apple/Grape juice	1–4	15–30	—	—	12.0/15.0
Jell-O	24	1.5	—	—	15.8

[1]Or citrate or lactate. [2]Used for burns and contains 12.5 g/l albumin. [3]Excess World Health Organization (WHO) formula causes ↑ Na, give with free water.

Description

Table 13-20 Treatment of Dehydration by Oral Rehydration

Oral rehydration	WHO recommendations
Wheat- and rice-based oral electrolyte solutions are superior to glucose solutions for	• First, hydrate with 100 ml/kg WHO formula over 4 hours.

rehydration, ↓ stool frequency volume.	• Then, 50 ml/kg of water or breastmilk over next 2 hours. • If still dehydrated, 50 ml/kg WHO formula next 6 hours. • Then, 100 ml/kg of WHO formula over next 24 hours, then 150 ml/kg/day of WHO formula. Give additional free H_2O with WHO formula or hypernatremia may occur.

Description

The latest improved ORS formula contains less glucose and sodium (245 mOsm/l compared with the previous 311 mOsm/l). The lower concentration of the new formula allows for a quicker absorption of fluids, reducing the need for intravenous fluids and making it easier to treat children with acute noncholera diarrhea without hospitalization.

According to UNICEF and WHO, oral rehydration therapy should be combined with guidance on appropriate feeding practices. Provision of zinc supplements (20 mg of zinc per day for 10–14 days) and continued breastfeeding during acute episodes of diarrhea protect against dehydration and reduces protein and calorie consumption that have the greatest impact on reducing diarrhea and malnutrition.

14 ■ GASTROENTEROLOGY

MEDICINES

Table 14-1 Common GI Therapeutic Agents

Drug	Available forms	Dosing
Bisacodyl (Dulcolax)	Suppository: 10 mg Tab: 5 mg	Oral (≥3–10 years): 5 mg/day Oral (>10 years): 5–15 mg/day Rectal (≥2–10 years): 5 mg every day Rectal (>10 years): 5–10 mg every day
Cimetidine	Solution: 300 mg/5 ml Tab: 200, 300, 400, 800 mg	Infant: 5–10 mg/kg/day div every 6 hours to every 12 hours Child: 20–40 mg/kg/day div every 6 hours to every 8 hours, max 400 mg/dose Adolescents (≥16 years): 400 mg 4×/day or 800 mg bid
Docusate sodium (Colace)	Syrup: 60 mg/15 ml Solution: 12.5 mg/5 ml, 50 mg/5 ml, 50 mg/15 ml Cap/Tab: 50, 100, 250 mg Cap as calcium: 240 mg Suppository: 100 mg/5 ml; 283 mg/5 ml	Oral (6 months–2 years): 12.5 mg three times per day Oral (≥2–12 years): 50–150 mg/kg/day div every day or four times per day Oral (≥12 years): 500 mg/day div bid or three times per day Rectal (2–12 years): 100 mg/day Rectal (≥12 years): 283 mg every day
Famotidine (*Pepcid*)	Suspension: 40 mg/5 ml Cap/Tab: 10, 20, 40 mg Chewable tab: 10, 20 mg Injectable: 20 mg/2 ml	***Peptic ulcer***: 1–16 years: 0.25 mg/kg IV bid OR 0.5 mg/kg PO QHS (maximum of 40 mg/day) ***GERD:*** < 3 months: 0.5 mg/kg PO daily × 8 weeks ≥ 3–12 months: 0.5 mg/kg PO every 12 hours × 8 weeks 1–16 years: 1 mg/kg div bid (maximum of 40 mg/dose)
Glycerin	Infant suppository	Insert + retain > 15 minutes (bid or

		daily prn)
Lactulose	Solution: 10 g/15 ml	1–2 g/kg/day (1.5–3.0 ml/kg/day)
Lansoprazole (Prevacid)	Cap/Dissolving tab: 15, 30 mg	***GERD:*** ≥ 3 months: 7.5 mg bid or 15 mg daily 1–11 years: If ≤ 30 kg, 15 mg once daily. If > 30 kg, 30 mg once daily ≥ 12 years: 15 mg once daily
Metoclopramide (Reglan)	Injectable: 5 mg/1 ml Syrup: 5 mg/5 ml Tab: 5, 10 mg	<6 years: 0.1 mg/kg 6–14 years: 2.5–5 mg once >14 years: 10 mg once Max dose: 10 mg
Omeprazole (Prilosec)	Cap: 10, 20, 40 mg	5–10 kg: 5 mg daily 10 kg to < 20 kg: 10 mg daily ≥ 20 kg: 20 mg daily
Ondansetron (Zofran)	Injectable: 2 mg/ml Oral solution: 4 mg/5 ml Tab/ODT tab: 4, 8 mg	***Intravenous:*** < 6 months: safety not known ≥ 6 months: 0.10–0.15 mg/kg IV (max 4 mg) ***Oral:*** 8–15 kg: 2 mg PO 15–30 kg: 4 mg PO > 30 kg: 8 mg PO
Polyethylene glycol (PEG) 3350 (Miralax)	PEG 14 oz or 26 oz (1 cap = 17 g)	***Fecal impaction***: 1.0–1.5 g/kg/day for 3–6 days, max 100 g/day. Follow with maintenance dose 0.4 g/kg daily for 2 months ***Constipation:*** 0.2–0.8 g/kg/day (divided bid), max 17 g/day (mix with 4–8 oz fluid)
Ranitidine (Zantac)	Syrup: 15 mg/1 ml Tab: 75, 150, 300 mg Cap: 150, 300 mg Injectable: 25 mg/ml or 150 mg/6 ml	***IV prophylaxis for GI bleed*** Infants: 2–4 mg/kg/day div every 8 hours Children/adolescents: 3–6 mg/kg/day div every 6 hours, max 300 mg/day ***GERD***: *Oral* ≤ 16 years: 5–10 mg/kg/day div twice a day, max 300 mg/day

		> 16 years: 150 mg twice a day
Simethicone (Mylicon, GasX)	Drops: 40 mg/0.6 ml Tab: 80, 125, 180 mg	< 2 years: 20 mg 4×/day (max 240 mg/day) 2–12 years: 40 mg 4×/day (max 480 mg/day) > 12 years: 40–160 mg 4×/day (max 480 mg/day)
Sodium phosphate (Fleet Enema)	Solution: 66 mL, 133 ml	***Constipation, rectal***: 1–18 years: 2.5 ml/kg, max 133 ml/dose
Sucralfate (Carafate)	Suspension: 1 g/10 ml Tab: 1 g	***Peptic ulcer disease:*** 40–80 mg/kg/day div every 6 hours, max 1 g/dose ***Esophagitis:*** < 6 years: 500 mg/dose 4×/day ≥ 6 years: 1 g 4×/day

Description

Table 14-2 Etiologies for Crying in Infants*

Diagnosis	Frequency (percentage)Total n = 237
Crying with no other diagnosis	65 (27)
Viral illness	49 (21)
Gastroesophageal reflux	30 (13)
Colic	14 (6)
Other[1]	14 (6)
Gastroenteritis	12 (5)
Atypical colic (not meeting formal definition below)	11 (5)
Constipation	11 (5)
Bronchiolitis	8 (3)
Feeding disorder/difficulty	7 (3)
Otitis media	

	7 (3)
Vaccine adverse event	3 (1)
Reducible inguinal hernia	3 (1)
Clavicle fracture	2 (< 1)
Urinary infection (UTI)	2 (< 1)

Description

[1]One each of acute lymphoblastic leukemia, bacteremia + UTI, cellulitis, cholecystitis, dermatitis, epidural hematoma, gas, infantile spasms, intussusception, nephrolithiasis, nursemaid's elbow, toe trauma, thrush, spinal muscular atrophy.
Modified from Freedman SB, Al-Harthy N, Thull-Freedman J. The crying infant: diagnostic testing and frequency of serious underlying disease. *Pediatrics*. 2009;123(3):841-848.

Colic: Defined as paroxysms of crying that last >3 hours and occur >3 days/week for at least 3 weeks. Colic is a behavioral syndrome usually occurring in otherwise healthy infants aged 2 weeks to 4 months. Crying is more common in the evenings, and in bottle-fed infants. Variable associations with excess feeding (>125 kcal/kg/day), food allergy, reflux, incomplete burping after feeds, maternal smoking, abnormal intestinal microflora, and low birth weight have been found.

Evaluation—Serious diseases are uncommon (5.1% according to the study mentioned previously, with UTI being the most common serious diagnosis). Approximately 99% of all diagnoses made based on history and physical examination. Evaluation is directed at excluding serious disorders (congenital heart anomalies including anomalous left coronary artery from the pulmonary artery), infection, occult trauma of the head, torso, or extremity, corneal abrasion, surgical disorders (intussusception, hernia, volvulus, Hirschsprung's disease, testicular torsion), hair tourniquet, ingrown eyelash, child abuse, etc. After serious disease excluded, ensure that proper feeding techniques are used [e.g., volume of feeding (~115–125 kcal/kg/day), burping, upright status continued after feedings, appropriate formula, see page 209]. In breastfed infants, maternal diets that avoid dairy, soy, eggs, peanuts, wheat, and shellfish may improve symptoms. In formula-fed babies, changing to a hydrolyzed formula may improve symptoms.

Management—For those without serious disorders and a final diagnosis of colic, reassure parents that colic is self-limited. Do not use dicyclomine as this can cause apnea, seizures, and syncope. *Lactobacillus reuteri,* strain DSM17398, 5 drops daily, may decrease

symptoms in breastfed infants.* Oral hypertonic glucose was found in one study to be an effective remedy; however, more randomized studies are required to recommend this therapy. Studies on herbal treatment, physical therapy, acupuncture, and massage do not show sufficient evidence and have conflicting results.**

Sources:

*Sung V, D'Amico F, Cabana MD, et al. Lactobacillus reuteri to treat infant colic: a meta-analysis. Pediatrics. 2018;141(1). pii: e20171811.

**Biagioli E, Tarasco V, Lingua C, Moja L, Savino F. Pain-relieving agents for infantile colic. Cochrane Database Syst Rev. 2016;9:CD009999.

Table 14-3 Organic Causes of Constipation in Children

Anatomic malformation	Imperforate anus, anal/colonic stenosis, anteriorly displaced anus, spinal cord dysplasia
Drugs/Environmental exposures	Opiates, anticholinergics, antidepressants, antacids, laxative abuse, chemotherapy, lead poisoning, botulism
Metabolic/Endocrine	Diabetes, hypercalcemia, hypokalemia, hypothyroidism, porphyria, multiple endocrine neoplasia type 2B
Neurogenic	Hirschsprung's disease, anal sphincter achalasia, pseudo-obstruction (e.g., visceral myopathy, visceral neuropathy)
Spinal cord abnormalities	Myelomeningocele, spinal cord tumor, trauma, tethered cord
Systemic disease/other	Celiac disease, cystic fibrosis, milk protein intolerance, connective tissue disorders [e.g., scleroderma, systemic lupus erythematosus (SLE), Ehlers-Danlos], psychiatric disorder (e.g., anorexia nervosa), pelvic mass

Description

Consider the items in the table if there is failure to thrive, pilonidal dimples/hair tuft, sacral agenesis, flat buttocks, anteriorly displaced anus, tight empty rectum with palpable abdominal fecal mass, gush of liquid stool and air from rectum after digital exam, occult blood, absent anal wink, absent cremasteric reflex, or decreased low extremity tone/strength/relaxation phase of DTRs.

Table 14-4A Diagnosis/Management of Functional Constipation in Children <6 Months

Alarming signs and symptoms: onset of symptoms <1 month, delayed passage of meconium by 48 hours of life, failure to thrive, abdominal distension, bloody stool (gross or occult), empty rectum, explosive stool evacuation after digital rectal exam, tuft of hair or dimple at lumbosacral region. Refer to pediatric GI specialist if there are alarming signs.

Constipation diagnosed per Rome III/Rome IV criteria,[1] symptom duration > 1month, absence of organic pathology, no alarming signs

↓

Exclusively breastfed >2 weeks old?

↓

If yes, likely to be normal. Reevaluate after 2–4 weeks.
If not exclusively breastfed, verify proper formula preparation, keep a diary, education regarding stool patterns in infants.

↓

If patient continues to be symptomatic, and there is ***no fecal impaction***, consider ***maintenance therapy*** (see the following).

If patient continues to be symptomatic, and/or there is ***fecal impaction***, start medications.
First line:
- Oral PEG with or without electrolytes: 1–1.5 g/kg/day, max 100 g/day, × 3–6 days

Alternative:
- If PEG is not available, 1 enema/day (bisacodyl or sodium docusate) × 3–6 days.

Then start ***maintenance therapy*** for at least 2 months until symptom-free for 1 month.
First line:
- Oral PEG 0.4 g/kg/day, max 17 g/day. Mix with 4–8 oz fluid.

Alternative:
- If PEG is not available, oral lactulose 1–2 g/kg/day.

↓

If medications are not effective, refer to GI specialist.
If symptoms return after a symptom-free period, may restart medications. Refer to GI specialist after two relapses.

[1]Russo M, Strisciuglio C, Scarpato E, Bruzzese D, Casertano M, Staiano A. Functional chronic constipation: Rome III criteria versus Rome IV criteria. *J Neurogastroenterol Motil*. 2019;25(1):123-128.
Modified from Tabbers MM, DiLorenzo C, Berger MY, et al. Evaluation and treatment of functional constipation in infants and children: evidence-based recommendations from ESPGHAN and NASPGHAN. *JPGN*. 2014;58:258-274.

Description

Table 14-4B Diagnosis/Management of Functional Constipation in Children < 6 Months

Constipation diagnosed per Rome III criteria, symptom duration >2 months if age ≥4 years, absence of organic pathology, no alarming signs.

↓

If there is no fecal impaction, start with maintenance therapy (see the following), education, diary, and toilet training. Reevaluate after 2 weeks.

If there is ***fecal impaction***, start medications.

First line:
- Oral PEG with or without electrolytes: 1–1.5 g/kg/day, max 100 g/day, ×3–6 days.

Alternative:
- If PEG is not available, 1 enema/day (bisacodyl or sodium docusate) ×3–6 days.

If treatment for fecal impaction is not effective, refer to a pediatric gastroenterologist.

If treatment is effective for fecal impaction, continue with maintenance therapy, education, diary, and toilet training. Reevaluate after 2 weeks.

Maintenance therapy:
First line:
- PEG 0.4 g/kg/day mixed with 4–8 oz fluid.

Alternative:
- If PEG is not available, lactulose 1–2 g/kg/day.

↓

If maintenance therapy is effective, continue for 2 months until symptom free for 1 month. If symptoms return, refer to pediatric GI specialist.

If maintenance therapy is not effective, titrate medication dosages, reeducate and reassess. If symptoms persist, refer to GI specialist. If symptoms resolve after medication adjustment, continue maintenance therapy until symptom free for 1 month. If symptoms return, refer to pediatric GI specialist.

Modified from Tabbers MM, DiLorenzo C, Berger MY, et al. Evaluation and treatment of functional constipation in infants and children: evidence-based recommendations from ESPGHAN and NASPGHAN. *JPGN*. 2014;58:258-274.

Description

DIARRHEA

Acute gastroenteritis (AGE) is defined as frequent loose or watery stools (three or more within 24 hours) that may occur with or without vomiting, nausea, or fever. Symptoms usually resolve in less than 7 days but can last up to 14 days. Excess fluid losses can lead to dehydration in children.

Viruses are the most common cause of AGE in resource-rich countries. Rotavirus was once the leading cause of persistent or severe diarrhea in children. With the introduction of rotavirus vaccines, norovirus is now the leading cause of AGE. Other viruses that cause AGE include sapovirus, astrovirus, and enteric adenovirus. Clinical features of viral AGE may include nonbloody stools, vomiting, and respiratory symptoms.

Common bacterial causes of AGE include *Salmonella enterica* subspecies, *Campylobacter, Shigella, Yersinia*, and *Escherichia coli* O157:H7. Clinical features often include high fever (>40°C), blood or mucus in stool, and abdominal pain.

Source: Shane AL, Mody RK, Crump JA, et al. 2017 infectious diseases Society of America Clinical Practice guidelines for the diagnosis and management of infectious diarrhea. Clin Infect Dis. 2017;65(12):e45-e80.

Secretory diarrhea is enterotoxin induced (e.g., *Escherichia coli*, Vibrio, clostridia, some staphylococcal species, *Shigella*, Salmonella). Enterotoxins cause fluid and electrolyte secretion from crypt cells and block absorption of Na^+ and Cl^- by the carrier mechanism. Glucose coupled Na^+ absorption is not blocked. Fecal Na^+ is >60 mOsm/l, and stool osmotic gap (290 – 2 + [stool Na^+ + stool K^+]) < 100 mOsm/l.

Cytotoxic diarrhea is usually due to viral agents (e.g., rotavirus) and is characterized by the destruction of villous mucosa. Shortened villi decrease the intestinal surface area available for fluid absorption.

Osmotic diarrhea is usually due to malabsorption (e.g., lactose intolerance). Osmotically active agents retain fluid in the bowel. Osmotic diarrhea exacerbates cytotoxic and secretory diarrhea via impaired absorption of nutrients and electrolytes. Oral Mg and sorbitol cause osmotic diarrhea. Fecal Na^+ is < 70 mOsm/l, and stool osmotic gap (290 – 2 × [stool Na^+ + stool K^+]) > 100 mOsm/l. Fecal pH < 5.5 or reducing substances > 0.25–0.5% Σ carbohydrate malabsorption.

Dysenteric diarrhea is due to invasion of mucosa and submucosa of the colon and terminal ileum by infectious agents (e.g., Salmonella, *Shigella*, *Yersinia*, *Campylobacter*, enteroviruses). Edema, bleeding, and leukocyte infiltration typically occur.

CLINICAL EVALUATION OF THE CHILD WITH DIARRHEA

Clinical history should include the patient's age, onset, frequency, and duration of diarrhea, characteristics of emesis and diarrhea (bilious, bloody, presence of mucous), weight prior to illness, recent oral intake, changes in urine output, and systemic signs such as fever and mental status.

Physical examination should assess for the degree of dehydration quickly and accurately.

Acute weight loss is the gold standard of determining dehydration status, although the original weight prior to illness is often unavailable. Important components are general appearance (active, listless, less responsive), capillary refill time (≤2 seconds is normal), abnormal skin turgor, and abnormal respiration patterns (may indicate underlying metabolic acidosis). Other features to consider include the presence of tears, sunken eyes, mucous membranes, radial pulse, and tachycardia.

Laboratory testing is not necessary for children presenting with AGE. However, in the presence of bloody or mucoid stools, fever, severe abdominal pain, or signs of sepsis, stool cultures should be sent to evaluate for Salmonella, *Shigella*, *Campylobacter*, *Yersinia*, Shiga-toxin *E. coli* and *Clostridium difficile* (if age is greater than 2 years with history of antibiotic use). If there is a history of voluminous rice water stools, eating undercooked shellfish, exposure to salty waters, stool culture should also evaluate for Vibrio. If patients are younger than 3 months old, blood cultures should be obtained. In patients with bloody diarrhea and fever, it is also important to obtain complete blood count and serum electrolytes to monitor for possible signs of hemolytic uremic syndrome related to *E. coli* O157 infections.

Sources: Colletti JE, Brown KM, Sharieff GQ, Barata IA, Ishimine P; ACEP Pediatric Emergency Medicine Committee. The management of children with gastroenteritis and dehydration in the emergency department. J Emerg Med. 2010;38(5):686-698; Guarino A, Ashkenazi S, Gendrel D, Lo Vecchio A, Shamir R, Szajewska H. European Society for Pediatric Gastroenterology, Hepatology, and Nutrition/European Society for pediatric infectious diseases evidence-based guidelines for the management of acute gastroenteritis in children in Europe. JPGN. 2014;59:132-152; Shane AL, Mody RK, Crump JA, et al. 2017 infectious diseases Society of America Clinical Practice guidelines for the diagnosis and management of infectious diarrhea. Clin Infect Dis. 2017;65(12):e45-e80.

DIARRHEA THERAPY

First-line therapy for mild to moderate dehydration due to AGE is with a reduced osmolarity oral rehydration solution. Oral rehydration therapy (ORT) is often effective in AGE, as cotransport of sodium with glucose remains intact. WHO solution can be used in all ages and in those with hypotonic, isotonic, or hypertonic dehydration. For patients with severe dehydration have signs of sepsis, shock, or altered mental status, first-line therapy is resuscitation with IV isotonic fluids. Once the patient is rehydrated, maintenance fluids should be started to replace ongoing losses. See Table 14.5 for the American Academy of Pediatrics' guidelines for managing acute gastroenteritis.

Drug therapy: Kaolin-pectin (Kaopectate) is an adsorbent. Bismuth subsalicylate (Pepto-Bismol) inhibits intestinal secretions and is useful in traveler's diarrhea.

Antibiotics are indicated for *Shigella* and *Vibrio cholerae*. Azithromycin, ciprofloxacin, or ceftriaxone may be used to treat *Shigella*. *Vibrio cholerae* is treated with doxycycline (first line) or with ciprofloxacin, azithromycin, or ceftriaxone. *Yersinia enterocolitica* is treated with trimethoprim-sulfamethoxazole. Azithromycin is effective for *Campylobacter*. Antibiotics for Salmonella are not indicated unless the patient is younger than 3 months old, toxic appearing, or immunocompromised.

See pages 143–169 for antibiotic recommendations and dosing for specific organisms and exposures.

Recent studies have shown that the use of probiotics, specifically *Lactobacillus rhamnosus* GG, does not decrease the duration of diarrhea in acute gastroenteritis.

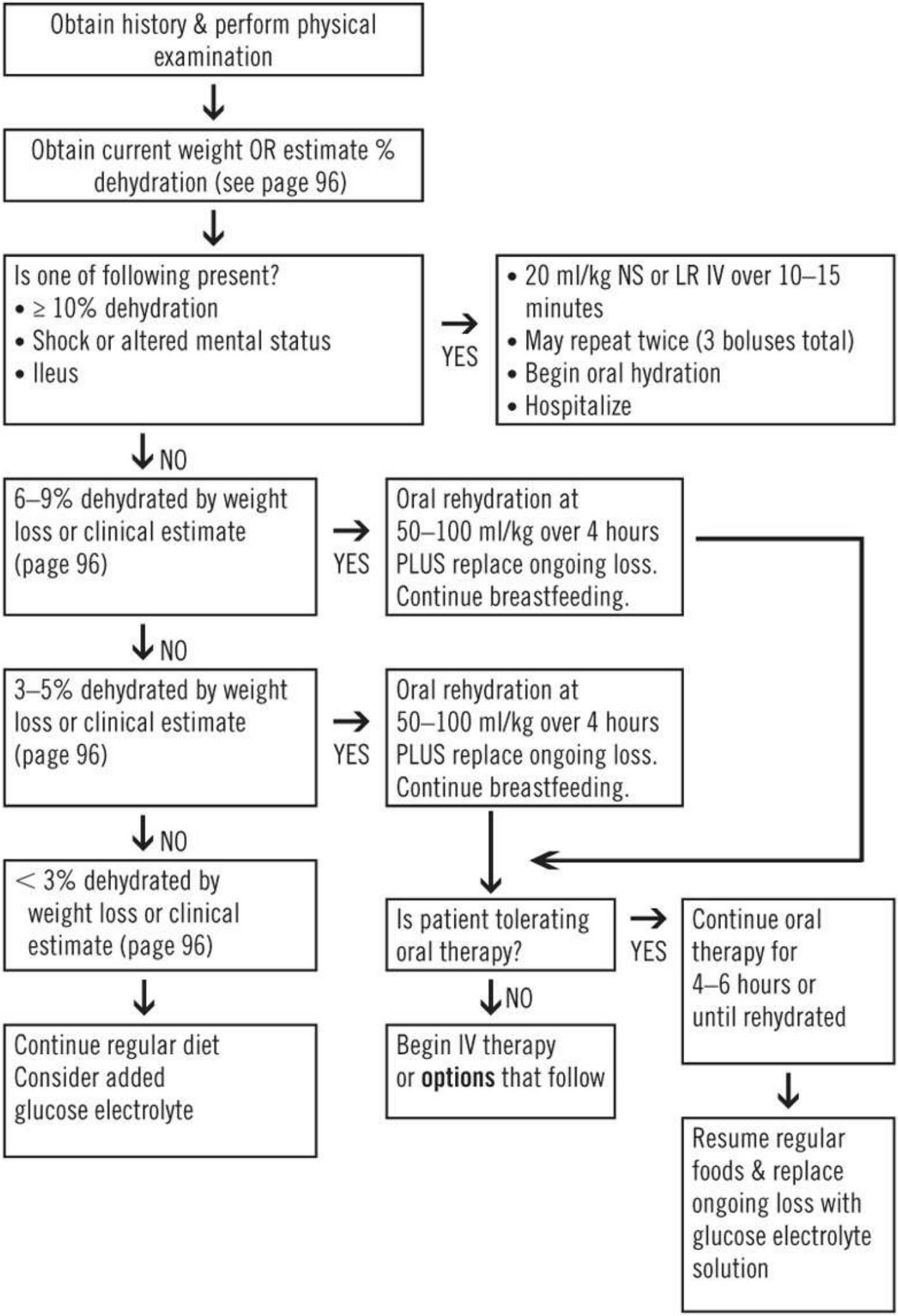
Chronic diarrhea: Culture the stool and test for lactose intolerance (reducing substances > 0.25–0.50% and pH < 5.5). If lactose intolerance suspected, discontinue dairy products for 2 weeks.

SPECIFIC AAP RECOMMENDATIONS

- Use oral rehydration therapy for mild to moderate dehydration. If oral rehydration fails, nasogastric hydration may be preferred to IV hydration. (See pages 97–99 for IV fluid recommendations, intraosseous, and NG options.)
- Children who require rehydration should continue to be fed age-appropriate diets after rehydration (early feeding will decrease the duration of diarrhea).
- As a general rule, pharmacologic agents should not be used for acute diarrhea (opiates/atropine are contraindicated; anticholinergic agents/bismuth subsalicylate, adsorbents, lactobacillus compounds are not recommended).

Sources: Subcommittee on Acute Gastroenteritis, Provisional Committee on Quality Improvement. Practice parameter: the management of acute gastroenteritis in young children. Pediatrics. 1996;97(3):424-435; Guarino A, Ashkenazi S, Gendrel D, Lo Vecchio A, Shamir R, Szajewska H. European Society for Pediatric Gastroenterology, Hepatology, and Nutrition/European Society for pediatric infectious diseases evidence-based guidelines for the management of acute gastroenteritis in children in Europe. JPGN. 2014;59:132-152; Shane AL, Mody RK, Crump JA, et al. 2017 infectious diseases Society of America Clinical Practice guidelines for the diagnosis and management of infectious diarrhea. Clin Infect Dis. 2017;65(12):e45-e80.

Table 14-5 American Academy of Pediatrics Practice Guideline for Managing Acute Gastroenteritis


Obtain history & perform physical examination
Obtain current weight OR estimate % dehydration (see page 96)
Is one of following present?
• ≥ 10% dehydration
• Shock or altered mental status
• Ileus
YES
• 20 ml/kg NS or LR IV over 10–15 minutes
• May repeat twice (3 boluses total)
• Begin oral hydration
• Hospitalize
NO
6–9% dehydrated by weight loss or clinical estimate (page 96)
YES
Oral rehydration at 50–100 ml/kg over 4 hours PLUS replace ongoing loss. Continue breastfeeding.
NO
3–5% dehydrated by weight loss or clinical estimate (page 96)
YES
Oral rehydration at 50–100 ml/kg over 4 hours PLUS replace ongoing loss. Continue breastfeeding.
NO
< 3% dehydrated by weight loss or clinical estimate (page 96)
Continue regular diet
Consider added glucose electrolyte
Is patient tolerating oral therapy?
YES
Continue oral therapy for 4–6 hours or until rehydrated
Resume regular foods & replace ongoing loss with glucose electrolyte solution
NO
Begin IV therapy or **options** that follow

Ondansetron (Zofran) 1.6 mg (6–12 months), 3.2 mg (1–3 years), 4 mg (4–12 years) orally every 8 hours 3 6 doses leads to ↓ vomiting/IV fluid use/admission rates.

Description

GASTROINTESTINAL BLEEDS

Table 14-6 Upper Gastrointestinal Bleeding—Etiology

Age	Most frequent causes	Features
Newborn/Infants	• Swallowed maternal blood • Vitamin K deficiency • Stress ulcers (hospitalized infants) • Gastritis/Esophagitis • Intestinal duplications and vascular anomalies • Milk protein allergy (rarer cause)	See Apt-Downey test, which follows
Toddlers	• Mallory-Weiss tears • Foreign body ingestion • Accidental ingestion of caustic chemicals • Gastritis • Frequent NSAID use • *Helicobacter pylori* infection • Henoch-Schönlein purpura • Hemolytic uremic syndrome (HUS) • Perianal streptococcal cellulitis • Varices	Mallory-Weiss tears: history of cough, retching, or vomiting Varices: look for liver cirrhosis, portal vein thrombosis, portal hypertension
Older children/adolescents	• Gastric ulcer, gastritis, esophagitis, varices • Pill esophagitis • Inflammatory bowel disease (Crohn's, ulcerative colitis) • Enteric infections • Anal fissures, hemorrhoids • Hemophilia	

Description

Table 14-7 Most Common Causes of Lower GI Bleed Presenting to a Pediatric ED

Age	Most frequent causes	Features

Newborn/infant	• Cow's milk protein allergy • Anal fissures • Volvulus • Necrotizing enterocolitis • Hirschsprung's disease • Intussusception • Intestinal duplications, vascular lesions	Milk protein allergy: associated with proctocolitis, hematochezia, may also be allergic to soy protein Volvulus: bilious emesis, prematurity Intussusception: lethargy, currant jelly stools (late sign) Vascular lesion: Dieulafoy lesion, AVM, hemangioma
Children	• Enteric infection • Meckel's diverticulum • Intussusception • Vasculitis (Henoch-Schönlein) • Hemolytic uremic syndrome • Lymphoid hyperplasia • Polyps • Rectal prolapse • Streptococcal perianal infection • Food coloring	HUS: after infection of *E. coli* O157:H7 Lymphoid hyperplasia: common in IgA-deficient patients or hypogammaglobulinemia Food coloring: fruit punch, beet, candies, licorice, blueberries spinach, iron
Adolescents	• Inflammatory bowel disease (Crohn's, ulcerative colitis) • Enteric colitis • Hemorrhoids • Anal fissure • Frequent NSAID use • Vascular malformations	

Description

EVALUATION AND MANAGEMENT OF SIGNIFICANT GI BLEEDING

- Place cardiac monitor, administer O_2, and insert two large bore IVs.
- Draw CBC, comprehensive metabolic panel, coagulation studies, type and cross at least 15 ml/kg of packed RBCs.
- Administer 20 ml/kg NS bolus and repeat to correct hypotension or shock.
- Consider blood transfusion if there is no response to first two fluid boluses.
- Consider plain radiograph for suspicion of foreign body ingestion; abdominal ultrasound for suspicion of portal hypertension.
- **Pharmacotherapy:** For severe GI bleeding, start proton pump inhibitors. For children < 40 kg, pantoprazole IV 0.5–1.0 mg/kg/day may be used. For children ≥ 40 kg, pantoprazole 20–40 mg/day may be used. For variceal bleeding in addition to symptoms previously

mentioned, consider vasopressin (0.002–0.005 units/kg/minute, titrate to maximum of 0.01 unit/kg/minute) or octreotide (1–2 mcg/kg IV bolus, followed by 1–2 mcg/kg/hour continuous infusion). Multiple serious side effects can occur with either medication; therefore, intensive monitoring is required if either is administered.

- **Endoscopy and specialty consult:** Considered first line in diagnostic and intervention management. Endoscopy identifies bleeding site in 75–90% of upper GI and 48–90% of lower GI bleeds. It also provides therapeutic management by coagulating or sclerosing the site of the bleeding.
- **Urgent surgery indications:** Unrelenting hemorrhage, >50–75 ml/kg blood transfused in 2 hours, perforation, vascular compromise, unable to identify GI bleeding site with endoscopy
- **Contrast studies** are not indicated acutely. Angiography can detect a bleeding site if the bleeding rate is >0.5–2.0 ml/minute. Embolization can ensue but carries major risks including femoral artery thrombosis and bowel ischemia.
- **Radionuclide scanning (Tc-99)**: May detect low-grade GI bleeding from a Meckel's diverticulum. Tc-99 has an affinity for parietal cells present in gastric mucosa and in 90% of Meckel's diverticulum. It has a sensitivity of 85–97% and specificity of 95% in pediatric patients. A positive scan consists of a persistent focus of uptake in the right lower quadrant or lower abdomen. This test is indicated for any child younger than 3 years who presents with persistent painless lower GI bleeding.

Erroneous stool guaiac testing: Acidic pH lowers the sensitivity of guaiac, so use specific gastric test cards (e.g., Gastroccult) when evaluating blood from an upper gastrointestinal source.

- *False positive*: Iron, red fruits, meats, iodine, bromide, horseradish, turnips, tomatoes, fresh red cherries, or chlorophyll
- *False negative*: Dried stool specimens, outdated reagent or guaiac card, bile, vitamin C, or certain antacids

Apt-Downey Test for Fetal vs. Maternal Blood: Mix stool in a test tube with an equal quantity of tap water. Centrifuge or filter out solids. Add one part 1.0% NaOH to five parts of supernatant. Read in 2 minutes. Fetal Hb resists alkali denaturation. A persistent pink color indicates the presence of fetal Hb. If supernatant turns yellow, Hb is adult and thus maternal.

NEONATAL JAUNDICE

Over 80% of newborn infants will develop jaundice in the first few days of life. This is due to increased RBC breakdown and increased enterohepatic circulation of bilirubin. Jaundice can be visibly detected at 2.5–3.0 mg/dl. Physiologic jaundice can last up to 2 weeks of life.

Persistent severe unconjugated hyperbilirubinemia (≥25 mg/dl) can lead to acute and chronic bilirubin encephalopathy. Acute bilirubin encephalopathy causes lethargy, hypotonia, poor suck, irritability and can eventually lead to opisthotonus, arching of neck, apnea, seizure, and death. Chronic bilirubin encephalopathy (kernicterus) leads to cerebral palsy, auditory and visual dysfunction, and intellectual disability.

Conjugated (direct) hyperbilirubinemia is always abnormal [perinatal infections, biliary/liver disease, inborn metabolic errors (galactose, tyrosine, thyroid)], and requires further evaluation. Direct bilirubin should be ≤ 15% of the total bilirubin level.

Unconjugated (indirect) hyperbilirubinemia is abnormal and requires evaluation if risk factors (see Table 14-8), presenting features (see the above discussion of neonatal jaundice), or specific levels are present (Table 14-10).

Table 14-8 Risk Factors for Severe Hyperbilirubinemia[1]

• Predischarge total serum bilirubin or transcutaneous bilirubin in the high-risk or high-intermediate risk zone (see chart on page 114).
• Lower gestational age or jaundice in first 24 hours.
• Exclusive breastfeeding (especially if nursing poorly or excess weight loss [> 8–10%]).
• Isoimmune or other hemolytic disease (G6PD deficient, hereditary spherocytosis)
• Prior jaundiced sibling, cephalohematoma or excess bruising, or East Asian race.
• Maternal diabetes, oxytocin use, and male sex are minor risk factors.

Description

[1]Neurotoxic risk: Isoimmune, G6PD deficient, asphyxia, sepsis, acidosis, albumin <3 mg/dl.

Table 14-9 Evaluation of Neonatal Jaundice >35-Week Gestation

Jaundice ≤ 24 hours old	• Transcutaneous bilirubin (TcB) and/or total serum bilirubin (TSB)
Excessive jaundice for age	• TcB and/or TSB
Jaundice requiring phototherapy, or rapidly rising TSB not explained by history and physical examination	• Blood type, Coombs' test (if cord blood not tested) • CBC, peripheral smear

	• Direct or conjugated bilirubin • *Depending on age, TSB level:* Repeat TSB 4–24 hours • *Optional:* Reticulocyte count, G6PD, and end tidal carbon monoxide (ETCO)
TSB nearing exchange levels or no phototherapy response	• Reticulocyte count • G6PD • Albumin • ETCO *if available*
High direct/conjugated bilirubin (above lab normal cutoffs)	• Urinalysis and urine culture • Evaluate for sepsis, bowel or biliary disease if indicated by history and physical examination
Jaundice ≥ 3 weeks of age or sick infant	• Direct or conjugated bilirubin • *Direct bilirubin* elevated assess for cholestasis • Check thyroid, galactosemia screens, assess for hypothyroidism

Description

Subcommittee on Hyperbilirubinemia. Management of hyperbilirubinemia in the newborn infant 35 or more weeks of gestation. *Pediatrics*. 2004;114(1):297-316; Varvarigou A, Fouzas S, Skylogianni E, Mantagou L, Bougioukou D, Mantagos S. Transcutaneous bilirubin nomogram for prediction of significant neonatal hyperbilirubinemia. *Pediatrics*. 2009;124(4):1052-1059.

Table 14-10 Transcutaneous Bilirubin (TcB) Cutoffs for High, Low, and Minimal Risk[1] for Significant Hyperbilirubin[2,3] Levels in Newborns Born at <35 Weeks

Hours since birth	High risk level (mg/dl)	Low risk level (mg/dl)	Minimal risk level (mg/dl)
12	6.5	4.5	4.2
18	7.7	5	4.8
24	8	5.8	5.3
36	9.3	8	7.8
48	11	9.5	8.8
60	12.5	11	10
72	13.5	13	12.5

[1]High-risk bilirubin level [likelihood ratio (LR) > 10 that serum bilirubin is high], low risk (LR < 0.1), minimal risk (LR = 0) . [2]Significant = any serum bilirubin that exceeds the threshold for phototherapy. [3]Most studies indicate that the TcB can underestimate the TSB (especially at high levels). Therefore, always measure the TSB if (1) TcB is at 70% of the level recommended for use of phototherapy, (2) therapeutic intervention is being considered, (3) TcB is above the 95th percentile on a TcB nomogram or 75th percentile on a TSB nomogram, or (4) upon follow-up after discharge in an infant where the TcB was > 13 mg/dl.

Modified from Varvarigou A, Fouzas S, Skylogianni E, Mantagou L, Bougioukou D, Mantagos S. Transcutaneous bilirubin nomogram for prediction of significant neonatal hyperbilirubinemia. *Pediatrics*. 2009;124(4):1052-1059.

Description

Table 14-11 Bilirubin Cutoffs (mg/dl) for Initiating Therapy in Jaundiced Newborns Born at <35 Weeks

Age	24 hours	48 hours	72 hours	96 hours	5–7 days
Cutoff for starting phototherapy[1,2]	*Total serum bilirubin in mg/dl*				
Low risk (≥38 weeks and well)	12	15	17.5–18	20	21
Medium risk (≥38 weeks + risk, 35–37 6/7 weeks + well)	10	13	15.5	17	18
High risk (35–37 6/7 weeks + risk)	6.5–7	11	13.5	14.5	15
Cutoff for starting exchange transfuion[1,3]	*Total serum bilirubin in mg/dl*				
Low risk	19	22	24	25	25
Medium risk	16.5	19	21	22	22
High risk	15	17	18.5	19	19

[1]Risk factors include isoimmune hemolytic disease, G6PD deficiency, asphyxia, lethargy, temperature instability, sepsis, acidosis, and albumin <3 g/dl. [2]It is an option to provide home phototherapy for levels 2–3 mg/dl below cutoffs, but do not use home therapy for any newborn with risk factors. [3]Immediate consult for exchange transfusion is indicated for signs of encephalopathy, or TSB ≥ 5 mg/dl above cutoffs, or total bilirubin (μmol/l) to albumin (μmol/l) ratio level is ≥ 0.94 for low-risk, ≥ 0.84 for medium-risk, or ≥ 0.8 for high-risk newborn. Modified from Petrova A, Mehta R, Birchwood G, Ostfeld B, Hegyi T. Management of neonatal hyperbilirubinemia: pediatricians' practices and educational needs. *BMC Pediatr*. 2006;6:6; Varvarigou A, Fouzas S, Skylogianni E, Mantagou L, Bougioukou D, Mantagos S.

Transcutaneous bilirubin nomogram for prediction of significant neonatal hyperbilirubinemia. *Pediatrics*. 2009;124(4):1052-1059.

Description

15 ■ HEMATOLOGY AND ONCOLOGY

Table 15-1 Normal RBC Indices (Mean ± 2 Standard Deviations)

Age	Hb (g/dl)	Hct (%)	MCV (fl)	MCH (pg)	MCHC (g/dl)
Birth	16.5 ± 3.0	51 ± 9	108 ± 10	34 ± 3	33 ± 3
1–3 days	18.5 ± 4.0	56 ± 14	108 ± 13	34 ± 3	33 ± 4
1 week	17.5 ± 4.0	54 ± 12	107 ± 19	34 ± 6	33 ± 5
2 weeks	16.5 ± 4.0	51 ± 12	105 ± 19	34 ± 6	33 ± 5
1 month	14.0 ± 4.0	43 ± 12	104 ± 19	34 ± 6	33 ± 4
2 months	11.5 ± 2.5	35 ± 7	96 ± 19	30 ± 4	33 ± 4
3–6 months	11.5 ± 2.0	35 ± 6	91 ± 17	30 ± 5	33 ± 3
0.5–2 years	12.0 ± 1.5	36 ± 3	78 ± 8	27 ± 4	33 ± 3
2–6 years	12.5 ± 1.0	37 ± 3	81 ± 6	27 ± 3	34 ± 3
6–12 years	13.5 ± 2.0	40 ± 5	86 ± 9	29 ± 4	34 ± 3
12–18 years (female)	14.0 ± 2.0	41 ± 5	90 ± 12	30 ± 5	34 ± 3
12–18 years (male)	14.5 ± 1.5	43 ± 6	88 ± 10	30 ± 5	34 ± 3

Description

CAUSES OF ANEMIA BY AGE

Neonate: Blood loss, isoimmunization, or congenital hemolytic anemia. *3 to 6 months:* Congenital disorder of hemoglobin (e.g., thalassemia), blood loss. *6 months to 2 years:* Iron deficiency is associated with early or excessive cow's milk.

Hereditary hemolytic anemia (spherocytosis, hemoglobinopathy, or red cell enzyme deficiency) suggested by a family history of anemia, jaundice, gallstones, or splenectomy. B_{12} deficiency suggested by tortuous retinal vessels (hemoglobinopathy), glossitis, and diminished vibratory/position sense. RBC distribution width (RDW) reflects cell heterogeneity. Variable RDW sizes are seen in hemolysis or reticulocytosis. Markedly high WBC counts, high glucose, sodium, and triglycerides falsely elevate RBC counts.

Table 15-2 Anemia Differential Diagnosis

Microcytic	Iron deficiency (RDW > 14%), thalassemia (RDW < 14%), chronic inflammation, sideroblastic anemia, lead poisoning, B_6 deficiency.

Macrocytic	Folic acid or B_{12} deficiency, Fanconi's syndrome, hepatic disease.
Normocytic (high reticulocyte count)	*Extrinsic disorders:* Antibody-mediated hemolysis, fragmentation hemolysis, DIC, hemolytic uremic syndrome, artificial heart valves, liver and renal disease. *Intrinsic disorders*: Membrane disorders. (spherocytosis, elliptocytosis), enzyme deficiencies (glucose-6-phosphate dehydrogenase or pyruvate kinase deficiency), hemoglobin disorders (SS, SC, S-thalassemia).
Normocytic (low reticulocyte count)	Diamond-Blackfan, transient erythroblastopenia of childhood, aplastic crisis, bone marrow infiltrate (leukemia, metastatic disease), renal disease, infection, malnutrition.

Description

DIAGNOSIS AND EVALUATION OF PATIENTS WITH SICKLE CELL DISEASE

- Most children are diagnosed by newborn screening, which is available in every state.
- Sickle cell screen may be negative up to 4 to 6 months of age and in sickle trait.
- A routine Hb is recommended to assess severity or change of anemia.
- Consider a reticulocyte count to screen for aplastic crisis. Mean reticulocyte for sickle cell patient is 12%; in aplastic crises it may be <3%.
- Urine-specific gravity is not a useful test for dehydration, as it may be low from isosthenuria (inability to concentrate the urine).
- Profound and sudden decrease in Hb combined with increased reticulocyte count is suggestive of splenic sequestration or hemolytic crisis.

FEVER IN SICKLE CELL ANEMIA

Penicillin prophylaxis decreases the incidence of sepsis and death for sickle cell children aged 6 months to 5 years. However, as these children are susceptible to invasive infections, all children with SCD with fever >38.5°C should be rapidly triaged and examined. Urgent complete blood count, reticulocyte count, blood culture, urine culture, and possibly lumbar puncture (based on the clinical exam) must be performed. Children with respiratory symptoms and signs should be investigated with a chest radiograph to rule out pneumonia and chest syndrome. Broad-spectrum antibiotics such as ceftriaxone or cefotaxime should be initiated even before any laboratory results or chest X-ray results. For severe cases such as meningitis, vancomycin should be added. The presence of a focal infection does not obviate the need for urgent delivery of antibiotics. A subset of children who meet ALL the following low-risk criteria and do not appear toxic may be managed as outpatients after a dose of parenteral ceftriaxone (75 mg/kg) in the ED after consultation with a hematologist, and with close 24-hour follow-up and retreatment.

Table 15-3 Low-Risk Criteria for Outpatient Management of Fever in Sickle Cell Patients

>12 months	Chest X-ray without infiltrate
Well appearing	No ceftriaxone in past 8 weeks
Fever < 39.5°C	No history of bacteremia or sepsis
Normal vital signs	No splenic sequestration in past 4 weeks
Tolerating PO	No recurrent visits for febrile illness
No concern for sequestration, vaso-occlussive crisis or chest syndrome	No history of noncompliance in past

No hypoxia	Fully immunized
No central venous device in place	High likelihood of follow-up (has transportation and phone, not currently in shelter, no missed clinic appointments in past)
Baseline hemoglobin levels	No allergy to cephalosporin
Reticulocyte > 1%, platelets >100,00/μl	Remain clinically stable 3 hours after antibiotic is received
WBC 5,000–30,000, negative urinalysis	Endemic *Streptococcus pneumoniae* in the community is sensitive to antibiotics

Description

Modified from Yawn BP, Buchanan GR, Afenyi-Annan AN, et al. Management of sickle cell disease: summary of the 2014 evidence-based report by expert panel members. *JAMA*. 2014;312(10):1033-1048; NIH/NHBLI Division of Blood Diseases and Resources. *The Management of Sickle Cell Disease*. 4th ed. Publication No. 02-2117; revised 2002.

MANAGEMENT OF SICKLE CELL DISEASE COMPLICATIONS

Acute chest syndrome **(ACS)** is a complex of pulmonary symptoms and a lung infiltrate. ACS is one of the most common serious complications of sickle cell anemia and the second most common cause of admission. Patients present with sudden cough, fever, and findings of lower respiratory tract infection such as rales and hypoxia. Chest X-ray reveals a pulmonary infiltrate. While there are no distinctive laboratory findings, the hemoglobin may drop below the baseline value during ACS. Treatment includes admission, oxygen, broad-spectrum antibiotics (cefotaxime or cefepime PLUS a macrolide), and fluids. Exchange blood transfusion is indicated for children with severe respiratory distress, multilobar infiltrates, inability to maintain oxygen saturation above 95% with supplemental oxygen, or the presence of pleural effusions.

Source: Howard J, Hart N, Roberts-Hareweood M, et al. Guideline on the management of acute chest syndrome in sickle cell disease. Br J Haematol. 2015;169(4):492-505.

Table 15-4 Causes of Acute Chest Syndrome

Cause	0–9 years	10–19 years
Infarction without known precipitant	15.9%	22.9%
Viral	10.9%	2.7%
Mycoplasma	8.8%	3.7%

Fat embolism +/− infection	7.3%	8.5%
Chlamydia	5.8%	8%
Mixed infections	4.9%	1.6%
Bacteria	4%	6.4%
Mycobacteria (TB and avium complex)	0.9%	0
Unknown	41.3%	42%

Description

Modified from Vichinsky EP, Neumayr LD, Earles AN, et al. Causes and outcomes of the acute chest syndrome in sickle cell disease. National Acute Chest Syndrome Study Group. *N Engl J Med*. 2000;342(25):1855-1865.

- ***Splenic sequestration (SS) crisis*** (1 to 6 years): Defined as a sudden enlargement of the spleen and a fall in hemoglobin by at least 2 g/dl below the baseline value. Second only to sepsis as a cause of death in children with sickle cell anemia The reticulocyte count and circulating nucleated red blood cells are elevated. Platelet count is decreased due to trapping in the spleen. Sequestration may occur without any prior warning or a cause, and typically occurs between 1 and 4 years of age. However, cases have been reported in younger children. Less commonly seen in older children due to autosplenectomy. Abdominal pain, shock, left upper quadrant tenderness (or mass), and hypotension may occur. Infants may develop severe anemia and shock precipitously. Patients are usually younger than 6 years if SS disease, but older if SC or S-β-thalassemia variants. Obtain CBC, type and cross, and reticulocyte count. Admit and treat hypovolemia with intravenous fluids. If symptomatic or Hg < 5g/dl, perform PRBC transfusion with 5–10 cc/kg. Be aware that some blood will be mobilized from the spleen after the resolution of sequestration, which can result in hypercoagulability.
- ***Aplastic crisis*** (6 months to young adulthood): Common especially in children with HbSS. Gradual fatigue, shortness of breath, fever, and syncope may occur. On examination, tachycardia or heart failure may occur. Hemoglobin is between 3 and 6 g/dl, and hallmark is a reduced reticulocyte count (<3%). Parvovirus B19 is the most common identified precipitant. Other causes include drug toxicity (phenylbutazone) and folate deficiency. Obtain complete blood count, reticulocyte count, and type and screen. Assess all children whose Hb is <6 or 2 g less than their baseline (if known) for aplastic crisis, SS, or ACS. Transfuse PRBCs to restore Hb to a safe level (but not necessarily to baseline levels).
- ***Bone complications:*** Avascular necrosis of the femoral head occurs in 12% of patients. Osteomyelitis secondary to salmonella is more common in patients with HbSS. Sickle dactylitis can cause small lytic lesions in the digits and is more common in patients with HbSC disease.
- ***Cardiac complications:*** Patients may develop congestive heart failure or compensatory cardiac dilation. There may be left ventricular hypertrophy on electrocardiography. Chest

radiography may demonstrate a large cardiac silhouette.

Abdominal complications: Liver, splenic, and mesenteric infarctions may occur. Bilirubin gallstones are common, although <10% are symptomatic. Abdominal pain in children with sickle cell disease should be managed conservatively with fluids, pain control, and assessment for splenic and liver sequestration besides gallstones.

Source: Rhodes MM, Bates DG, Andrews T, Adkins L, Thornton J, Denham JM. Abdominal pain in children with sickle cell disease. *J Clin Gastroenterol*. 2014;48(2):99-105.

Genitourinary complications: Priapism is a sustained unwanted erection lasting more than 4 hours with pain and a soft glans. Stuttering priapism is multiple self-limited episodes that last <3 hours that can be a harbinger of more prolonged events. Priapism lasting >3 hours is unlikely to resolve spontaneously. Prompt medical treatment is essential to reduce complications. Early consultation of urology and hematology is imperative. Treatment of priapism consists of hydration, pain management, oxygen, and sedation (if required). If symptoms persist after the previous medical management, use of oral agents (e.g., pseudoephedrine, PDE5 inhibitors), penile aspiration and corporal irrigation using α adrenergic agents (epinephrine, pseudoephedrine) may be effective. Current guidelines recommend against the routine use of transfusions in priapism. These patients are less likely to require surgery to correct priapism than patients without sickle cell disease although surgical interventions such as shunting have been used with variable results when all other medical treatments have failed. Other genitourinary complications include painless hematuria and renal papillary necrosis and isosthenuria (difficulty concentrating urine).

Source: Yawn BP, Buchanan GR, Afenyi-Annan AN, et al. Management of sickle cell disease: summary of the 2014 evidence-based report by expert panel members. *JAMA*. 2014;312(10):1033-1048.

Hand-foot syndrome (dactylitis, 6 months to 6 years): Due to vaso-occlusion in hands and feet. This syndrome is the most common presentation of sickle cell anemia at 6 to 24 months, and often the first crisis experienced. Non-pitting edema from symmetric infarction of the metacarpals/metatarsals occurs. Treat as pain crisis.

Pain crisis (all ages): Most common sites of pain in order of decreasing frequency: lumbosacral spine, thigh and hip, knee, abdomen, shoulder, chest. Mild cases can be managed with acetaminophen or NSAIDs. Intravenous opioids is the treatment of choice in severe cases and should be titrated. Meperidine is not recommended (especially in high or repeated doses), as a metabolite (normeperidine) it can cause CNS excitation and seizures. Hydration (oral or IV) and oxygen are commonly accepted adjuncts. A PCA pump may be helpful for pain control.

Source: Puri L, Nottage KA, Hankins JS, Anghelescu DL. State of the art management of acute vaso-occlusive pain in sickle cell disease. *Paediatr Drugs.* 2018;20(1):29-42.

Sickle stroke (all ages): Occurs in 10 to 20% of children with sickle cell disease. Strokes are usually ischemic. Transcranial Doppler (TCD) screening decreases incidence by 1 to 2%. Patients should start TCD screening at 2 years of age up to 16 years of age. If

screening is positive, treat with exchange transfusion to keep HbS < 20–30% of total and Hct < 35%. Mean age when strokes occur is 10 years although bleeds occur in older children. Presenting complaints may include headache, weakness, seizures, or coma. Any child with sickle cell anemia with symptoms of stroke should have an IV established and CBC, reticulocyte count, and type and screen ordered. An immediate exchange transfusion should be performed. A CT scan followed by an MRI/MRA will be required to confirm diagnosis. Consider admission to the intensive care unit to ensure close monitoring of vitals to prevent further neurological damage.

Source: Yawn BP, Buchanan GR, Afenyi-Annan AN, et al. Management of sickle cell disease: summary of the 2014 evidence-based report by expert panel members. *JAMA*. 2014;312(10):1033-1048.

Table 15-5 Causes of Abnormal Bleeding Tests[1]

Lab value	Causes
Thrombocytopenia Low platelet count (<150,000/ml)	• Spurious clotted sample • Pseudothrombocytopenia secondary to response to EDTA occurs in 1:1,500 people. This will correct if repeated with heparin tube. • Decreased production of platelets (due to drugs, toxins, or infections), splenic sequestration or platelet pooling, platelet destruction (due to collagen vascular disease, drugs, post-transfusion, infection, ITP, DIC, TTP, HUS, or vasculitis)
Platelet dysfunction (with normal count)	• Adhesion defects (e.g., von Willebrand disease) or aggregation defects (e.g., thrombasthenia)
↑ BT (>9 minutes) Abnormal PFA-100 (platelet function test)	• All platelet disorders, DIC, ITP, uremia, liver failure, aspirin, abnormal PFA-100
↑ PTT (>35 seconds)	• Coagulation pathway defects (common factors II, V, X, intrinsic VIII, IX, XI, XII, von Willebrand), DIC, liver failure, heparin
↑ PT (> 12–13 seconds)	• Coagulation pathway defects (common factors II, V, X, extrinsic VII) DIC, liver failure, warfarin, circulating anticoagulants (i.e., lupus anticoagulant)
↑ TT (> 8–10 seconds)	• DIC, liver failure or uremia, heparin, hypofibrinogenemia
↓ Fibrinogen, ↑ Fibrin split products (FSP)	• DIC

Description

[1]BT—bleeding time; TT—thrombin time; PTT—partial thromboplastin time; PT—prothrombin time; DIC—disseminated intravascular coagulopathy; ITP—idiopathic thrombocytopenic purpura; TTP—thrombotic thrombocytopenic purpura; HUS—hemolytic uremic syndrome.

Table 15-6 Replacement Factors

Medication	Dose (Consult hematology for dosing recommendations, see recommendations for factor 8, 9 deficiencies on page 123)
Amicar	Aminocaproic acid: 25–100 mg/kg PO/IV every 6–8 hours for up to 7 days.
Cryoprecipitate	Cryoprecipitate: 2–4 bags/10 kg, 1 bag = 50–100 units factor VIII activity.
DDAVP	*Desmopressin*: 0.3 mcg/kg in 50 ml NS IV over 30 minutes OR via nasal spray (1 puff if < 50 kg, 2 if > 50 kg); useful if baseline activity > 10%.
Activated factor VIIa	Recombinant activated human factor VII (recombinant FVIIa) 90–120 mcg/kg every 2–3 hours IV.
Factor VIII	Standard half-life products include: Advate, Hemofil-M, Koate, Kovaltry, Novoeight, Nuwiq, Recombinate, and Xyntha. There are now longer half-life products available that include: Adynovate, Afstyla, and Eloctate. Refer to prescribing information in the product insert for the use of factor replacement. Consult hematology. 1 unit/kg factor VIII ↑ activity level by 2% (factor VIII half-life = 12 hours)
Factor IX	Standard half-life products include: AlphaNine SD, BeneFIX, Ixinity, Mononine, and Rixubis. There are now longer half-life products available that include Alprolix and Idelvion—refer to the product information for the use of factor replacement.
Bispecific factor VIII	Emicizumab is a bispecific monoclonal antibody used to replace activated factor VIII in patients who have hemophilia A without factor VIII inhibitors. *Source*: Mahlangu J, Oldenburg J, Paz-Priel I, et al. Emicizumab prophylaxis in patients who have hemophilia A without inhibitors. *N Engl J Med.* 2018;379(9):811-822. Emicizumab (ACE910) is an activated factor VIII used in patients with hemophilia A with factor VIII inhibitors. *Source*: Oldenburg J, Mahlangu JN, Kim B, et al. Emicizumab prophylaxis in hemophilia A with inhibitors. *N Engl J Med*. 2017;377(9):809-818.
von Willebrand factor (VWF)	Three plasma-derived VWF include: Humate-P, Alphanate, Wilfactin. Vonvendi is a recombinant human VWF. Recommendations for replacement doses of VWF are empirical,

	since no laboratory tests adequately predict the hemostatic effects. The dose given is also dependent on the site and the degree of bleeding.
Activated prothrombin complex	Used for treatment of acute breakthrough bleed in patients with inhibitors. Dose: 50–11 international units/kg every 6–12 hours IV.

Description

Modified from Callaghan MU, Sidonio R, Pipe SW. Novel therapeutics for hemophilia and other bleeding disorders. *Blood*. 2018;132(1):23-30.

Table 15-7 Treatment of von Willebrand Disease (VWD)

Nose bleed	Nasal DDAVP on side not bleeding. If no response in 1 hour, IV DDAVP. If no response, pack, ENT consult, VWF
Major bleed	CNS or GI bleed, major trauma: VWF
Menorrhagia	DDAVP injection. Consider Amicar + DDAVP: 1 spray each nostril one time during acute episode
Oral bleed	Nasal DDAVP and aminocaproic acid
Surgery	*Minor:* DDAVP SC/IV + Amicar *Major:* VWF

Description

Table 15-8 Factor VIII Deficiency Treatment

Bleed type	% activity desired	Dose[3] (units/kg)	Duration of therapy
Severe[1]			
CNS injury	80–100	40–50	14 days
GI bleed	80–100	40–50	3 days more than bleed
Major trauma	80–100	40–50	Depends on injuries
Retroperitoneal	80–100	40–50	6 days
Retropharyngeal	80–100	40–50	4 days
Pending surgery	80–100	40–50	Variable
Moderate[2]			
Mild head trauma	40–50	20–25	Variable
Deep muscle	40–50	20–25	Every day until resolution
Hip or groin injury	40–50	20–25	Repeat once in 1–2 days
Mouth, lip, dental[3]	40–50	20–25	Variable
Hematuria	40–50	20–25	3–5 days
Mild[2]			
Laceration[4]	40–50	20–25	Until sutures out for 24 hours
Common joint	40–50	20–25	Recheck in 1–2 days
Soft tissue, small muscle[5]	40–50	20–25	Variable

[1]If baseline activity is 0%. Assume all severe bleeding cases have baseline of 0%. [2]Desmopressin (DDAVP) 0.3 mcg/kg IV or intranasal or subcutaneous has been used for mild and moderate bleeding states, especially useful if baseline factor is >10%. [3]To prepare for dental/oropharyngeal procedures, consider aminocaproic acid (Amicar) 100 mg/kg PO every 6 hours for 6 days or cyklokapron 25 mg/kg every 6 hours for 6 days. Also consider topical epinephrine, surgicel, or avitene. Cautery may worsen bleeding. [4]Epistaxis and minor lacerations may not need replacement. [5]Consider admission to observe for compartment syndrome.

Description

OTHER TREATMENT OPTIONS IN HEMOPHILIA

Fresh frozen plasma (FFP) contains all coagulation factors and is used for unknown bleeding disorders. FFP or cryoprecipitate can be used to treat VWD. FFP 40 ml/kg raises activity of any factor to 100%. May cause fluid overload.

Cryoprecipitate: 5 to 10 units factor VII activity/ml (1 bag = 10 ml, 50–100 units factor VIII activity).

Desmopressin (DDAVP): 0.3 mcg/kg in NS IV over 30 minutes. Mild to moderate bleeding in VWF and hemophilia A. Causes seizures/↓ Na in those younger than 4 years.

Source: Ozgonenel B, Rajpurkar M, Lusher JM. How do you treat bleeding disorders with desmopressin? *Postgrad Med J*. 2007;83(977):159-163.

Prothrombin complex (factors II, VII, IX, X) can be used to treat hemophilia B but can precipitate thrombi and/or DIC.

HEMOLYTIC UREMIC SYNDROME (HUS)

HUS—A post-infectious disorder causing (1) nephropathy, (2) microangiopathic hemolytic anemia, and (3) thrombocytopenia. It commonly occurs in those younger than 5 years following a URI or gastroenteritis (esp. *E. coli* 0157:H7, *Shigella, Salmonella*). Organisms produce toxin that kills GI organ cells; 30% reoccur. *Treatment:* Admit and manage complications: (1) dialysis if congestive heart failure, BUN > 100, encephalopathy, anuria > 24 hours or hyperkalemia. (2) If hypertension, treat with antihypertensives. (3) Administer fluids and blood (especially if Hb < 8 g/dl) for hypotension. (4) If seizures, treat with appropriate medications and obtain CT or MRI. (5) Plasma exchange or plasmapheresis is indicated for CNS involvement or severe renal involvement. (6) Platelet transfusion has the potential to worsen disease causing further organ damage.

Modified from Picard C, Burtey S, Bornet C, Curti C, Montana M, Vanelle P. Pathophysiology and treatment of typical and atypical hemolytic uremic syndrome. Pathol Biol. 2015;63(3):136-143.

Clinical features of HUS	
Prodrome	Upper-respiratory infection or gastroenteritis
Blood pressure	Hypertension in up to 50%
Gastrointestinal	75% have pain
Urinary	Decreased urination, gross hematuria is rare
Skin	Pallor, petechia, purpura
Central Nervous System	Seizures, coma, encephalopathy
Laboratory features of HUS	
Urine	Hematuria, proteinuria, casts
Hematology	
Low hemoglobin, low platelets, low WBC count, peripheral smear abnormalities (schistocytes, helmet cells)	
Chemistry	Hyponatremia, acidosis, hyperkalemia, elevated BUN/creatinine
PT/PTT	Are usually normal

HENOCH-SCHÖNLEIN PURPURA (HSP)

OVERVIEW

HSP is a systemic vasculitis with skin, joint, GI, or renal involvement. Scrotal, CNS, heart, and lung involvement are less common. HSP peaks at 4 to 5 years, can occur at any age. It is more common in winter and early spring. *Precipitants:* streptococci, mycoplasma, hepatitis B, salicylates, antibiotics, and food allergens. HSP is pathophysiologically a small vessel vasculitis, with WBCs infiltrating and necrosing the walls of capillaries, arterioles, and venules. *Evaluation:* CBC, creatinine/BUN/electrolytes. Rule out meningococcemia/sepsis/DIC. *Treatment:* Supportive care and steroids are used for abdominal pain and renal involvement, although their benefit has not been clearly established.

CLINICAL FEATURES

- *Skin*—Involved in most. Petechiae, coalesce to large ecchymoses. Purpura are gravity dependent occurring on the buttock and legs.
- *Painless edema*—25 to 35% (usually at dorsum of hands and feet), with painful edema of face, scalp.
- *GI tract*—50 to 90% with vomiting, or bleeding. Intussusception (3 to 6%), pancreatitis, or bowel infarcts occur.
- *Joint*—Involvement in 50 to 75%, usually knees/ankles, transitory periarticular swelling, nonmigratory. This is first site in 25% and resolves with rest.
- *Renal*—50% and may be the only site that is permanent. Episodic gross hematuria occurs in 30 to 40%.

Modified from Hetland LE, Susrud KS, Lindahl KH, Bygum A. Henoch-Schönlein purpura: a literature review. *Acta Derm Venereol*. 2017;97(10):1160–1166.

IDIOPATHIC THROMBOCYTOPENIC PURPURA (ITP)

OVERVIEW

ITP is an autoimmune disorder with antibodies vs. platelets. ITP is the most common platelet disorder in children, often between ages of 1 year and 4 years; 70% have prior viral infection (e.g., rubella, rubeola). Bone marrow has normal WBCs and RBCs. Eosinophilia and megakaryocytes (immature/basophilic stippling) may be present.

Treatment may be indicated if bleeding or platelets < 10,000–20,000/mm^3. Debate exists as to treatment indications.

CLINICAL FEATURES

- *Skin*—Bruising and petechiae are most common.
- *Mucous membranes*—Epistaxis, gum and GYN bleeding, and hematuria are less common than skin manifestations.
- *Hematologic*—Platelets usually < 20,000/mm^3, ± anemia.
- *GI*—Liver, spleen, and lymph nodes are not enlarged.
- *CNS*—Most common threat to life.
- *Systemic*—±HIV, lupus, lymphoma.

ITP Treatment: (1) *Steroids*—(1a) If active bleed and platelets <20,000, methylprednisolone 30 mg/kg (max dose, 1 g) IV over 30 minutes every 24 hours × 2–3 doses, OR 6 mg/kg IV over 30 minutes every 8 hours × 2–4 days; (1b) Prednisone 2 mg/kg/day × 2 weeks then tapered over third week. (2) *IV immune globulin*—1 g/kg/day over 4 hours × 1–2 days. (3) *IV anti-D immune globulin*—50 to 75 mcg/kg (Ig vs. D antigen of RBCs) over 5 minutes × 1 dose—leads to Hb drop of 0.5–2 g/dl. Only effective if Rh positive. (4) *Plasmapheresis.* (5) *Platelet transfusion*—10 to 30 ml/kg and platelet count should be assessed 10–20 minutes following infusion. Patients with ITP require larger-than-normal doses of platelets in transfusion due to rapid destruction. (6) *Splenectomy, rituximab, thrombopoietin receptor agonists* (TPO-RAs), or immunosuppressive therapy is appropriate for patients who continue to have clinically significant bleeding, patients with platelet counts <10,000 to 20,000/microL after first-line therapy has failed.

Modified from George JN, Woolf SH, Raskob GE, et al. Idiopathic thrombocytopenic purpura: a practice guideline developed by explicit methods for the American Society of Hematology. *Blood*. 1996;88(1):3-40.

Underlying disorders leading to thromboemboli include protein S, protein C, antithrombin, antiphospholipid antibodies (e.g., lupus anticoagulant, anticardiolipin, anti-β2-glycoprotein), factor V Leiden (especially if on estrogens), prothrombin G20210A, elevated factor VIII, hyperhomocysteinemia, high lipoprotein(a), dysfibrinogenemia, and hypo/dysplasminogenemia. There is ↑ risk of clotting if genetic thrombophilia is four times higher than general population. Healthy children with thrombophilias rarely develop thrombi unless additional genetic disorders or exogenous risk factors are present (see the table that follows). *Presenting clinical features* are not defined, and adult scoring systems have not been reproduced in children. Deep venous thrombi may not cause symptoms. In admitted children who die from pulmonary embolism (PE), up to 50% have no symptoms attributable to the PE, and the diagnosis is only suspected in 15%.

Table 15-9 Risk Factors for Pulmonary Emboli and Deep Venous Thrombi in Children

Central venous catheter	33%	Birth control pill, abortion/miscarriage	5%
Cancer	23%	Obesity	3%
Congenital heart disease	15%	Lupus	2%
Trauma	15%	Sickle cell anemia	2%
TPN administration	8%	Liver failure	2%
Infection	7%	Other	4%
Nephrotic syndrome	6%	No risk factor identified	4%
Recent surgery	6%		

Modified from Monagle P, Chan AKC, Goldenberg NA, et al. Antithrombotic therapy in neonates and children: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest*. 2012;141(2 Suppl):e737S-e801S.

Description

FEVER AND NEUTROPENIA (INFECTIOUS DISEASE SOCIETY GUIDELINES)

Fever—Single oral temp ≥ 38.3°C (101°F) or ≥ 38°C (100.4°F) over at least 1 hour.
Neutropenia—Neutrophils < 500/mm^3 or < 1,000/mm^3 with predicted ≤ 500/mm^3.
Evaluation—Blood culture (peripheral and catheter), culture lesions, urine and stool, CXR, CBC with differential, liver function tests, electrolytes.

Table 15-10 Antimicrobials for Neutropenia

Alternate dosing may be needed if < 3–6 months old.
(1) Cefepime 50 mg/kg (max 6 g/day) IV every 8 hours, OR (2) ceftazidime150 mg/kg/day (max 6 g/day) IV divided every 8 hours, OR (3) imipenem 60–100 mg/kg/day divided every 6 hours (max 4 g/day), OR (4) aminoglycoside PLUS antipseudomonal β-lactam ADD vancomycin 10 mg/kg (max 500 mg) IV every 6 hours if any of the following: low BP, central catheter, chemotherapy + any mucosal damage (e.g., oral ulcerations), prophylaxis with quinolones before fever, known colonization with penicillin-resistant pneumococci, known gram-positive blood culture before susceptibility testing.

Description

Modified from Lehrnbecher T, Robinson P, Fisher B, et al. Guideline for the management of fever and neutropenia in children with cancer and hematopoietic stem-cell transplantation recipients: 2017 update. *J Clin Oncol*. 2017;35(18):2082-2094.

Table 15-11 Hyperviscosity (Hyperleukocytosis) Syndrome

Etiology	**Diagnosis**
• ↑ Serum proteins with sludging and ↓ circulation. Common causes: leukemia (especially ALL).	• WBC (esp. blasts) > 100,000 cells/mm^3 • ↑ Serum viscosity—Ostwald viscometer • Serum protein electrophoresis
Clinical features	**Management**
• Fatigue, headache, somnolence • Dyspnea, interstitial infiltrates, hypoxia, RV failure, renal failure • ↓ Vision, seizure, deafness, myocardial infarction • Retinal bleed and exudates	• IV Normal Saline (NS), plasmapheresis • Platelets if count < 20,000/mm^3 • Phlebotomy with NS, and exchange transfusion (keep Hb ≤ 10 g/dl) • Antileukemic therapy

Description

Table 15-12 Passive Hepatomegaly

Clinical features	Management
• Associated with tumor infiltrate (esp. neuroblastoma and <4 weeks old) • May cause mechanical compromise of lungs, heart, GI/renal systems, or disseminated intravascular coagulation	• Treat persistent emesis, hypoxia, leg edema, renal insufficiency, or DIC • Chemotherapy • Low-dose radiation 150 cGy/day × 3 • Surgical enlargement of abdominal wall

Description

Table 15-13 Spinal Cord Compression[1]

Back pain Weakness Local back tenderness Paraplegia Loss of bowel or bladder control Sensory abnormality	80% 67% 67% 57% 57% 14%	*Diagnosis*—Stat MRI is diagnostic study of choice. Plain films are abnormal in only 35%, bone scan in 54%. Use CT and MRI instead. *Management*—(1) Dexamethasone 1 mg/kg IV, then 0.25 to 0.5 mg/kg PO every 6 hours, (2) surgical decompression (esp. previously unknown tumor type), (3) radiation or chemotherapy depending on cancer sensitivity.

Description

[1]≥ 90% due to sarcomas (rhabdomyosarcoma, Ewing's, osteogenic), neuroblastoma, and lymphoma.

Modified from Klein SL, Sanford RA, Muhlbauer MS. Pediatric spinal epidural metastases. *J Neurosurg*. 1991;74(1):70-75; Lewis DW, Packer RJ, Raney B, Rak IW, Belasco J, Lange B. Incidence, presentation, and outcome of spinal cord disease in children with systemic cancer. *Pediatrics*. 1986;78(3):438-443; Kelly KM, Lange B. Oncologic emergencies. *Pediatr Clin North Am*. 1997;44:809.

Table 15-14 Superior Vena Cava Syndrome[1]

Clinical features	Management
Headache, swollen face, altered mental status, syncope, dyspnea, plethora, and venous distention of the face, neck, and arms with trachea compression	• Radiation (can ↑ swelling, cause resp. deterioration, distort histology). • Diuretics/steroids are unproven but are often used. • Cyclophosphamide ± vincristine and anthracycline if non-Hodgkin's or Hodgkin's lymphoma suspected.
Diagnosis	

CXR first, then CT or MRI. Obtain an ECG and echo if possible cardiac involvement and pulmonary function testing if lung involvement.	• Consult for stent of SVC.

Description

[1]Anterior > middle mediastinal mass (most common lymphoma, Hodgkin's, ALL) or clot (e.g., central venous catheter) obstructing superior vena cava.

TUMOR LYSIS SYNDROME/TLS GUIDELINES

Cairo-Bishop definition (≥ 2 of following within 3 days prior or 7 days after cytotoxic chemotherapy, esp. leukemia/lymphoma): Uric acid ≥ 8 mg/dl, K^+ ≥ 6 mEq/l, P ≥ 2 mmol/l, Ca ≤ 1.75 mmol/l (or ↑ 25% of any of these from baseline). Clinical TLS is present if arrhythmia, seizures, or renal insufficiency develop. Low-risk patients include indolent non-Hodgkin's, ALL with WBC ≤ 50,000, AML/CLL with WBC ≤ 10,000, heme/solid cancers growing slowly. All others = high or intermediate risk.

Source: Howard SC, Trifilio S, Gregory TK, Baxter N, McBride A. Tumor lysis syndrome in the era of novel and targeted agents in patients with hematologic malignancies: a systematic review. *Ann Hematol*. 2016;95(4):563-573.

Table 15-15 Management of Symptomatic, Intermediate, or High-Risk Tumor Lysis Patients

• Hydration with NS to keep urine output 80–100 ml/m^2/hour • Diuretics may be needed • $NaHCO_3$ is NOT recommended • Rasburicase (Elitek): 0.1–0.2 mg/kg IV in 30 minutes (NOT if G6PD deficient) • Allopurinol if Elitek not used	• IV Calcium if symptomatic low Ca • Treat K^+ ≥ 7 mmol/l • Phosphate buffers if high P • Consider dialysis for K^+ ≥ 7 mmol/l, uremia, fluid overload, severe hyperphosphatemia

Description

Modified from Coiffer B, Altman A, Pui CH. Guidelines for the management of pediatric and adult tumor lysis syndrome: an evidence-based review. *J Clin Oncol*. 2008;26:2726-2778.

TRANSFUSION AND BLOOD PRODUCTS

Cross-matching and ordering blood products: Type-specific noncross-matched blood causes a fatality in 1 in 30 million transfusions. Non-ABO antibodies occur in 0.04% of nontransfused and 0.3% of previously transfused.

Whole blood has no WBCs and 20% of normal platelets after 24-hour storage. Factors V + VIII decline to 40% after 21 days; 70% of RBCs remain after 21–35 days storage. With storage, K^+ and ammonia increase (beware in liver failure) and Ca^{+2} decreases (beware in liver dysfunction as citrate is not effectively metabolized by the liver).

Packed red blood cells (PRBCs): Hematocrit rises 1% for each ml/kg of PRBCs transfused. Fewer antigens are present in PRBCs compared to whole blood. (1) *Leukocyte-poor RBCs* are derived from filtering RBCs and should be used if one (severe), or two (sequential) febrile nonhemolytic transfusion reactions. (2) *Washed RBCs* are useful if prior anaphylaxis due to antibodies to IgA or other proteins. (3*) Frozen deglycerolized RBCs* are the purest RBC product. Use if there is a reaction to washed RBCs or a transfusion reaction due to anti-IgA antibodies. (4) *Irradiated RBCs*—use if immunocompromised.

Fresh frozen plasma (FFP): ABO cross-match prior to transfusion. Indications: (1) coagulation protein deficiency when specific factor concentrates are undesirable or unavailable, (2) warfarin reversal, (3) diffuse bleeding + documented coagulopathy, or (4) active bleeding with liver disease and a secondary coagulopathy.

Factor VIII preparations: (1) cryoprecipitate is made from single donor and contains fibrinogen, VWF, and factors VIII and XIII. (2) Factor VIII concentrate is pooled from multiple donors. (3) Several recombinant factor VIII products are available.

Table 15-16 Blood Products

Component	Indication	Dose	Adverse effects	Special features
Albumin 5%[1]	Shock	10–20 ml/kg	Rare volume overload, fever, urticaria	Stable storage, no filter, no disease transmission
Plasmanate[1]	Shock	See above	Rare volume overload, fever, urticaria, hypotension	Stable storage, no filter, no disease transmission
Hetastarch 6% (Hespan)[1]	Volume expansion	10–20 ml/kg	Pruritus, coagulopathy	Stable leukopheresis, no disease transmission
Dextran[1]	Volume expansion	10 ml/kg	Allergy, bleed, renal failure	Same as hetastarch
Whole blood[2]	Hemorrhagic shock	10 ml/kg will ↑ Hb 1 g/dl	Transfusion reactions, hemolysis, disease transmission	Thrombocytopenia, coagulopathy, leukopenia
Packed RBCs[2]	↑ O_2 carrying capacity and shock	3 ml/kg will ↑ Hb 1 g/dl	Less allergic and febrile reactions than whole blood	Administer 10–15 ml/kg
Washed RBCs	↓ allergic reactions	3 ml/kg will ↑ Hb 1 g/dl	Rare	Takes 1 hour to wash and > 70% of RBCs lost
Leukocyte poor RBCs	99.9% of WBCs are removed	3 ml/kg will ↑ Hb 1 g/dl	Rare	Use if 2 febrile nonhemolytic reactions to washed RBCs
Apheresis platelets	Poorly functioning or decreased platelets	5–10 ml/kg	Transfusion reactions are rare	No cross-matching, ABO compatibility is preferred
FFP	Coagulopathy with bleeding	10–25 ml/kg	Transfusion reactions are rare	No cross-matching, ABO group compatibility preferred

[1]No cross-match needed. [2]For acute hemorrhage, initiate transfusion with 20 ml/kg of whole blood or 10 ml/kg of PRBCs. Request sickle prep negative. Blood if sickle cell disease. Avoid mixing blood + D_5W or Ringer's lactate due to hemolysis and clotting, respectively.

Description

Factor IX concentrate: Prothrombin complex contains factors II, VII, IX, and X. One unit raises a recipient's activity 1.5%. Factors IX and X are thrombogenic and can cause DIC; therefore, use cautiously in hepatic and vascular disease.

Platelet concentrate: One unit = 5 to 10 thousand platelets. Platelets are not refrigerated and only survive 7 days. Platelet counts > 50,000/ml are desirable prior to surgery. ABO cross-matching is not necessary. ITP dose 0.1–0.4 units/kg.

Albumin and plasma protein fraction (PPF): 25% salt-poor albumin contains excess sodium (160 mEq Na^+/l) and is hyperoncotic compared to plasma. 5% buffered albumin solution is iso-oncotic compared to plasma. PPF contains 88% albumin and 12% globulins and is iso-oncotic compared to plasma.

TESTING BLOOD PRIOR TO ADMINISTRATION

Complete cross-match—Three phases: (1) Immediate spin phase detects ABO incompatibility from IgM and takes 5–10 minutes. (2) Albumin phase takes 15–30 minutes. (3) Antihuman globulin phase takes 15–30 minutes. Albumin and antihuman globulin phases detect IgM, IgG, + other antibodies causing hemolytic transfusion reactions.

Unexpected antibody screen: Uncovers non-ABO antibodies (e.g., Kell, Duffy) in recipient's serum. 0.04% of recipients will have an unexpected positive antibody screen if no prior transfusion, and 1% will have a positive screen if prior transfusion. This test is important if prior transfusion or pregnancy.

Abbreviated cross-match: (1) Immediate spin alone or (2) stat cross-match—omit immediate spin and shorten antihuman globulin and albumin phase to 15 minutes.

TRANSFUSION REACTIONS

Hemolytic transfusion reactions occur in 1/40,000 transfusions and are usually due to ABO incompatibility. Symptoms: Palpitations, abdominal and back pain, syncope, and a sensation of doom. Consider if temperature rises ≥ 2°C. Immediately stop transfusion and look for hemoglobinemia and hemoglobinuria. Notify blood bank and perform direct antiglobulin (Coombs test), haptoglobin, peripheral smear, serum bilirubin, and repeat antibody screen and cross-match. Keep urine output ≥ 1–2 ml/kg/hour and consider alkalization of urine to limit renal failure. Mannitol is not useful. It increases urine flow by decreasing tubular reabsorption without improving renal perfusion.

Anaphylactic reaction almost exclusively occurs with anti-IgA antibodies (1/70 people). It usually begins after the first few ml of blood with afebrile flushing, wheezing, cramps, vomiting, diarrhea, and hypotension. Discontinue the transfusion and treat with diphenhydramine, epinephrine, and steroids.

Febrile nonhemolytic reactions occur during or soon after initiation of 3 to 4% of all transfusions, most frequently in multiply transfused or multiparous patients with antileukocyte antibodies. Stop transfusion and treat as transfusion reaction.

Urticarial reactions cause local erythema, hives, and itching. Further evaluation unnecessary unless fever, chills, or other adverse effects are present. This is the only type of transfusion reaction in which the infusion can continue.

Infections: AIDS, CMV, or hepatitis may be transmitted with blood products.

Modified from Vossoughi S, Perez G, Whitaker BI, Fung MK, Stotler B. Analysis of pediatric adverse reactions to transfusions. *Transfusion*. 2018;58(1):60-69.

16 ■ HYPERTENSION

Hypertension (HTN) = Mean systolic BP or diastolic BP ≥ 95th percentile or BP ≥ 130/80 (whichever is lower) for age, sex, and height on three occasions.
Appropriate blood pressure cuff size: R mid-arm, cuff bladder length 80–100%/width ≥ 40% of the arm circumference.

Elevated BP: BP ≥ 90th percentile to <95th percentile, or 120/80 mm Hg to <95th percentile (whichever is lower). Recommend lifestyle interventions (healthy diet, sleep, and physical activity). Repeat BP in 6 months.

Hypertensive urgency: Defined as significantly elevated BP without evidence of end organ damage. Often develops over days to weeks.

Hypertensive emergency: defined as elevated BP associated with end organ damage. Often develops over hours.

Hypertensive encephalopathy: most common presentation of acute hypertension, with headache, confusion, vomiting, visual disturbances, focal neurologic findings.

Stage I HTN: BP ≥ 95th percentile to ≥95th percentile +12mm Hg, or 130/80 to 139/89 (whichever is lower). If asymptomatic, lifestyle counseling and refer for repeat BP in 1 to 2 weeks. If you suspect underlying disease or symptomatic, obtain urine analysis, basic metabolic panel, and a complete blood count. CXR and ECG to screen for cardiac hypertrophy/heart failure; however, echocardiogram has been shown to be far more specific. Consider CT head if concerned for intracranial process resulting in HTN. If patient is stable and asymptomatic, can consider oral medications.

Stage II HTN: BP levels ≥95th percentile +12 mm Hg, or ≥140/90 mm Hg (whichever is lower) for age, sex, and height. This requires evaluation (same as Stage I evaluation) including an echocardiogram to evaluate for LVH and cardiac target organ damage and initiation of antihypertensives. Presence of LVH is an indication to initiate therapy.

Table 16-1 Stage I and Stage II Hypertension Cutoffs

Stage I (95th percentile) and Stage II (95th percentile + 12mm Hg) BP for Child with Average (50th percentile) Height					
		Males		Females	
Age (years)	BP percentiles	SBP	DBP	SBP	DBP
2	95th	106	59	106	64
	95th + 12mm Hg	118	71	118	76
5	95th	109	69	110	71
	95th + 12mm Hg	121	81	122	83

8	95th	114	74	113	74
	95th + 12 mm Hg	126	86	125	86
11	95th	118	78	118	77
	95th + 12 mm Hg	130	90	130	89
14	95th	130	81	125	80
	95th + 12 mm Hg	142	93	137	92
17	95th	135	85	127	81
	95th + 12 mm Hg	147	97	139	93

Modified from Amirav I, Vandall-Walker V, Rasiah J, Saunders L. Patient and researcher engagement in health research: a parent's perspective. *Pediatrics*. 2017;140(3).

Description

ETIOLOGY OF PEDIATRIC HYPERTENSION

- *Primary HTN:* Predominant type of HTN in children in the United States. Often in children older than 6 years old with risk factors (positive family history in immediate family member, overweight/obese).
- *Renal disease:* Most common secondary cause of HTN in children. HTN and encephalopathy (or seizures) may be first presentation of acute post-streptococcal glomerulonephritis. Na retention/fluid overload occur due to ↓ glomerular filtration rate, causing ↑ BP, hematuria, periorbital edema, and RBC casts.
- *CNS disease:* Cushing's triad of bradycardia, bradypnea, and HTN is found with ↑ intracranial pressure (ICP) due to tumors, bleeding, trauma, or infection.
- *Neuroblastomas:* Cause HTN due to catecholamine release, similar to neurofibromatosis and pheochromocytoma. HTN may be episodic with flushing, palpitations, anxiety, sweating, and chest pain.
- *Drug toxicity:* HTN can be due to steroids, oral contraceptives, phenylephrine, pseudoephedrine, albuterol, cyclosporine A, and drugs of abuse. Chronic lead toxicity can cause HTN, as can licorice through its mineralocorticoid effects. NSAIDs may interfere with efficacy of antihypertensives (ACE inhibitors specifically); however, they do not appear to impact BP in those without HTN.
- *Aortic coarctation (CoA):* This is the most common cause of HTN in the first year of life. Associated with R arm BP ≥ 20 mm Hg than lower extremity BP. CoA also causes up to 2% of secondary HTN in children and adolescents.
- *Other:* Burn victims often exhibit HTN due to sympathetic discharge. Forty-three percent of babies with bronchopulmonary dysplasia exhibit HTN.

HYPERTENSIVE ENCEPHALOPATHY

BP autoregulation is lost and vasodilation occurs causing cerebral edema. Vasodilators in children with HTN and ↑ ICP may be detrimental.

TREATMENT OF HYPERTENSIVE ENCEPHALOPATHY

Great caution should be taken when treating hypertensive emergencies. BP should be reduced no more than 25% in the first 8 hours to avoid cerebral hypoperfusion, with a BP goal ~95th percentile.

- *Sodium nitroprusside* is a commonly used drug in hypertensive emergencies, except with a space occupying cranial lesion due to its vasodilatory effect. It has a rapid onset and a short half-life; it is light sensitive. Metabolism produces cyanide, which is converted in the liver and excreted by the kidneys; therefore, caution should be used in patients with renal/hepatic failure. Cerebral vasodilation may increase ICP.
- *Esmolol* is a cardioselective β_1 blocker, has rapid onset, and is ultra-short acting. It is not affected by renal/hepatic function; therefore, it is an excellent choice for multiorgan failure. Side effect of bronchospasm, bradycardia, congestive heart failure (CHF).
- *Hydralazine* is a vasodilator with a long duration of action, making titration difficult.

However, it can be administered IV/PO/IM, making it versatile if no IV is established.

- *Nicardipine* is extremely effective for a controlled reduction of BP in children. It ↓ peripheral vascular resistance, has little effect on heart rate, and can ↑ ICP. If given via peripheral IV, it can cause thrombophlebitis.
- *Labetalol* is an α and β blocker, safe in renal disease, does not ↑ ICP, and has little to no effect on cardiac output. It can cause bronchospasm and worsens congestive heart failure. Difficult to titrate due to long half-life.

Table 16-2 Drugs in Hypertensive Emergencies

Drug	Dose (max), route, preparation	Mechanism	Onset (lasts)	Features
Most common				
Esmolol	100–500 mcg/kg/minute, IV	β_1-blocker	<1 minute	Can cause/worsen bronchospasm and severe bradycardia
Hydralazine	0.2–0.6 mg/kg/dose (0.4 mg/kg/dose), IV/IM	Direct vasodilator	5–30 minutes (4–12 hours)	Causes tachycardia. Administer every 4 hours when given IV bolus
Labetalol	0.2–1.0 mg/kg/dose (40 mg/dose), IV/IM bolus Infusion: 0.25–3 mg/kg/hour	α/β blocker	2–5 minutes (3–5 hours half-life)	Contraindicated in asthma and heart failure

Nicardipine	1–3 mcg/kg/minute, as infusion	Calcium channel blocker	15 minutes (10–15 minutes)	Reflex tachycardia. Increases cyclosporine and tacrolimus level
Sodium nitroprusside	0.53–10 mcg/kg/minute, IV infusion	Direct vasodilator	<1 minute	Can cause cyanide poisoning
Less common				
Clonidine	0.05–1 mg/dose, may be repeated up to 0.8 mg total dose	Alpha agonist		Dry mouth and drowsiness
Fenoldopam	0.2–0.8 mcg/kg/minute, IV infusion	Dopamine receptor agonist		High doses worsen tachycardia
Hydralazine	0.2–0.6 mg/kg/dose (25 mg/dose), IV or IM	Direct vasodilator		
Isradipine	0.05–0.1 mg/kg/dose (5 mg/dose), PO, every 6–8 hours	Calcium channel blocker		Exaggerated decrease in BP if co-ingested with azole antifungals
Minoxidil	0.1–0.2 mg/kg/dose (10 mg/dose), PO, every 8–12 hours	Direct vasodilator		Long acting

https://www.ncbi.nlm.nih.gov/pubmed/15942520
https://www.ncbi.nlm.nih.gov/pubmed/27147865

Description

17 ■ IMMUNIZATIONS

Table 17-1 Immunization Schedule

	Month									Year		
Age	**Birth**	**1**	**2**	**4**	**6**	**12**	**15**	**18**	**24**	**4–6**	**11–12**	**16–18**
Hepatitis B	HB	HB			HB							
Rotavirus			RV	RV	RV							
DTP			DTP	DTP	DTP		DTP			DTP	**Tdap**	
H influenza B			Hib	Hib	Hib	Hib						
Pneumococci 13[1]			PCV	PCV	PCV	PCV			PPSV23[2]			
Polio			IPV	IPV	IPV					IPV		
MMR						*MMR*				*MMR*		
Varicella						*VAR*				*VAR*		
Meningococcal[3]			*MCV if high risk (asplenia, complement deficient)*								MCV	MCV
Papillomavirus											HPV[4]	
Influenza (IIV) [5]					Influenza							
Hepatitis A[6]						*HA*		*HA*				

[1]Do not give PCV13 and PPSV23 during the same visit. [2]Add PPSV23 if underlying disease (immunocompromised, sickle cell, functional asplenia or cerebrospinal fluid leak, cochlear implant). Give first dose at age 2 years and booster at 5 years. [3]Routine vaccination with first dose 11 years and second dose 16 years. Meningococcal serogroup B: Start first dose at 16 years. Menveo recommended for asplenia, sickle cell, immunocompromised, and HIV with first dose at 2 months of age, then 4 months, 6 months, and 12 months. Menactra for complement deficient with first dose at 9 months and second dose 12 weeks later. [4]HPV: First dose at 9 years and second dose 6 months later. If first dose after 15 years, then second dose 1 month later, and third dose 6 months later. [5]Inactivated influenza vaccine (IIV): give first dose 6 months and if never vaccinated for influenza and less than 9 years, give second dose at 4 weeks apart from the first dose. [6]Hepatitis A vaccine: First dose given at 12 months and second dose at 18 months.

Description

See website (www.cdc.gov) for details, especially specialized instructions for anyone with underlying medical disorders.

Table 17-2 Hepatitis B Exposure

Type of exposure	Status of source	Treatment if exposed patient is:	
		Unvaccinated	Vaccinated
Percutaneous/ Mucosal	HBsAg+	HBIG[1], HBV[2]	HBV and HBIG if exposed HBsAb–
Known source	High risk for HBsAg+	HBV and HBIG if source HBsAg+	HBV and HBIG if source HBsAg+ and exposed HBsAb–
Perinatal[3]	Mother is HBsAg+	HBV and HBIG within 12 hours of birth	HBV
Mucosal/Sex/ Perinatal	Unknown	HBV	HBV
Sex	HBsAg+	HBIG, HBV	HBV

[1]HBIG—hepatitis B immune globulin. [2]HBV, repeat in 1 month and 6 months. [3]If mother is HBsAg+, give HBV and HBIG within 12 hours of birth. Check anti-HBs and HBsAg at 9 to 12 months after completion of the HBV vaccination.

Description

Hepatitis A Exposure: If ≤2 weeks since exposure, then give immune globulin (IG) and hepatitis A vaccine if ≤12 months, or hepatitis A vaccine if 12 months to 40 years, and if ≥40 years, give IG or hepatitis A vaccine if IG is not available.
Hepatitis C Exposure: No treatment.
See website (www.cdc.gov) for details.

Table 17-3 Tetanus Immunization

Prior immunization	All other wounds	Clean, minor wounds
Uncertain or <3 doses	Tdap[1], TIG[2]	Tdap, DTap, or Td
3 doses or more	Tdap if >5 years since last dose	Tdap if >10 years since last dose

Description

[1]Tdap if ≥7 years old for those who have not received Tdap or then can use Td, and DTaP if <7 years. [2]TIG—tetanus immune globulin.

See website (www.cdc.gov) for details.

POSTEXPOSURE RABIES PROPHYLAXIS

If questions arise regarding prophylaxis and local and state health departments are unavailable, call the CDC at 404-639-1050 (days), 404-639-2888 (nights and weekends).

- Human diploid cell vaccine (HDCV): 1 ml IM, on days 0, 3, 7, and 14.
- RIG (rabies immune globulin)—20 units/kg: *Full dose* SC around wound (if possible) and remainder IM distal to RIG site. Do not give near site of first HDCV.

See website (www.cdc.gov) for details.

Table 17-4 Postexposure Rabies Prophylaxis

Animal		Treatment
Dogs, cats, ferrets	Healthy and can observe for 10 days	Prophylaxis if animal shows signs of rabies
	Rabid or suspected	RIG and HDCV
	Unknown	If high risk then RIG and HDCV
Bats, skunks, raccoons, coyotes, foxes, mongooses	All regarded as rabid unless geographic area known to be free of rabies	RIG and HDCV
Rodents, rabbits, hares, livestock		Consult public health but rarely require rabies prophylaxis

Description

- Postexposure prophylaxis for someone potentially exposed to HIV to prevent from being infected. Must start within 72 hours.
- PEP hotline number: 888-448-4911.
- See website (www.cdc.gov) for details.

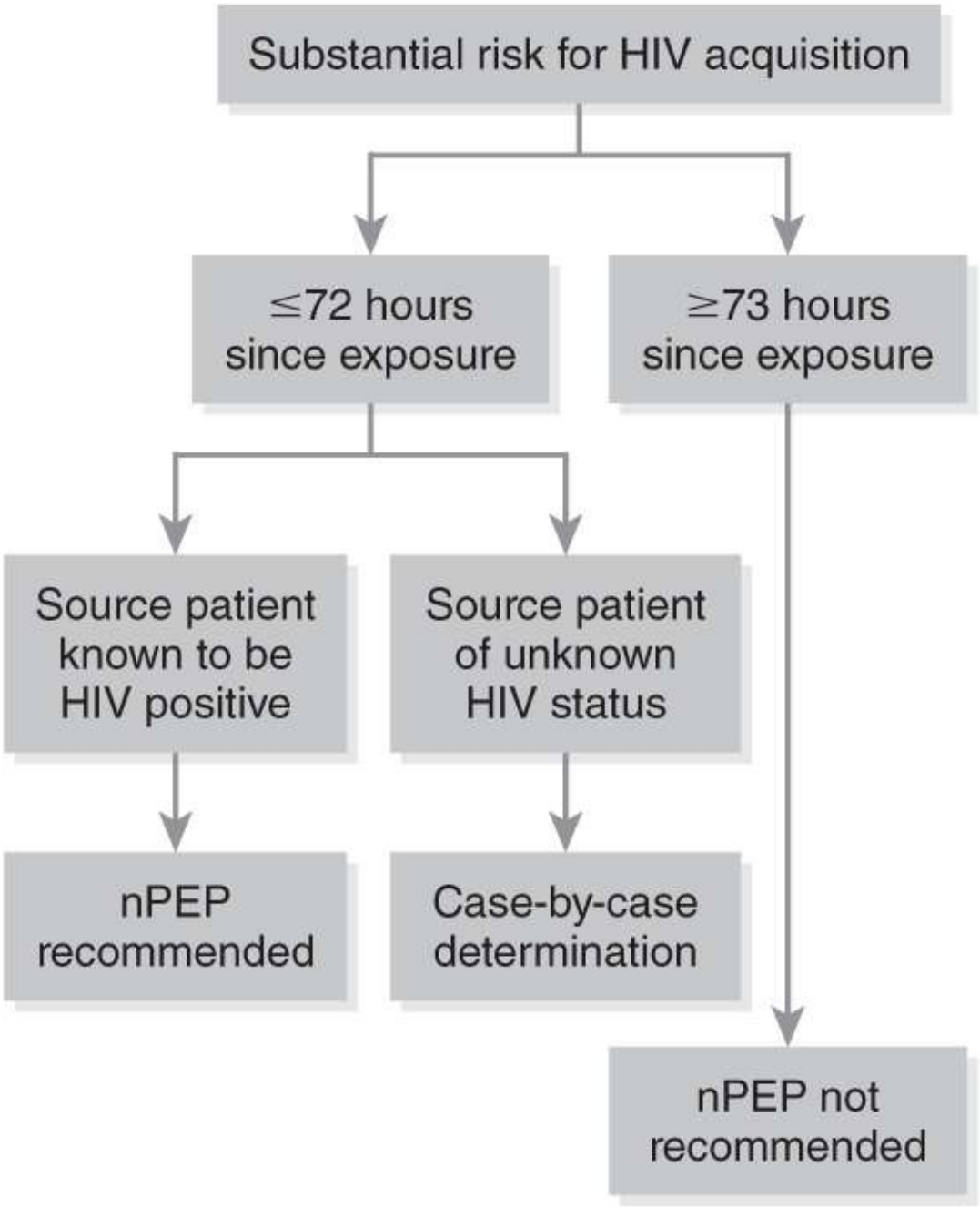


Figure 17-1 Algorithm for Evaluation of HIV Nonoccupational Postexposure Prophylaxis (nPEP)

Description

Substantial risk for HIV acquisition

- Exposure of: vagina, rectum, eye, mouth, or other mucous membrane, nonintact skin or percutaneous contact.

- With: blood, serum, vaginal secretions, rectal secretions, breast milk, or any body fluid that is visibly contaminated with blood.
- When: the source is known to be HIV positive.

Test	Source person	Exposed persons			
	Baseline	Baseline	4–6 weeks after exposure	3 months after exposure	6 months after exposure
For all those considered for or prescribed nPEP for any exposure					
HIV Ag/Ab testing	Yes	Yes	Yes	Yes	Yes
Hepatitis B serology	Yes	Yes	—	—	Yes
Hepatitis C antibody testing	Yes	Yes	—	—	Yes
Syphilis	Yes	Yes	Yes	—	Yes
Gonorrhea	Yes	Yes	—	—	—
Chlamydia	Yes	Yes	—	—	—
Pregnancy	—	Yes	Yes	—	—
For those started on nPEP					
Serum creatinine	Yes	Yes	Yes	—	—
AST and ALT	Yes	Yes	Yes	—	—
For all persons with HIV infection confirmed at any visit					
HIV viral load	Yes	Yes			
HIV genotypic resistance	Yes	Yes			

Description

- nPEP is not contraindicated for pregnant women.

Table 17-5 Regimens and Drug Choices for Adult and Pediatric HIV PEP

- Unusual or severe toxicities from antiretroviral drugs should be reported to the

manufacturer or the FDA or 1-800-332-1088.
- Treatment is for 28 days of a three-course antiretroviral regimen.
- See website (www.cdc.gov) for details.

Adults and adolescents ≥ 13 years with normal renal function	Tenofovir DF 300 mg and emtricitabine 200 mg daily with Raltegravir 400 mg twice daily or dolutegravir 50 mg daily Or Tenofovir DF 300 mg and emtricitabine 200 mg daily with darunavir 800 mg daily and ritonavir 100 mg daily
Children 2–12 years	Tenofovir DF, emtricitabine, and raltegravir with drug dosed to age and weight Or Tenofovir DF, emtricitabine, and lopinavir/ritonavir with drug dosed to age and weight Or Zidovudine and lamivudine with raltegravir or lopinavir/ritonavir
Children 3–12 years	Tenofovir DF, emtricitabine, and darunavir/ritonavir with drug dosed to age and weight
Children 4 weeks to <2 years	Zidovudine oral solution, lamivudine oral solution with raltegravir or lopinavir/ritonavir oral solution with drug dosed to age and weight Or Zidovudine and lamivudine with raltegravir or lopinavir/ritonavir
Children birth to 27 days	Consult a pediatric HIV specialist

Description

Modified from Panlilio AL, Cardo DM, Grohskopf LA, Heneine W, Ross CS. Updated U.S. Public Health Service guidelines for the management of occupational exposures to HIV and recommendations for postexposure prophylaxis. *MMWR*. 2005:54(RR09):1-17.

Table 17-6 Drugs and Dosing for PEP

Drug	Dosing
Tenofovir DF	8 mg/kg max 300 mg every day (2–11 years)
Emtricitabine	6 mg/kg max 200 mg every day (3 months–17 years) 3 mg/kg every day (0–3 months)

Raltegravir	400 mg bid (6–12 years and >25 kg) Chewable tablets: 75 mg bid (2–12 years and 11 to <14 kg) 100 mg bid (2–12 years and 14 to <20 kg) 150 mg bid (2–12 years and 20 to <28 kg) 200 mg bid (2–12 years and 28 to <40 kg) 300 mg bid (2–12 years and ≥40 kg)
Dolutegravir	50 mg every day (≥12 years and ≥40 kg)
Darunavir/Ritonavir	20 mg/kg darunavir and 3 mg/kg ritonavir (3 to 18 years and 10–15 kg) 375 mg darunavir and 48 mg ritonavir (3–12 years and 15 to <30 kg) 450 mg darunavir and 100 mg ritonavir (3–12 years and ≥40 kg) All dosed twice daily with food
Lopinavir/Ritonavir	Suspension: 16/4 mg/kg bid (14 days–12 months) 12/3 mg/kg bid (>12 months–18 years for <15 kg) 10/2.5 mg/kg bid (>12 months–18 years for 15 kg to 40 kg) 400/100 mg bid (>12 months–18 years for ≥40 kg) Tablets: Two 100/25 mg bid (>12 months–18 years for 15–25 kg) Three 100/25 mg bid (>12 months–18 years for 25–35 kg) Four 100/25 mg bid (>12 months–18 years for >35 kg)
Zidovudine	If ≥ 35 weeks gestational age: 4 mg/kg bid (birth to 41 days) 12 mg/kg bid (at least 4 weeks of age for 4 to <9 kg) 9 mg/kg bid (at least 4 weeks of age for 9 to <30 kg) 300 mg bid (at least 4 weeks of age and ≥30 kg)
Lamivudine	2 mg/kg bid (< 27 days) 4 mg/kg max 150 mg bid (≥4weeks) 75 mg bid (children < 16 years and 14 to <20 kg) 75 mg AM and 150 mg PM (children < 16 years and 20 to <25 kg) 150 mg bid (4 weeks to 18 years and ≥25 kg)

Description

18 ■ INFECTIOUS DISEASE

EMPIRIC ANTIMICROBIAL THERAPY

Table 18-1 Empiric Antimicrobial Therapy

Abscess	• Drainage required, see specific site in text for antibiotics (e.g., brain, parapharyngeal). See methicillin-resistant *Staphylococcus aureus* (MRSA) if skin (page 154)

Acne
Retin-A, Epiduo gel, and Tazorac are not approved <12 years old or if pregnant
No tetracycline derivatives if ≤8 years old.
	• *Mild*—Topical benzoyl peroxide (BP) or topical retinoid.
	• *Moderate*—Topical combination therapy (retinoid + BP OR retinoid + BP + antibiotics (abx))
	• *Severe*—Oral abx + topical retinoid + BP +/− topical abx
	• *Example product formulations/combinations*
	  ◦ Topical retinoid: tretinoin, adapalene, tazarotene
	  ◦ Topical BP + retinoid: EpiDuo Gel
	  ◦ Topical BP + Abx: Acanya, BenzaClin, Benzamycin, and Duac gel
	  ◦ Topical retinoid + Abx: Veltin or Ziana Gel
	  ◦ Oral abx: Doxycycline 50–150 mg every day, erythromycin 250–500 mg every day, tetracycline 500 mg bid, minocycline IR 50–100 mg every day

Adenitis	• *See cellulitis—face options; consider cat scratch, mycobacteria*
Aeromonas	• Diarrhea—ciprofloxacin or levofloxacin × 3–5 days. *Refer to Lexicomp for dosing*
Amebiasis	*See Entamoeba histolytica*
Ancylostoma	*Ancylostoma braziliense—See cutaneous larval migrans* *Ancylostoma duodenale—See hookworm*
Anthrax exposure	*See pages 30–32 for exposure prophylaxis and disease treatment*
Appendicitis Regimens are for suspected perforation (e.g., pain >36–48 hours, temp >101°F, diffusely tender)	• *First line:* Piperacillin-tazobactam OR ertapenem OR moxifloxacin • *Alternative agents:* Ciprofloxacin or levofloxacin + metronidazole OR cefepime + metronidazole *Refer to Lexicomp for dosing*
Arthritis, septic	*See septic arthritis*

Ascaris lumbricoides (roundworm)	• First line: Mebendazole (Vermox) 100 mg PO bid × 3 days OR albendazole 200 mg PO × 1 dose if ≤ 13 kg, or 400 mg PO × 1 dose if > 13 kg • Second line: (≥ 15 kg) ivermectin 150–200 mcg/kg/dose × 1 dose
Avian "flu"	*See influenzae*
Balanitis	• *Mild*—Topical antibiotic (mupirocin 2% ointment bid) and/or antifungal (clotrimazole 1% cream or miconazole 2% cream four times per day). Addition of 1% hydrocortisone may be beneficial. • *Moderate to severe*—Clindamycin OR Augmentin + Bactrim (see Table 18.2 for dose)
Bell's palsy (Consider otic or mastoid disease)	• *Herpes* is the cause in a large number of cases: prednisone 1–2 mg/kg/day (max 60 mg) × 7–10 days AND (acyclovir 10 mg/kg/dose PO 4 × per day OR if ≥ 50 kg, valacyclovir (Valtrex) 1 g PO three times per day × 7–10 days) • Debate exists as to efficacy of antivirals[1]
Bites, animals Oral dosing, see Table 18-2 *Need to consider tetanus and rabies prophylaxis*	• *Dog or Cat—PO:* Augmentin 22.5 mg/kg PO bid OR clindamycin + levofloxacin. *IV*: ampicillin/sulbactam OR clindamycin + levofloxacin • *Rat*—Prophy: penicillin VK or doxycycline (>8 years old); if clinical evidence of infection: IV penicillin, cefuroxime, cefotaxime, or doxycycline • *Reptiles*—First line: Augmentin. Alternatives: cefpodoxime + metronidazole OR levofloxacin + clindamycin
Bite, human Consider MRSA coverage (page 154) If question of joint involvement, consult orthopedic or hand surgeon	• *PO:* Augmentin 22.5 mg/kg PO bid OR clindamycin + (either ciprofloxacin OR TMP-SMX) • *IV*—Ampicillin/Sulbactam, cefoxitin, or piperacillin-tazobactam. PCN allergic: clindamycin + (either ciprofloxacin OR TMP-SMX)
Bordetella pertussis	• Azithromycin (1–5 months: 10 mg/kg/day × 5 days. ≥ 6 months: 10 mg/kg/day PO on day 1, then 5 mg/kg/day) OR clarithromycin OR TMP-SMX. See dose Table 18-2. Only decreases disease if given in catarrhal stage. Antibiotics can decrease recurrence and transmission.
Botulism	*See Clostridium botulinum*

Bowel perforation	*See appendicitis regimens*
Brain abscess	• Ceftriaxone AND vancomycin AND metronidazole (meningitis doses). Substitute aztreonam for ceftriaxone if penicillin allergy.
Bronchitis	• Antibiotics are not indicated unless cystic fibrosis, bronchopulmonary dysplasia, chronic aspiration, lung hyperplasia, or ciliary dyskinesia. If cough persists > 4 weeks, consider reactive airway disease, foreign body aspiration, cystic fibrosis, sinusitis, pertussis, or tuberculosis.
Bubonic plague	*See plague on page 33 for exposure/disease/treatment and antimicrobials, see Table 18-2*.
Campylobacter jejuni	• *Diarrhea*—Azithromycin 10 mg/kg/day PO × 3 days (max 500 mg/day) OR erythromycin 40 mg/kg/day PO divided four times per day × 5 days (max 2 g/day)
Candida	• *Thrush: (neonate)*—Nystatin 1 ml/cheek four times per day apply with cotton swab. *(Child)* 400,000–600,000 units swish and swallow four times per day until clear for 48 hours. Suspension: 100,000 units/ml • *Pharyngeals candidiasis—Fluconazole* 6 mg/kg PO × 1 (max 400 mg/day), then 3 mg/kg/day (max 200 mg/day) × 7–14 days (21 days for *esophageal*) (if <14 days old, dose every 72 hours, otherwise every 24 hours)
Cat scratch disease	• Azithromycin OR TMP-SMX (see dose Table 18-2) • Mild disease resolves without treatment
Cellulitis bite	*See bite recommendations*
Cellulitis—face, periorbital, or orbital	• *Mild, immunized, healthy, no MRSA*—Augmentin or clindamycin • *Ill, unimmunized, sinusitis, or MRSA*—Vancomycin + (either ampicillin/sulbactam OR ceftriaxone OR aztreonam). ADD metronidazole to ceftriaxone or aztreonam containing regimen if dental infection is source.
Cellulitis trunk or extremity *See MRSA page 154*	• *Mild–moderate (and methicillin resistance not suspected)*—Cephalexin OR dicloxacillin OR macrolide (dose Table 18-2) • *Mild–moderate (methicillin resistance possible)*—Linezolid (Zyvox) OR Septra OR clindamycin, see dose Table 18-2

	• *Moderate–severe*—Oxacillin OR nafcillin 25–50 mg/kg IV every 6 hours (max 12 g/day) OR ertapenem (Invanz) if > 3 months, 15 mg/kg IV/IM every 12 hours (max 1 g/day) OR cefazolin 25–33 mg/kg IV every 6–8 hours (max 6 g/day) AND *treat* MRSA
Cervical adenitis	*See cellulitis—face options; consider cat scratch, mycobacteria*
Chlamydia trachomatis, urethritis, cervicitis *See PID if needed* also treat empirically for gonorrhea	• Adolescents: Azithromycin 1 g PO × 1 dose OR doxycycline 100 mg PO bid× 7 days • Pregnancy: Azithromycin 1 g PO × 1 dose • Infants/children < 45 kg (anogenital tract): Erythromycin base/ethylsuccinate: 12.5 mg/kg/dose four times per day × 14 days. • Dosing is for urethritis, cervicitis, or asymptomatic stage only. *See conjunctivitis for neonatal recommendations*
Cholecystitis	*See Appendicitis choices on Table 18-2*
Cholera	*See Vibrio cholera*
Clostridium botulinum First provide respiratory support.	• *Infant botulism*—age < 1 year: Human botulinum immunoglobulin (BabyBIG). Age > 1 year: Heptavalent equine serum botulinum antitoxin. Contact 770–488-7100 or CDC (1–800-CDC-INFO) via each state's health department for agent. AVOID antibiotics—may lyse *C. botulinum* in gut and increase toxin load. • *Foodborne botulism*—Heptavalent equine serum botulinum antitoxin. See previous contacts
C. difficile	*Clostridium difficile—See Pseudomembranous colitis*
Conjunctivitis *Macrolides (esp. erythromycin) may cause pyloric stenosis <6 weeks*	• *Neonate*—If gonorrhea, ceftriaxone 25–50 mg/kg IM × 1 dose (max 125 mg) OR cefotaxime 100 mg/kg/day IV divided every 12 hours × 1 day. If severe infection, therapy may need to be continued for > 1 day. ADD azithromycin 20 mg/kg PO × 3 days or erythromycin 7.2–15 mg/kg PO four times per day × 14 days. • *>2 weeks*—Erythromycin (Ilotycin) 0.5% ointment apply every 4 hours until clear × 2 days OR gentamicin (Garamycin) 0.3% ointment/solution—apply every 3–4 hours × 7–10 days OR Polytrim (if > 2 months) 1 drop every 3–6 hours × 7–10 days OR tobramycin (Tobrex) 0.3% solution/ointment—apply every 3–4 hours × 7–10 days

	• ≥*1 year*—Azithromycin (AzaSite) 1 drop twice a day × 2 days, then 1 drop every day × 5 days OR besifloxacin 0.6% (Besivance) 1 drop three times per day × 7 days OR ciprofloxacin (Ciloxan) 0.3% solution 1–2 drops every 2 hours × 2 days, then every 4 hours × 5 days OR moxifloxacin (Vigamox) 0.5% solution 1 drop three times per day × 7 days OR above > 2 weeks old regimen
Corneal ulcer	*See keratitis (bacterial) recommendations* • Do not patch eye if *Pseudomonas* is a concern (e.g., contact lenses); also, consult ophthalmology and ensure *Pseudomonas* coverage if contact lens wearer
Cryptosporidium parvum	• *If immunocompetent*—Nitazoxanide (Alinia): 100 mg/5 ml or 500 mg tab available. Use 5 ml if 1–3 years old, 10 ml if 4–11 years, 500 mg (or 25 ml) if ≥ 12 years old administered every 12 hours with food × 3 days. Efficacy not established ≥ 12 years old. • *If HIV+*—Treat with antiretrovirals; nitazoxanide may not be effective
Cutaneous larval migrans	• Albendazole (Albenza) 15 mg/kg PO × 1 (max 400 mg; 200 mg tab) OR ivermectin (Stromectol) 200 mcg/kg PO × 1 (if ≥ 15 kg only).
Cyclospora	• TMP-SMX × 7–10 days, see Table 18-2
Dacryocystitis	*See cellulitis—face*
Dental infection	• *Outpatient*—Penicillin VK, amoxicillin-clavulanic acid, or clindamycin (Table 18-2) • *Inpatient*—Ampicillin/sulbactam (Unasyn) 50–100 mg/kg IV every 6 hours (max dose: ampicillin 8 g/day) OR clindamycin 25–40 mg/kg/day IV divide every 8 hours (max 2.7 g/day)
Diarrhea	*See Salmonella, Shigella, Escherichia coli, Campylobacter, Yersinia, traveler's, Vibrio*
Diphtheria *Rare disease, primarily in persons from developing countries*	• *Antitoxin*—(1) Laryngeal-pharyngeal: 20,000–40,000 units IM; (2) nasopharyngeal: 40,000–60,000 units IM; (3) extensive disease > 3 days or neck swelling 80,000–120,000 units IM. Call CDC/state health department: 404-639-8257, 770-488-7100. • *Antibiotics*—Erythromycin OR penicillin G IV × 14 days. • *Exposure to infected person (household or habitual*

	contact)—Erythromycin 40–50 mg/kg/day × 7–10 days (max 2 g/day) OR penicillin G benzathine 600,000 units IM (if <30 kg) or 1,200,000 units IM (if 30 kg) × 1. Culture for *C. diphtheriae* and observe × 7 days with follow-up cultures 2 weeks later.
Discitis	*See osteomyelitis and MRSA.*
E. coli diarrhea	• Rifaximin (Xifaxan) if ≥ 12 years old: 200 mg PO three times per day × 3 days OR Septra OR cefixime OR azithromycin (Zithromax) × 5 days (see dosing, Table 18-2) OR STEC Shiga toxin *E. coli* (0157:H7); does not improve with antibiotics
Ehrlichiosis *(disease detail on Table 18-10)*	• Doxycycline 4.4 mg/kg/day PO or IV divided bid (max 200 mg/day) for ≥3 days after defervescence for total of 5–10 days of therapy; rifampin, chloramphenicol, and possibly fluoroquinolones have been recommended as alternatives (consult infectious disease experts for dosing/indications)
Encephalitis	*See herpes simplex*
Endocarditis *(prophylaxis indicated next)*	• *Unknown organism*—Penicillin G 150,000 units/kg/day divided every 4–6 hours (max 24 million units/day) OR ceftriaxone (Rocephin) 100 mg/kg every 24 hours (max 4 g/day**)** AND gentamicin 2–2.5.5 mg/kg IV every 8 hours AND vancomycin 60 mg/kg/day divided every 8 hours; alter regimen once sensitivity known • *Penicillin allergic*—Daptomycin (Cubicin) 6–8 mg/kg every 24 hours (not FDA approved for peds) OR gentamicin 2–2.5.5 mg/kg every 8 hours AND vancomycin 40–60 mg/kg/day divided every 6 hours (max 2 g/day)
Endocarditis—Prophylaxis *See indications Table 8-1*	• Administer PO drugs 1 hour and IV/IM 30 minutes preprocedure: amoxicillin 50 mg/kg PO OR azithromycin 15 mg/kg PO OR clindamycin 20 mg/kg PO/IV OR ceftriaxone (Rocephin) 50 mg/kg IV/IM OR ampicillin 50 mg/kg IV/IM
Entamoeba histolytica	• *Asymptomatic amebiasis*—Iodoquinol 30–40 mg/kg/day PO divided every 8 hours (max 2 g/day) × 20 days OR paromomycin (Humatin) 25–35 mg/kg/day PO divided every 8 hours × 7 days (max 2 g/day) • *Mild to moderate intestinal disease*—Metronidazole (Flagyl) 35–50 mg/kg/day PO/IV divided every 8 hours × 7–10 days OR tinidazole (*Fasigyn/Tindamax*) 50 mg/kg/day

	(if > 3 years old) PO every 24 hours (max 2 g/day) × 3–5 days AND complete therapy of iodoquinol or paromomycin as per *Asymptomatic amebiasis*. • *Severe intestinal or extraintestinal disease*—(Metronidazole IV regimen above OR tinidazole oral regimen above) PLUS paromomycin as per *Asymptomatic amebiasis*
Enterobius vermicularis (pinworms)	• Primary: Mebendazole 100 mg PO × 1 OR pyrantel pamoate 11 mg/kg base (max of 1 g) • Alternative: albendazole 15 mg/kg PO × 1 (max 400 mg) • Repeat dose in 2 weeks to kill incubating parasites.
Epididymo-orchitis *(consider torsion)*	• *Prepubertal*—Treat as urinary tract infection, see pages 166–167 • *Postpubertal*—Treat as per gonorrhea (*uncomplicated disease* recommendations) AND doxycycline × 10–14 days
Epiglottitis	• Ceftriaxone 75–100 mg/kg IV (max 2 g/day) every 24 hours
Esophagitis	*See Candida—esophageal*
Giardia lamblia	• Primary: Tinidazole (if > 3 years old) 50 mg/kg/day PO × 1 dose (max 2 g/day) • Alternative: Metronidazole 15–30 mg/kg/day divided three times per day × 5–7 days (max 250 mg/dose) OR Nitazoxanide bid for 3 days (100 mg/dose if 1–3 years old; 200 mg/dose if 4–11 years; 500 mg/dose if ≥ 12 years) OR albendazole (if ≥ 2 years old) 10 mg/kg/day once daily × 5 days (max 400 mg/dose)
Gingivitis	*See herpes simplex—gingivostomatitis*
Gonorrhea *(also treat for Chlamydia)*	• *Arthritis, dermatitis*—Ceftriaxone (Rocephin) 50 mg/kg IV/IM (max 1 g/day) every 24 hours × 7 days • *Meningitis or endocarditis*—Ceftriaxone 50 mg/kg IV every 12 hours (max 4 g/day) × 14 days if meningitis OR × 28 days if endocarditis • *Ophthalmia neonatorum or conjunctivitis*—Ceftriaxone 50 mg/kg IM/IV × 1 (max neonatal dose 125 mg, otherwise max dose 1 g) • *PID—see pelvic inflammatory disease* • *Uncomplicated* (cervicitis/urethritis/pharyngitis or proctitis)—Ceftriaxone 125 mg IM OR cefixime (Suprax) 8 mg/kg PO × 1 (max 400 mg)

Helicobacter pylori	• 2 antibiotics (amoxicillin, clarithromycin, or metronidazole) PLUS [(proton pump inhibitor—lansoprazole, esomeprazole, pantoprazole, omeprazole) or bismuth subsalicylate] × 14 days[2]
Herpes simplex *keratitis (contact ophthalmologist for treatment coordination and recommendation)*	• *Encephalitis*[3,4]—(non-HIV-exposed/-positive) 3 months–12 years: Acyclovir 10–15 mg/kg/dose IV every 8 hours × 21 days. ≥ 12 years: 10 mg/kg/dose every 8 hours for 21 days. • *Genitalis—first episode*—Acyclovir < 12 years old: 40–80 mg/kg/day PO divided into 3–4 doses/day × 5–10 days (max 1,200 mg/day); ≥ 12 years old: 200 mg five times daily, or 400 mg three times per day × 7–10 days. OR *unapproved options*—(1a) famciclovir if ≥ 45 kg or adolescents: 250 mg PO three times per day × 7–10 days OR (2) valacyclovir 20 mg/kg/dose (max 1000 mg/dose) bid × 7–10 days. • *Genitalis—recurrence*—Acyclovir < 12 years old: 20 mg/kg/dose (max 400 mg/dose) three times per day. ≥ 12 years old 200 mg five times daily, or 400 mg three times per day, or 800 mg bid × 5 days, or 800 mg three times per day × 2 days OR *unapproved options* (1) famciclovir (adolescents) 1 g PO bid × 1 day or 500 mg × 1, then 250 mg bid × 2 days total or 125 mg bid × 5 days (1b) 125 mg PO bid × 5 days OR (2) valacyclovir <50 kg: 20 mg/kg/dose (max 1000 mg/dose) bid × 5 days; ≥ 50 kg: 1000 mg once daily × 5 days. • *Genitalis—suppressive therapy*—Use each agent for 1 year; acyclovir 20 mg/kg/dose (max 400 mg/dose) bid, OR *unapproved options* (1) famciclovir (adolescents only) 250 mg PO bid OR (2) valacyclovir 20 mg/kg/dose (max 1000 mg) once daily • *Gingivostomatitis and labialis*—Acyclovir 20 mg/kg/dose four times per day × 5–7 days (max 1.2 g/day); for *herpes labialis*—acyclovir 5% cream or ointment, topically 5×/day × 4 days OR penciclovir 1% cream every 2 hours while awake × 4 days OR docosanol 10% 5×/day until healed OR famciclovir 1.5 g PO × 1 dose (adolescents only) • *Keratitis*[3,4,5]—[ganciclovir 0.15% gel 1 drop 5×/day until corneal ulcer heals then 1 drop three times per day × 7 days (only approved ≥ 2 years old) OR trifluridine 1% 1 drop every 2 hours (max 9 drops/day) while awake until re-epithelialization of corneal ulcer occurs, then 1 drop every 4 hours for another 7 days] many experts recommend adding oral therapy (such as acyclovir 80 mg/kg/day (max dose

	400 mg) divided 5×/day × 7–14 days). Topical therapy might cause corneal toxicity—close follow up by an ophthalmologist is recommended. Topical steroids are relatively contraindicated; they are sometimes used during stromal (not epithelial) stage to decrease scarring.
Herpes simplex	• *Neonatal disease*[3,4]—Acyclovir 20 mg/kg IV every 8 hours × 14 days for disseminated disease, and for 21 days if CNS/neurologic involvement. *Premie neonates*—20 mg/kg IV every 8–12 hours; ADD topical antiviral if neonate eye disease (*trifluridine* dosing as per keratitis, mentioned previously)
Herpes zoster	• *Immunocompetent/Healthy host and ≥ 12 years old*—Acyclovir 800 mg 5×/day × 5–7 days OR valacyclovir 1 g PO three times per day × 5 days • See *varicella* for chicken pox disease/exposure management • *Disseminated or immunocompromised or severe chicken pox*—Acyclovir 10 mg/kg/dose IV every 8 hours × 7–10 days
HIV exposure	*See pages 139–142*
Hookworm	• Mebendazole (Vermox) 100 mg PO bid × 3 days or 500 mg PO × 1, OR albendazole (Albenza) 15 mg/kg PO × 1 (max 400 mg) OR pyrantel pamoate 11 mg/kg/day × 3 days (max 1 g/day) • Test for cure in 2 weeks, and if disease still present, repeat treatment.
Impetigo *MRSA, page 154*	• Localized disease or limiting person-to-person spread: topical retapamulin OR mupirocin apply three times per day • More extensive[6] disease or systemic symptoms: Augmentin (90 mg/kg/day in two divided doses for 10 days) OR cefadroxil OR cephalexin OR azithromycin PO for 5 days (dose on Table 18-2); see MRSA if this is a concern
Influenza treatment[7] *Start therapy at **any time** if any of the following are present: progressive symptomatic illness, <2 years of age, chronic medical condition,*	• *Influenza A or B*—Oseltamivir (Tamiflu) administered bid × 5 days (see dosing on Table 18-2, p. 174) • *Severe disease, not responding, unable to take orals/inhaled medicines*—IV Peramivir: 0–30 days: 6 mg/kg every 24 hours IV; 31–90 days: 8 mg/kg every 24 hours IV; 91–180 days: 10 mg/kg every 24 hours; 181 days–5 years: 12 mg/kg every 24 hours; 6–17 years: 10

immunocompromised, hospitalized, pregnant, within 2 weeks post-partum. Can consider therapy if symptom onset ≤ 2 days for patients not at risk of influenza complications. Peramivir—Not approved, CDC recommended emergency use (see CDC website for updates)	mg/kg every 24 hours (max 600 mg/day); do not use if Tamiflu resistant and ↓ dose if renal insufficiency.
Influenza prophylaxis	• *Influenza A/B*—Oseltamivir (Tamiflu); use same dose as administered for treatment but only administer every 24 hours
IV catheter-port-central line infection[3,4,5,8,9]	• Vancomycin 15 mg/kg IV every 6 hours AND ceftriaxone 50–100 mg/kg IV every 24 hours OR cefepime 50 mg/kg/dose IV every 8 hours OR piperacillin-tazobactam 240 to 300 mg piperacillin/kg/day divided in 3 to 4 doses; maximum daily dose: 16 g/day. Can add gentamicin 2–2.5 mg/kg IV every 8 hours for severe cases. *Immunodeficient or neutropenic: see neutropenic fever*
Keratitis *Coordinate care with ophthalmologist for most cases*	• *Bacterial*—Bacteria cause 65–90% of all keratitis cases. Consider *Nocardia* and *Mycobacterium* after refractive surgery (LASIK). *Treatment*: (1) Fortified tobramycin (14 mg/ml) AND [fortified cefazolin (50 mg/ml) OR fortified vancomycin (15–50 mg/ml)] OR (2) Fortified cefazolin + third/fourth generation fluoroquinolone topically OR (3) gatifloxacin (Zymar) or moxifloxacin (Vigamox). *Dosing:* One drop is applied every 5–15 minutes × first hour. Then, antibiotic is applied every 30 minutes, but alternated so that a drop is instilled every 15 minutes, for 6–12 hours. Then, administer one 1 drop of each hour while awake × 24–72 hours, then slowly reduce to every 6–8 hours × 10–14 days. *Zymar/Vigamox* not approved < 1 year old. • *Viral—See herpes simplex and herpes zoster* • *Parasitic—Acanthamoeba* can cause infection in contact lens wearer (esp. if wear overnight); specialized treatment
Lice	*See pediculus humanus capitis (pediculosis)*

Ludwig's angina	*See retropharyngeal abscess antibiotics (consult surgeon)*
Lyme disease[3,10] *See Table 18-11 for detail regarding early vs. late disease*	• *Early* (all PO)—Doxycycline 4.4 mg/kg/day divided bid (max 100 mg/dose) × 10 days OR amoxicillin 50 mg/kg/day divided three times per day (max 500 mg/dose) × 14 days OR cefuroxime 30 mg/kg/day divided bid (max 500 mg/dose) × 14 days. If unable to take beta-lactam or doxycycline: Azithromycin 10 mg/kg/day once daily for 7 days. (Administer doxycycline or amoxicillin for 14 days for isolated facial palsy. Administer oral agent for 28 days for arthritis.) • *Early disease with meningitis or carditis or more than mild early arthritis or later stage disease*—Ceftriaxone 75–100 mg/kg/day IV every 24 hours (max 2 g) OR penicillin G 200,000–400,000 units/kg/day IV (max 24 million units/day) divided every 4 hours × 14–28 days.
Mastoiditis[10] *CT brain and mastoids*	• *Acute*—1st episode: Cefuroxime (Zinacef) 150 mg/kg/day IV/IM divided every 8 hours (max 6 g/day) OR ceftriaxone (Rocephin) 50 mg/kg/day IV/IM administered every 24 hours (max 2 g/day) × 10 days. Consider coverage of MRSA (page 154). • *Acute exacerbation of chronic otitis media*—Vancomycin 15 mg/kg/dose every 6–8 hours + piperacillin-tazobactam 300 mg/kg tazobactam/day divided every 6–8 hours. • *Chronic*—Cefepime (Maxipime) 100–150 mg/kg/day divided every 8 hours IV (max 6 g/day) OR meropenem (Merrem) if > 3 months—20 mg/kg IV every 8 hours (max 3 g/day). *If severe infection: 40 mg/kg IV every 8 hours—max 6 g/day*. OR ceftazidime (Fortaz) 100–150 mg/kg/day IV/IM divided every 8 hours (max 6 g/day) PLUS MRSA coverage, page 154, ± surgery.
Measles[3,10]	• *Exposure*—Measles vaccine, if administered within 72 hours of exposures, if *susceptible* and ≥ 6 months. *Susceptible* = all persons unless they had documented measles, born before 1957, lab evidence immunity, or completed appropriate live-virus vaccination. DO NOT give if neomycin allergy, TB, immunosuppressed, steroid use, hematological cancer, pregnant, ≤ 3 months from blood/immunoglobulin use. Use of live vaccine ≤ 72 hours after exposure prevents disease. • Use immunoglobulin (IG) within 6 days of exposure for any of the following: immunosuppressed, pregnant women without evidence of measles immunity, infants < 6 months

	of age, or infants 6–11 months if unable to receive MMR vaccine. *Infants:* IGIM 0.5 ml/kg (max 15 ml). *Pregnant women without evidence of measles immunity and severely immunocompromised hosts:* IVIG 400 mg/kg. Give measles vaccine 6 months after IGIM, if child is at least 12 months of age. • Treatment: Vitamin A × 2 days, as follows; < 6 months: 50,000 IU once daily; 6–11 months: 100,000 IU once daily; ≥ 12 months: 200,000 IU once daily × 2 days

Meningitis
preterm to <1 month old[4,10,11]
	• *Empiric Therapy:* Ampicillin + cefotaxime [OR] Ampicillin + gentamicin. Add acyclovir if history or physical exam findings are concerning for HSV encephalitis.
	• Ampicillin dosing: PNA ≤ 7 days 200–300 mg/kg/day every 8 hours. PNA > 7 days 300 mg/kg/day every 6 hours.
	• Cefotaxime: PNA ≤ 7 days and ≥ 2 kg: 100–150 mg/kg/day every 8–12 hours. PNA > 7 days and ≥ 2 kg: 150–200 mg/kg/day every 6–8 hours.
	• Gentamicin dosing:
	  ◦ 0–4 weeks old + birth weight (bw) < 1,200 g, 2.5 mg/kg every 18–24 hours
	  ◦ <1 week old and bw > 1,200 g, use 2.5 mg/kg every 12 hours
	  ◦ 1–4 weeks old and bw 1,200–2,000 g, 2.5 mg/kg every 8–12 hours
	  ◦ 1–4 weeks old and bw > 2,000 g, 2.5 mg/kg every 8 hours

Meningitis[4,10,11] 1 month–50 years *If possible administer dexamethasone before antibiotics*	• *1–2 months old*—Cefotaxime 225–300 mg/kg/day divided every 6–8 hours (max 12 g/day) AND vancomycin 15 mg/kg IV every 6 hours • *2 months–8 years*—Ceftriaxone 100 mg/kg/day IV divided every 12–24 hours (max 4 g/day) AND vancomycin 15 mg/kg IV every 6 hours • Add acyclovir if history or physical exam findings are concerning for HSV encephalitis. • Add dexamethasone 0.4 mg/kg IV every 12 hours × 2 days if *Haemophilus influenzae* type b or *Streptococcus pneumoniae* suspected (controversial).
Meningococcemia	*See Neisseria meningitidis disease*
Community-acquired MRSA (CA-MRSA)[3,4]	• *Outpatient therapy*—Clindamycin 30–40 mg/kg day PO every 6–8 hours (max single dose: 450 mg) [OR] (if ≥ 2 months) sulfamethoxazole-trimethoprim 8–12 mg

	trimethoprim/kg/day PO every 12 hours.
MRSA *Inpatient treatment*	• *Empiric inpatient therapy*—Vancomycin 15 mg/kg/dose every 6–8 hours
Molluscum contagiosum[3]	• No consensus on management • Most effective and quick cure: physical destruction of lesions (curettage), cryodestruction with liquid nitrogen, electrodesiccation, and chemical agents (to elicit a local inflammatory response) • Topical cantharidin 0.7% (Cantharone), topical salicylic acid with (lactic acid or acetic acid) (Compound W, Duofilm, Duoplant, Mediplast, Mosco Corn and Callus Remover, Occlusal HP, multiple wart removing products)
Mumps	• Vaccine is NOT effective in preventing disease after exposed
Necator	*Necator americanus—See hookworms*
Necrotizing fasciitis[12] *(surgical consult) See MRSA page 154*	• Vancomycin 15 mg/kg every 6–8 hours PLUS piperacillin-tazobactam 100 mg piperacillin/kg/dose IV every 6 hours (max of 4 g piperacillin/dose) PLUS clindamycin 13 mg/kg/dose IV every 8 hours (max 900 mg/dose).
Neisseria meningitidis[3,4,10]	• *Exposure defined*—Prophylaxis if household contacts, same childcare or nursery, share toothbrush, close social contact, ate or slept in same dwelling in past 7 days or if sat directly next to diseased person on flight > 8 hours. No prophylaxis for healthcare worker unless mouth-to-mouth resuscitation, intubated, or suctioned patient before antibiotic administration. • *Exposure treatment*—Rifampin 10 mg/kg PO every 12 hours × 2 days (max daily dose 600 mg); if < 1 month old, 5 mg/kg PO every 12 hours × 2 days OR ceftriaxone 125 mg if ≤ 15 years old, or 250 mg IM if > 15 years old • *Disease*—See meningitis for empiric coverage. Definitive therapy: Penicillin G IV (300,000 U/kg/day IV; maximum, 12 million units/day, divided every 4–6 hours) OR ceftriaxone 100 mg/kg/day divided every 12–24 hours; maximum daily dose: 4,000 mg/day. Treat for 5–7 days.
Neutropenic fever[3,4,10] *Fever:* Single oral temp. ≥ 38.3°C (101°F)	• Cefepime 50 mg/kg IV every 8 hours (max 6 g/day) OR meropenem 20 mg/kg IV every 8 hours (max 1 g/dose) OR piperacillin/tazobactam 300–400 mg tazobactam/kg/day divided every 6–8 hours (max 4 g tazobactam/dose)

OR ≥ 38°C (100.4°F) for ≥ 1 hour. *Neutropenia*: < 500 cells/mm^3 OR < 1,000 cells/mm^3 and predicted to drop < 500 mm^3	• ADD vancomycin 15 mg/kg IV every 6 hours if: ↓ BP, central catheter, chemotherapy + mucosal damage, quinolone or sulfonamide use before fever onset, known colonization with pneumococci resistant to penicillin, or known gram-positive blood culture, or cellulitis (MRSA). • ADD macrolide if pneumonia (Zithromax, Biaxin); OR antifungal, OR antiparasitic if these infections are a concern.
Omphalitis[13,14]	• ≤ *2 months old*—Vancomycin AND gentamicin (see meningitis dosing) • > *2 months old*—Vancomycin AND ceftriaxone (see meningitis dosing) • ADD metronidazole to above regimens if anaerobic coverage is needed (e.g., foul smelling discharge, born to mothers with amnionitis).
Onychomycosis	*See tinea unguium*
Osteomyelitis[10] *Consider Pseudomonas if foot/rubber sole puncture or immune deficiency*	• Vancomycin 15 mg/kg/dose every 6–8 hours + [ceftazidime or cefepime]. • Cephalosporin dosing: cefepime 50 mg/kg IV every 8 hours (max 6 g/day) OR ceftazidime 50 mg/kg IV every 8 hours (max 6 g/day)
Otitis externa[4,10]	• Ear drops: ciprofloxacin + dexamethasone—4 drops into affected ear twice daily OR ciprofloxacin + hydrocortisone—3 drops into affected ear(s) twice daily OR ofloxacin 5–10 drops into affected ear(s) once daily. Duration: 7 days • *If "malignant": chronic, ill or* Pseudomonas *suspected*—See chronic mastoiditis antibiotic choices and doses, page 153
Otitis media	*See CDC/AAP/AAFP recommendations, Table 18-15*
Papillomavirus[10] *If flat anogenital warts test for syphilis (VDRL or RPR)* Respiratory papillomatosis—Best treated by ENT with lasers, intralesional interferon, cidofovir, or	• *Flat warts on skin*—Topical salicylic acid (over the counter), tretinoin (Retin-A) 0.025–0.1% cream applied daily (AVOID these medicines on mucosa, cryotherapy, or laser surgery.) • *Anogenital warts* (condylomata acuminata)—Imiquimod 5% (Aldara; only approved ≥ 12 years) apply every hours 3×/week—wash off in 6–10 hours. UNAPPROVED agents in children (1) podofilox 0.5% (Condylox) apply bid 3 consecutive days/week for up to 4 weeks OR (2) podophyllin 10–25% (Podocon-25, Podofin, Podofilm)—apply initially for 30 minutes to test skin sensitivity, apply

indole-3-carbinol	one drop at a time and allow to dry until affected area covered. In 1–4 hours wash off. Consider application of petroleum jelly or talcum powder to nonaffected area to avoid skin contact. Repeat once a week for up to 6 weeks. Use lowest dose possible (5–10%), and do not apply to bleeding, friable lesions to decrease systemic toxicity.
Parapharyngeal	*Parapharyngeal abscess: See retropharyngeal abscess*
Pediculus humanus capitis[4,15,16] (pediculosis or lice)	• *First Line:* Permethrin 1% lotion/shampoo—Apply sufficient quantity to saturate hair/scalp to shampoo-washed and towel-dried hair/scalp. Also apply behind the ears and at the base of the neck. Leave on × 10 minutes. Repeat in 7–10 days. • Treatment failure with permethrin: Benzyl alcohol (Ulesfia) 5% lotion (use only if ≥ 6 months old)—Saturate dry scalp and hair, rinse off with water after 10 minutes, repeat in 1 week (1 bottle/8 ounces) OR ivermectin 0.8% solution (ivermectin not approved < 15 kg) OR malathion 0.5% shampoo × 10 minutes, reapply in 1 week OR spinosad 0.9% suspension 10 minutes, reapply in 1 week. • *Resistance to topical therapy*—Sulfamethoxazole/trimethoprim (TMP) 5 mg TMP/kg/dose bid PO × 10 days (max 320 TMP/day), best if combined with permethrin OR ivermectin (Stromectol) 200 mcg/kg PO on days 1 and 10 if > 15 kg
Pelvic inflammatory disease[17] (PID) *Age > 12 years* *Inpatient (CDC) treatment* Choose Regimen A, B, or C	• *Regimen A*—[Cefoxitin (Mefoxin) 2 g IV every 6 hours OR cefotetan 2 g IV every 12 hours] AND doxycycline 100 mg PO/IV every 12 hours × 14 days • *Regimen B*—Clindamycin 900 mg IV every 8 hours AND gentamicin 2 mg/kg × 1, then 1.5 mg/kg IV every 8 hours • *Regimen C*—Ampicillin/Sulbactam (Unasyn) 3 g IV every 6 hours AND doxycycline 100 mg IV every 12 hours • *Switch* to oral outpatient medications that follow once clinically improved for 24 hours.
PID, *Outpatient (CDC)*[17] *treatment* Choose Regimen A or B	• *Regimen A*—Ceftriaxone 250 mg IM × 1 AND doxycycline 100 mg PO bid × 14 days ± ADD metronidazole 500 mg PO bid × 14 days • *Regimen B*—Cefoxitin 2 g IM × 1 AND probenecid 1 g PO × 1 AND doxycycline 100 mg PO bid × 14 days ± ADD metronidazole 500 mg PO bid × 14 days

Perforated bowel	*Or peritonitis; see appendicitis perforation regimens*
Peritonsillar	*Peritonsillar abscess—see retropharyngeal abscess.*
Pertussis	*See Bordetella pertussis, pages 144 (antibiotics), 188 (disease)*
Pinworm	*See Enterobius vermicularis*
Pharyngitis[18] *Group A strep.* *Do not use erythromycin, 48% resistance*	• Penicillin G benzathine (<27 kg: 600,000 units IM × 1; ≥ 27 kg: 1.2 million units IM × 1) OR azithromycin × 3–5 days OR first generation cephalosporin OR amoxicillin 50 mg/kg once daily (max 1000 mg/dose) × 10 days OR penicillin VK (children: 250 mg 2–3 × daily; adolescents 500 mg 2 × daily) × 10 days. • PCN Allergy (nonimmediate hypersensitivity): cephalexin 20 mg/kg/dose bid × 10 days (max 500 mg/dose) or cefadroxil 30 mg/kg/dose once daily (max 1000 mg/dose) × 10 days • PCN Allergy (immediate hypersensitivity): azithromycin 12 mg/kg/dose once daily (max 500 mg/dose) × 5 days OR clarithromycin 7.5 mg/kg/dose 2×/day (max 250 mg/dose) × 10 days
Plague (*Yersinia pestis)*[3,19] *Side effects vs. disease risk must be considered before drug selection.* *Streptomycin not widely available.*	• *Disease* detail—see page 145. • *Exposure*—(if exposed to known or suspected plague source within the previous 6 days)—Doxycycline or ciprofloxacin × 7 days—dosing Table 18-2 • *Treatment*—(1) streptomycin 15 mg/kg/dose IM twice daily OR (2) gentamicin 2.5 mg/kg/dose every 8 hours. Alternative agents to consider: ciprofloxacin, levofloxacin, moxifloxacin, tetracycline, doxycycline, and chloramphenicol.
Pneumocystis jiroveci[4,10,20] (carinii)—Treatment Most require admittance due to high infant/child mortality rates	• *First line:* Sulfamethoxazole/trimethoprim (15–20 mg TMP/kg/day PO or IV divided every 6–8 hours × 14–21 days. • *Alternatives:* Pentamidine 4 mg/kg/day IV × 14–21 days, OR 1 of following (specialized dosing/cautions): (trimethoprim + dapsone) OR atovaquone (Mepron) OR (primaquine + clindamycin) • ADD Solumedrol 1 mg/kg IV every 12 hours OR prednisolone OR prednisone PO 1 mg/kg/day bid if pO_2 < 70 mm Hg
	• Ampicillin/sulbactam (Unasyn) 150–200 mg

Pneumonia[4,21] *Aspiration*	ampicillin/kg/day IV divided every 6 hours (max 2000 mg ampicillin/dose) OR clindamycin 30–40 mg/kg/day IV divided every 6–8 hours (max dose 2.7 g/day)
Pneumonia *0–3 months old*[4,10] *If severe, add MRSA coverage, page 154*	• *0–4 weeks*—Ampicillin 100–300 mg/kg/day IV divided every 8–12 hours AND (gentamicin—*see meningitis dosing* or cefotaxime 50 mg/kg/dose every 12 hours if ≤ 1 week old or every 8 hours if > 1 week old) • *> 4 weeks–3 months*—Ampicillin 100–200 mg/kg/day divided every 6 hours AND cefotaxime 50 mg/kg IV every 6 hours (max 12 g/day) • If *Chlamydia* is cause, use erythromycin 12.5 mg/kg/dose PO/IV four times daily × 14 days. Beware of pyloric stenosis risk with EM
Pneumonia[22] *Community acquired* *> 3 months old* *Limited evidence suggests that linezolid has better alveolar penetrance compared to vancomycin*	• *Inpatient > 3 months old*—Cefotaxime 100–200 mg/kg/day divided every 6–8 hours (max 12 g/day) or ceftriaxone 50 mg/kg/day administered every 24 hours (max 2 g/day) AND azithromycin (Zithromax) or clarithromycin (Biaxin) or erythromycin; see doses on Table 18-2, AND if moderate–severe disease, significant effusion, cavitary lesion, or other MRSA risk, linezolid (Zyvox) 10 mg/kg IV every 8 hours (if full term, >1 week old) or vancomycin 15 mg/kg IV every 6 hours (max 1 g/dose) • *Outpatient, < 5 years old*—First line: Amoxicillin 90 mg/kg/day divided every 12 hours (max 4000 mg/day). Alternative: amoxicillin/clavulanate 90 mg/kg/day (amoxicillin component) divided every 12 hours. Amoxicillin allergy: cefpodoxime, cefuroxime or cefprozil; see dosing Table 18-2. NOTE: Mycoplasma *and* Chlamydia *pneumonia can occur ≤ 4 years. If these organisms are suspected (fully immunized infant/child, wheezing, afebrile, interstitial pattern etc.), substitute* azithromycin *as first line OR add* azithromycin *as a second agent.* See doses on Table 18-2 • *Outpatient, ≥5 years old:* Amoxicillin 90 mg/kg/day divided every 12 hours (max 4000 mg/day). Add azithromycin if unable to distinguish bacterial from atypical CAP. Alternative: amoxicillin/clavulanate 90 mg/kg/day (amoxicillin component) divided every 12 hours. Amoxicillin allergy: cefpodoxime, cefuroxime or cefprozil; see dosing Table 18-2
Pneumonia *Cystic fibrosis*	• Ceftazidime (Fortaz) 50 mg/kg IV every 8 hours (max 6 g/day) or ticarcillin clavulanate (Timentin) 200–300

If penicillin allergy, consider quinolone	mg/kg/day of ticarcillin IV divided 4–6 hours (max ticarcillin 18 g/day) • AND (gentamicin or tobramycin 2.5 mg/kg IV every 8 hours)
Pneumonia *Hospital acquired*[23] *(cover S. aureus (± MRSA), Pseudomonas, and other gram-negative bacilli)*	• Cefepime (Maxipime) 50 mg/kg IV every 8 hours (max 2 g/dose) OR meropenem (Merrem) if > 3 months, 20 mg/kg IV every 8 hours (max 3 g/day; *if severe infection 40 mg/kg IV every 8 hours, max 6 g/day*), OR piperacillin-tazobactam[24] (Zosyn) 240–300 mg/kg/day (piperacillin component) divided every 6–8 hours (max 16 g/day) OR fluoroquinolone • ± *2nd antipseudomonal antimicrobial* (e.g., aminoglycoside: Gentamicin 2–2.5 mg/kg IV every 8 hours) • ± *MRSA coverage (if MRSA risk factors, or >10% of S. aureus isolates in unit are methicillin resistant, or MRSA prevalence unknown, or presence of necrotizing pneumonia, empyema, or lung abscess):* Vancomycin 15 mg/kg IV every 6 hours (max 1 g/dose) OR linezolid (Zyvox) 10 mg/kg/dose IV every 8 hours (max 600 mg/dose)

Pseudomembranous colitis
Only patients with severe disease require treatment with any listed medication
	Children < 5 years old often are asymptomatic carriers of *C. difficile* (most common in infants under 1 year of age) so do not automatically treat positive stool studies < 5 years old.
	• Mild to moderate:
	  ◦ Metronidazole (Flagyl) 30 mg/kg/day PO or IV divided every 6 hours (max 500 mg/dose)
	• Severe:
	  ◦ Vancomycin 40 mg/kg/day PO divided every 6 hours (max 125 mg/dose) × 10 days.
	• Severe and complicated:
	  ◦ Vancomycin 40 mg/kg/day PO divided every 6 hours (max 125 mg/dose) PLUS metronidazole 30 mg/kg/day IV every 6 hours (max 500 mg/dose) × 10 days
	  ◦ If complicated with ileus or toxic colitis: vancomycin 40 mg/kg/day PO every 6 hours (max 500 mg/dose) PLUS metronidazole 30 mg/kg/day IV every 6 hours (max 500 mg/dose) PLUS vancomycin 500 mg/100 ml normal saline enema every 8 hours as needed × 10 days

Pterygoid abscess	*See retropharyngeal abscess*
Pyelonephritis	*See urinary tract infection recommendations, pages 166–167.*

Q fever (inhaled biologic with flulike symptoms, fever, endocarditis, hepatitis; 9–40 days incubation)	*Acute Q fever:* • Doxycycline[3] 100 mg orally twice daily (children ≥ 8 years of age) or 4.4 mg/kg/day orally divided twice daily for children <8 years (max dose 100 mg) × 14 days • Children younger than 8 years of age with mild illness: doxycycline 4.4 mg/kg/day orally divided twice daily × 5 days[25] • Doxycycline allergic: trimethoprim-sulfamethoxazole 4–20 mg/kg/day (trimethoprim component) orally divided every 12 hours (max 160 mg trimethoprim per dose) *Chronic Q fever*: limited evidence in children; combination doxycycline and hydroxychloroquine (minimum duration of 18 months) • Risk of disease must be weighed against risk of dental staining from the use of doxycycline in children ≤ 8 years old.
Rabies	*See pages 138–139 for exposure recommendations.*
Retropharyngeal abscess	• Clindamycin 40 mg/kg/day divided every 6 hours to every 8 hours[26] OR • Ampicillin-sulbactam 50 mg/kg/dose (ampicillin component) every 6 hours (max 2000 mg ampicillin per dose)[27] OR • Ceftriaxone 50–75 mg/kg every 24 hours (max 2000 mg) PLUS metronidazole 10 mg/kg/dose every 8 hours[28]
Rocky Mountain Spotted Fever *Do not wait for lab confirmation to treat*	• First line: Doxycycline 4.4 mg/kg/day orally or IV divided bid (max 100 mg/dose[29]) • *Tetracycline allergy*—Contact infectious disease expert and consider rapid desensitization procedures in an inpatient setting, or chloramphenicol (increased risk of death) 50–100 mg/kg/day IV divided every 6 hours (max 4 g/day). Continue antibiotics until afebrile × 3 days or total duration of 7–10 days.
Roundworm	*See Ascaris lumbricoides*
Salmonella Gastroenteritis (non-typhi)	• *Sepsis or focal infection*—Cefotaxime 100–200 (225–300 if meningitis) mg/kg/day IV divided every 6–8 hours (max dose 12 g/day), OR ceftriaxone 100 mg/kg IV divided every 12 hours to every 24 hours (max 4 g/day) × 7–10 days. • *Diarrhea*—Treat only if septic, age < 3–6 months, immunocompromised, hemoglobinopathy, or bacteremia. Give an initial dose of ceftriaxone 100 mg/kg (max 2000 mg). Step down oral therapy with azithromycin[3,30] 20 mg/kg

	for the first dose, followed by 10 mg/kg/day × 3 days if immunocompetent (14 days if immunocompromised).
SARS	*See coronavirus, page 193*
Scabies[4]	• Permethrin (drug of choice) 5% cream (Elimite) to entire body (+ scalp in infants) for 8–14 hours then wash off, OR crotamiton 10% lotion or 10% cream (Eurax) apply a thin layer from neck to toes once daily for 3 days followed by a cleansing bath 48 hours after the last application; treatment may be repeated in 7 days, OR ivermectin (Stromectol) 200 mcg/kg per dose PO × 2 doses administered at least 7 days apart (ivermectin not approved < 15 kg), OR 6% sulfur in petroleum ointment massaged into all skin surfaces from neck to toes × 2–3 days with cleansing of each application after 24 hours, OR lindane (not recommended in children <50 kg due to safety concerns, consider alternative agents) 1% lotion to body overnight then wash off
Sepsis	• Treat per meningitis or neutropenia depending on source *See management algorithm/goal directed therapy, page 175.*
Septic arthritis *Surgical drainage and orthopedic consult* *Consider* Pseudomonas *if foot puncture or immune deficient*	• Cefazolin 50 mg/kg/dose IV every 8 hours • If community-acquired MRSA represents > 10% of *S. aureus* in geographic area: clindamycin 40 mg/kg/day divided every 6 hours–every 8 hours[31] • If clindamycin resistance is >10% in *S. aureus* isolates: vancomycin[32] • Consider empiric coverage for *Kingella* in children <36 months using a cephalosporin such as cefuroxime (50 mg/kg/dose every 8 hours), or ceftriaxone (100 mg/kg/day)
Shigella diarrhea	• Most infections are self-limited, and rehydration is the mainstay of management. Antimicrobial therapy is indicated in severe disease or immunocompromised patients[3] • Azithromycin (Zithromax) 10 mg/kg PO daily × 3 days OR ciprofloxacin 15 mg/kg/dose (max 500 mg/dose) PO bid × 3 days OR sulfamethoxazole-trimethoprim (use only if susceptible) 10 mg/kg (trimethoprim component, max 160 mg TMP/dose) per day divided bid × 3 days (immunocompetent)
Shunt infection	*See ventricular shunt*

Sinusitis *Obtain CT of sinus/orbits, and consult ENT if orbital/periorbital cellulitis*	• First line: Amoxicillin-clavulanate 45–90 mg/kg/day PO divided bid[33] • Ceftriaxone 50 mg/kg IV or IM (if cannot tolerate PO)[34] • Penicillin allergic: Clindamycin 30–40 mg/kg/day divided every 8 hours PLUS cefixime 4 mg/kg/dose bid or cefpodoxime 10 mg/kg/day OR levofloxacin 10–20 mg/kg/day PO divided every 12–24 hours. Continue antibiotics for a total of 10–28 days or until symptom free, then 7 days.
Smallpox	• See page 33 for detail regarding disease. • *Exposure*—(1) Vaccine within 2–3 days of exposure provides some protection. Limited availability through CDC. • *Tecovirimat*[35] *(available only through US Strategic National Stockpile)*: 13–25 kg: 200 mg PO bid, 25– 40 kg: 400 mg PO bid, ≥40 kg: 600 mg PO bid [duration = 14 days]
Sporotrichosis	Source: Soil/thorny plants (e.g., roses, hay, straw). Typical incubation is 7–30 days (max is 3 months). • *Cutaneous or Lymphocutaneous*[3]—Itraconazole (Sporanox) 6–10 mg/kg/day PO divided bid (max 200 mg/dose) × 3–6 months. *Alternative treatment:* Potassium iodide, initial dose: 50 mg PO three times per day; increase as tolerated to ≤ 50 mg/kg/dose (max 2500 mg/dose) three times per day. Continue at maximum tolerated dosage for several weeks after lesions resolve. • *Disseminated sporotrichosis/severe pulmonary infection*—Amphotericin B 0.7 mg/kg/dose IV once daily followed by a prolonged course of itraconazole
Staphylococcus	*See MRSA, page 154, and specific infection*
Submandibular abscess	*See peritonsillar abscess*
Syphilis[36] *Congenital disease*	• *Congenital disease (≤ 4 weeks old), possible congenital syphilis, normal physical examination*—(normal CSF, X-rays, CBC/platelets): Aqueous crystalline penicillin G 50,000 units/kg/dose IV every 12 hours for the first 7 days of life followed by 50,000 units/kg/dose IV every 8 hours thereafter for a total of 10 days, OR penicillin G procaine 50,000 units/kg/dose IM × 10 days, OR (if mother received appropriate regimen of penicillin more than 1 month before delivery and there is clinical serologic follow-up) penicillin G benzathine 50,000 units/kg/dose IM × 1 dose. *Proven or probable disease*—Aqueous crystalline penicillin G 50,000

	units/kg/dose IV every 12 hours for the first 7 days of life followed by 50,000 units/kg/dose IV every 8 hours thereafter for a total of 10 days OR procaine penicillin G 50,000 units/kg/dose IM once daily × 10 days • *Congenital disease (>4 weeks)*—Aqueous crystalline penicillin G 50,000 units/kg/dose IV every 4–6 hours × 10 days
Syphilis *Early acquired, late, latent, and neurosyphilis*	• *Early acquired [primary, secondary, early latent (acquired in prior 12 months)]*—Penicillin G benzathine 50,000 units/kg IM × 1 (max 2.4 million units). Consult with an infectious disease specialist if penicillin allergic. No pediatric data for use of doxycycline. • *Late (>1 year) or unknown latency*—Penicillin G benzathine 50,000 units/kg (max dose 2.4 million units) IM every week × 3. • *Neurosyphilis*—Aqueous crystalline penicillin G 50,000 units/kg/dose every 4–6 hours × 10–14 days (max dose 24 million units/day)

Tick bite[3]	• *Early localized disease:* ≥8 years: doxycycline 4 mg/kg/day PO divided bid (max 100 mg/dose) × 14 days. < 8 years (or unable to tolerate doxycycline): amoxicillin 50 mg/kg/day PO divided three times per day (max 1.5 g/day) × 14 days OR cefuroxime 30 mg/kg/day divided bid (max 1 g/day) × 14 days
	• *Disseminated disease:*
	  ◦ Isolated facial palsy: same PO therapy as for early localized disease, × 14–21 days
	  ◦ Arthritis: same PO therapy as for early localized disease, × 28 days
	  ◦ Recurrent arthritis: repeat first oral arthritis regimen OR ceftriaxone 50–75 mg/kg IV once daily (max 2 g/day) × 14 days. *Alternatives to ceftriaxone*: penicillin G 200,000–400,000 units/kg/day IV divided every 4 hours (max 18–24 million units/day) OR cefotaxime 150–200 mg/kg/day IV divided every 8 hours–every 6 hours (max 6 g/day)
	  ◦ AV block or carditis: PO regimen (as per early localized disease) if asymptomatic × 14–21 days, OR ceftriaxone (or alternatives listed above) 50–75 mg/kg/dose IV once daily (followed by PO therapy) × 14 days
	  ◦ Meningitis: ceftriaxone (or alternative regimens listed above) 50–75 mg/kg/dose IV once daily × 14 days OR

	doxycycline 4–8 mg/kg/day PO divided bid × 14–21 days • Encephalitis/other late neurologic disease: ceftriaxone (or alternative regimens listed above) 50–75 mg/kg/dose once daily × 14–28 days
Tinea capitis or kerion—*Monitor patients closely for liver, hematologic, and electrolyte disorders*	• Griseofulvin microsize (liquid): ◦ *1 month to ≤2 years of age*: 15–25 mg/kg/day PO once daily or divided bid (max 1 g/day) × ≥ 6 weeks ◦ *> 2 years*: 20–25 mg/kg/day PO once daily or divided bid (max 1 g/day) × ≥ 6 weeks • OR Griseofulvin ultramicrosize (tablets): ◦ *> 2 years:* 10–15 mg/kg/day PO once daily (max 750 mg/day) × ≥ 6 weeks • OR terbinafine (tablets- may be crushed): 4–6 mg/kg/day PO once daily (max 250 mg) or ◦ *10–20 kg:* 62.5 mg PO once daily ◦ *20–40 kg:* 125 mg PO once daily ◦ *>40 kg:* 250 mg PO once daily ◦ Duration: *T tonsurans*—2–6 weeks, *M canis*—8–12 weeks • OR fluconazole (not FDA approved for tinea capitis, lower cure rates) 6 mg/kg/day PO once daily (max 400 mg/day) × 3–6 weeks • Topical treatment with selenium sulfide, ketoconazole, or ciclopirox shampoos may be useful as an adjunct.
Tinea corporis, cruris, pedis	• *Topical options*—Ketoconazole daily, econazole daily • ≥ *2 years:* Miconazole bid, clotrimazole bid, tolnaftate bid, naftifine daily (cream, tinea corporis), sertaconazole daily (tinea corporis) • ≥ *10 years:* Ciclopirox (cream, suspension) bid • ≥ *12 years:* Naftifine daily (cream/gel, tinea pedis and tinea cruris), luliconazole daily, terbinafine daily (cream-bid for tinea pedis), butenafine daily (bid for tinea pedis), oxiconazole 1–2 × daily, sertaconazole bid (tinea pedis). *Duration: 2–4 weeks* *Oral (if extensive lesions or failure of topical therapy)*—Griseofulvin, terbinafine, or fluconazole (see Tinea capitis)
Tinea unguium	• *Topical therapies (preferred due to decreased adverse effects)*—Ciclopirox 8% (≥12 years) daily × 4–8 weeks, tavaborole 5% solution (≥6 years) daily × 48 weeks • *Oral treatment:*

	• Terbinafine (tablets):
	  • *10–20 kg:* 62.5 mg PO once daily
	  • *20–40 kg:* 125 mg PO once daily
	  • *> 40 kg:* 250 mg PO once daily
	Duration = 6 weeks (fingernails), 12 weeks (toenails)

Tinea versicolor (Pityriasis versicolor)	• *Uncomplicated: Topical therapy*—Selenium sulfide shampoo once daily × 3–7 days OR clotrimazole cream bid × 2–3 weeks. Other topical therapies include ketoconazole, bifinazole, miconazole, econazole, oxiconazole, clotrimazole, terbinafine, ciclopirox, and zinc pyrithione. • *Oral (for extensive lesions or resistant infection)*—Fluconazole 300 mg PO once weekly × 2–4 weeks, OR ketoconazole (Nizoral) if ≥ 2 years old, 3.3–6.6 mg/kg/day PO every 24 hours × 10 days
Tracheitis, bacterial	• Nafcillin OR oxacillin 100–150 mg/kg/day IV divided every 4–6 hours (max 12 g/day), OR vancomycin 40 mg/kg/day IV divided every 6–8 hours (max 4 g/day) • PLUS a 3rd generation cephalosporin such as ceftriaxone 50–75 mg/kg/day (max 2000 mg) OR if > 2 months old and penicillin allergic, clindamycin 20–40 mg/kg/day IV divided every 6–8 hours (max 2700 mg/day). *If MRSA suspected, see page 154 (rows with MRSA)*
Traveler's diarrhea	*See E. coli antibiotic regimens*

Trichomonas	• Metronidazole (Flagyl):
	  • *<45 kg:* 45 mg/kg/day PO divided three times per day × 7 days (max 2 g/day)
	  • *≥45 kg:* 2 g PO × 1 OR 500 mg PO bid × 7 days if single dose unsuccessful
	• OR tinidazole:
	  • *> 3 years:* 50 mg/kg PO × 1 (max 2 g/dose)
	• *Adolescents:* 2 g PO × 1 OR 2 g PO daily × 5 days if treatment failure

Tularemia	• Gentamicin 5–6 mg/kg/day IV/IM divided every 8 hours to every 12 hours × 7–10 days, OR ciprofloxacin (mild disease) 15 mg/kg/dose (max 400 mg/dose) IV every 12 hours × 10 days *See pages 33–34 for detail presentation and diagnosis*
Urethritis *Adolescent dosing only (≥13 years)*	• *Nongonoccocal urethritis:* Azithromycin (Zithromax) 1 g PO × 1, OR doxycycline 100 mg PO bid × 7 days, OR erythromycin base 500 mg PO four times per day × 7 days

	OR levofloxacin 500 mg PO once daily × 7 days • *M. genitalium:* Azithromycin 1 g PO × 1 OR moxifloxacin 400 mg PO daily × 7–14 days (treatment failure) • Other causes: *N. gonorrhoeae, C. trachomatis, Trichomonas*, HSV, adenovirus
Urinary tract infection[37] *See pages 190–191, for expert guidelines regarding management and Table 18-2 for oral dosing*	• *Inpatient*—Ceftriaxone 50–75 mg/kg/day IV divided every 12–24 hours (do not use < 28 days old), OR gentamicin 2–2.5 mg/kg IV every 8 hours (see meningitis dosing for gentamicin in neonates) + ampicillin 50 mg/kg/dose IV every 6 hours (esp. if gram positive bacteria/*Enterococcus*) OR piperacillin-tazobactam IV 240–300 mg/kg/day (piperacillin component) divided every 6 hours–every 8 hours (max 16 g/day) • *Outpatient options*—Cephalexin 50–100 mg/kg/day PO divided every 6 hours–every 8 hours (max 4 g/day), OR cefixime 8 mg/kg/day PO divided every 12 hours–every 24 hours (max 400 mg/day), OR sulfamethoxazole-trimethoprim 6–12 mg/kg/day (trimethoprim component) PO divided every 12 hours (max 160 mg TMP/dose), OR amoxicillin-clavulanate 20–40 mg/kg/day PO divided every 8 hours, OR nitrofurantoin (Furadantin, Macrodantin) 5–7 mg/kg/day PO divided every 6 hours, nitrofurantoin (Macrobid-adolescents) 100 mg PO every 12 hours • Treat 14 days if fever or toxic, 7–14 days if no fever or toxicity. Use of short courses (3–5 days) in pediatrics is controversial and might only be appropriate in adolescents with uncomplicated disease.
Vaginosis (bacterial)[36]	• *Children ≥45 kg or adolescents*—Metronidazole 500 mg PO bid × 7 days, OR metronidazole vaginal gel 0.75% (Metrogel), 1 applicatorful (5 g) intravaginally daily × 5 days, OR clindamycin 2% cream 5 g intravaginally × 7 days, OR tinidazole 2 g PO once daily × 2 days, OR tinidazole 1 g PO once daily × 5 days, OR clindamycin 300 mg PO bid × 7 days.
Varicella disease	Generally, supportive care only. Acetaminophen for fever/prodromal symptoms and/or antihistamines for relief of pruritis. • *Nonimmunocompromized children ≥2 years (initiate within 24 hours of rash onset)*—Acyclovir 20 mg/kg/dose PO every 6 hours × 5 days (max 3200 mg/day) OR valacyclovir 60 mg/kg/day PO divided every 8 hours (max 3 g/day) × 5 days; use in preadolescent children is not routinely

	recommended. Consider use in adolescents (greater risk for more severe disease), or chronic cutaneous/pulmonary disorder, or on chronic salicylates or on steroids ± second household case. • *Immunocompromised or severe disease*—Acyclovir 30 mg/kg/day IV divided every 8 hours × 7–10 days
Varicella exposure	• *Healthy, non-pregnant patients ≥12 months*—Vaccine: Administer vaccine 0.5 ml IM to susceptible children within 3–5 days of exposure if no prior immunization • *Varicella immune globulin (VZIG or VARIZIG)*—Give to exposed patients if they are (1) immunocompromized, (2) neonates whose mother has varicella (5 days pre to 2 days after delivery), (3) premature infants born ≥ 28 weeks who are exposed during neonatal period whose mothers do not have evidence of immunity, (4) premature infants born < 28 weeks or who weigh ≤ 1,000 g at birth and were exposed during the neonatal period regardless of maternal history of varicella disease or vaccination, (5) pregnant women without evidence of immunity • VZIG/VARIZIG is given within 4–10 days of exposure if above risk factors present. *VZIG dose*—≤ 2 kg: 62.5 units, 2.1–10 kg: 125 units, 10.1–20 kg: 250 units, 20.1–30 kg: 375 units, 30.1–40 kg: 500 units, >40 kg: 625 units (max 625 units) OR • *IVIG (if VZIG unavailable):* 400 mg/kg IV × 1 (within 4–10 days of exposure) • *Acyclovir*—Acyclovir 20 mg/kg four times per day (max single dose 800 mg) during period of risk (if VZIG or VARZIG contraindicated, mildly immunocompromised without evidence of immunity or patients for whom varicella prevention is desired)
Vascular catheter	*See IV catheter*
Ventricular CSF shunt[38] infection *Consult neurosurgeon*	• Vancomycin 60 mg/kg/day IV divided every 6 hours (max 4 g/day) PLUS an anti-pseudomonal beta-lactam (cefepime 50 mg/kg IV every 8 hours (max 2 g/dose), OR ceftazidime 150 mg/kg/day IV divided every 8 hours (max 6 g/day), OR meropenem 40 mg/kg/dose IV every 8 hours (max 2 g/dose) • *Beta-lactam allergy:* Add aztreonam 90–120 mg/kg/day divided every 6 hours–every 8 hours (max 8 g/day) OR ciprofloxacin 15 mg/kg/dose IV every 12 hours (max 400 mg/dose)

	• Intrathecal antibiotics and externalization of shunt may be needed and is best guided by a neurosurgeon.
Vibrio species[3,39]	• *Management is typically supportive. Diarrhea is usually mild and self-limited.* • *Sepsis with/without hemorrhagic bullae, wound infections:* 3rd generation cephalosporin (ceftazidime 150 mg/kg/day IV divided every 8 hours, OR ceftriaxone 50–100 mg/kg/day IV divided every 12 hours–every 24 hours) PLUS doxycycline (≥ 8 years) 2.2 mg/kg/dose IV/PO every 12 hours (max 200 mg/day) OR ciprofloxacin 10 mg/kg/dose IV every 12 hours (max 400 mg/dose) OR Sulfamethoxazole-trimethoprim 6–12 mg TMP/kg/day PO divided every 12 hours PLUS gentamicin 2–2.5 mg/kg/dose IV every 8 hours (children whom doxycycline or ciprofloxacin are contraindicated) • *Severe diarrhea:* Doxycycline 2.2 mg/kg/dose PO every 12 hours (max 200 mg/day) OR ciprofloxacin 10–15 mg/kg/dose PO twice a day (max 750 mg/dose)
Warts	*See Papillomavirus*
Yersinia enterocolitica	• Immunocompromised patients, neonates, and those with sepsis or extra intestinal disease require treatment. • 3rd generation cephalosporin (ceftriaxone 50–100 mg/kg/day IV divided every 12 hours–every 24 hours, OR cefotaxime 150–180 mg/kg/day IV divided every 8 hours. Alternatives include sulfamethoxazole-trimethoprim, aminoglycosides, fluoroquinolones, tetracycline, or doxycycline
Yersinia pestis	*See Plague page 33 (disease) and 158 (antimicrobials)*

Description

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Table 18-2 Common Oral Antimicrobial Doses and Mixtures

Antimicrobial	Formulations	Dose (Frequency)[1]
Acyclovir	200, 400, 800, 200 mg/5 ml	See herpes pages 149–151, varicella pages 167–168
Albendazole (Albenza)	200 mg	See infection (max 400 mg/day)
Amoxicillin (Amoxil)	Suspension: 125, 200, 250 and 400 mg/5 ml Caps: 250, 500 mg Tabs: 500, 875 mg	30–50 mg/kg/day (bid to three times per day) 80–90 mg/kg/day DRSP[2]
Amoxicillin/clavulanate (Augmentin)	Suspension*: 125, 200, 250 and 600 mg/5 ml Tabs*: 250, 500, 875 mg Chew tabs*: 200 mg	45 mg/kg/day (bid) 80–90 mg/kg/day if DRSP[2] (*dosing is in mg of amoxicillin)
Ampicillin (Principen)	Suspension: 125 and 250 mg/5 ml Caps: 250, 500 mg	50–100 mg/kg/day (four times per day)
Azithromycin[3] (Zithromax)	Suspension: 100 and 200 mg/5 ml, Tabs: 250, 500 mg	Pneumonia/Otitis media 10 mg/kg × 1 on first day, then 5 mg/kg daily × 4 Pharyngitis 12 mg/kg/day × 5 days 20 mg/kg/day × 3 days Max dose 500 mg
Cefaclor (Ceclor) *Second generation*	Suspension: 125, 250, and 375 mg/5 ml Caps: 250 mg, 500 mg	20–40 mg/kg/day (three times per day) Max 500 mg/dose
Cefadroxil (Duricef) *First generation*	Suspension: 250, 500 mg/5 ml Cap: 500 mg, Tab: 1000 mg	30 mg/kg/day (bid) Max 1,000 mg/dose
Cefdinir (Omnicef) *Third generation*	Suspension: 125 and 250 mg/5 ml Cap: 300 mg	14 mg/kg/day (every 12–24 hours) Max 600 mg/day

Cefditoren (Spectracef) *Third generation*	Tab: 200, 400 mg (only use ≥ 12 years old)	200–400 mg bid Max 400 mg/dose
Cefixime (Suprax) *Third generation*	Suspension: 100, 200, 500 mg/5 ml Caps: 400 mg Chew tab: 100 and 200 mg	8 mg/kg/day (every 12–24 hours) (UTI: 16 mg/kg on day 1) Max 400 mg/day
Cefpodoxime (Vantin) *Third generation*	Suspension: 50 and 100 mg/5 ml Tabs: 100, 200 mg	10 mg/kg/day (bid) Max 200–400 mg/dose
Cefprozil (Cefzil) *Second generation*	Suspension: 125 and 250 mg/5 ml Tabs: 250 mg, 500 mg	15–30 mg/kg/day (bid) Max 500 mg/dose
Ceftibuten (Cedax) Third generation	Suspension: 180 mg/5 ml Caps: 400 mg	9 mg/kg/day (daily) Max 400 mg/dose
Cefuroxime (Ceftin) *Second generation*	Suspension: 125 mg/5 ml Tabs: 250, 500 mg	20–30 mg/kg/day (bid) Max 500 mg/dose
Cephalexin (Keflex) *First generation*	Suspension: 125 and 250 mg/5 ml Caps/Tabs: 250, 500 (750 mg capsule)	25–50 mg/kg/day (four times per day) Max 500 mg/dose
Clarithromycin (Biaxin)	Susp: 125 and 250 mg/5 ml Tabs: 250, 500 mg	15 mg/kg/day (bid) Max 500 mg/dose
Clindamycin (Cleocin)	Solution: 75 mg/5 ml Caps: 75, 150, 300 mg	8–25 mg/kg/day (three times per day/bid) (30–40 mg/kg/day if DRSP[3]) Max 1800 mg/day
Dicloxacillin (Dynapen)	Caps: 250, 500 mg	12.5–25 mg/kg/day (four times per day), max 250 mg/dose Use 50–100 mg/kg/day if completing osteomyelitis therapy (max dose 500 mg)
Doxycycline(>8 years) (Vibramycin)	Tab/Cap: 50, 75, 100, 150 mg Suspension: 25 mg/5 ml. Syrup: 50 mg/5 ml	4.4 mg/kg/day (bid) Max 200 mg/day

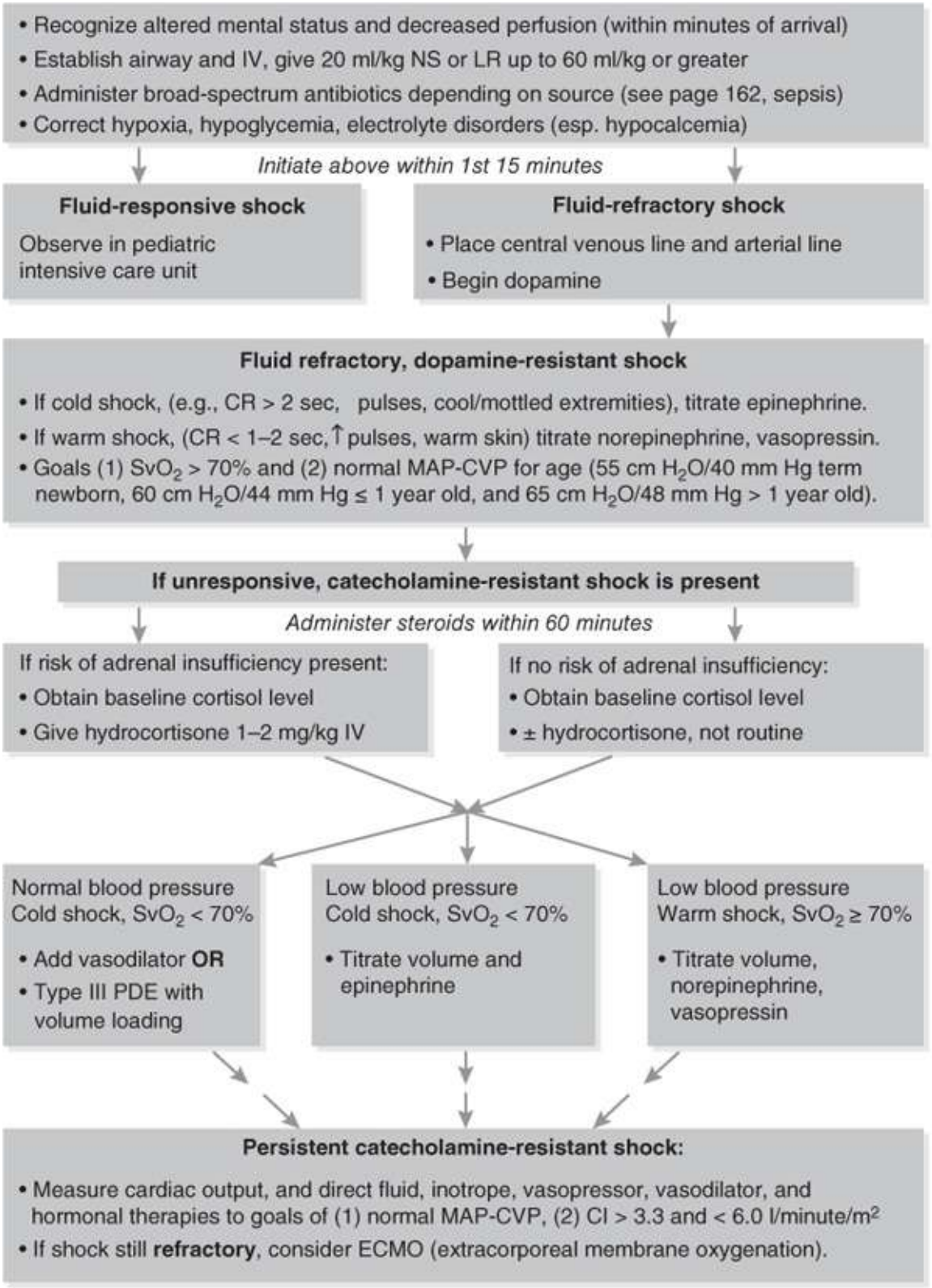
Erythromycin (ERYC, EES, E-mycin)	Suspension: 200 and 400 mg/5 ml Tab: 250, 400, 500 mg	30–50 mg/kg/day (3–4×/day) Max 2000–4000 mg/day
Erythromycin/Sulfisoxazole (Pediazole)	Suspension: 200 mg EM and 600 mg SS per 5 ml	50 mg EM/kg/day (four times per day) Max EM dose 500 mg
Fluconazole (Diflucan)	Suspension: 10 and 40 mg/ml Tabs: 50, 100, 150, 200 mg	6–12 mg/kg/dose × 1, then 3–12 mg/kg/dose once daily Max 600 mg/dose
Griseofulvin Microsize (Grifulvin V) Ultramicrosize tablets (Gris-PEG)	Suspension: 125 mg/5 ml (micro) Tabs: (micro) 500 mg Tabs: (ultra) 125 mg, 250 mg	Micro: 20–25 mg/kg/day (every day to bid) Ultra: 10–15 mg/kg/day (every day) Max dose (micro) 1 g Max dose (ultra) 750 mg
Itraconazole (Sporanox, Tolsura)	Cap: 100 mg, 65 mg Solution: 10 mg/ml	5 mg/kg/day every 12 hours (see specific infection)
Ivermectin (Stromectol)	Tab: 3 mg	200 mcg/kg/day (see specific infection)
Linezolid (Zyvox)	Tab: 600 mg Suspension: 100 mg/5 ml	30 mg/kg/day (three times per day) if < 12 years Administered bid if ≥ 12 years Max dose 600 mg
Mebendazole (Emverm)	Tabs: 100 mg chewable	Dosing variable—see specific infection
Metronidazole (Flagyl)	Tabs: 250, 500 mg Cap: 375 mg Suspension can be compounded	15–50 mg/kg/day divided three times per day Max 2250 mg/day
Nitrofurantoin (Macrodantin, Macrobid, Furadantin)	Suspension: 25 mg/5 ml Caps: 25, 50, 100 mg	Furadantin, Macrodantin: 5–7 mg/kg/day (four times per day) Macrobid (adolescents): 100 mg bid Max dose 100 mg

Nystatin (Bio-Statin)	Suspension: 100,000 units/ml Tabs: 500,000 units Caps: 500,000 units, 1,000,000 units	Infants: 200,000–400,000 units four times per day or 100,000 units to each side of mouth four times per day Child: 400,000–600,000 units four times per day Max dose 600,000 units
Oseltamivir (Tamiflu)	Caps: 30, 45, 75 mg Suspension: 6 mg/ml	Treatment: ≤8 months: 3 mg/kg/dose bid Infants ≥ 9 months: 3–3.5 mg/kg/dose bid Children & adolescents: ≤15 kg: 30 mg bid > 15–23 kg: 45 mg bid > 23–40 kg: 60 mg bid >40 kg: 75 mg bid
Penicillin V Potassium	Suspension: 125 and 250 per 5 ml Tab: 250, 500 mg	25–75 mg/kg/day every 6 hours to every 8 hours Max dose 2 g/day
Pyrantel pamoate (Reese's Pinworm Medicine)	Tab: 62.5 mg Suspension: 50 mg/ml	Pinworms, roundworms 11 mg/kg × 1 Hookworm 11 mg/kg × 3 days Max dose 1 g
Rifampin (Rifadin)	Caps: 150, 300 mg Suspension can be compounded	10–20 mg/kg/day (bid) Max dose 600 mg
Terbinafine (Lamisil)	Tab: 250 mg Suspension can be compounded	Tinea capitis: < 25 kg (125 mg/day) 25–35 kg (187.5 mg/day) > 35 kg (250 mg/day)
Trimethoprim/sulfa-methoxazole (Bactrim, Sulfatrim)	Suspension: 40 mg TMP and 200 mg SMX per 5 ml Tabs: 80/400 and 160 /800 mg	6–12 mg TMP/kg/day (bid) Max dose 160 TMP[4]
Vancomycin (Vancocin, Firvanq)	Caps: 125, 250 mg Solution: 25 mg/ml, 50 mg/ml	40 mg/kg/day divided every 6 hours to every 8 hours Max dose 2000 mg/day

Description

[1]Max dose—maximum individual (single) oral dose. [2]DRSP—drug-resistant *S. pneumonia*, for pneumonia and otitis media. [3]20 mg/kg × 1 dose required for *Chlamydia*. [4]Higher doses needed for severe UTI, *Shigella*, and pneumocystis infections.
Source: LexiComp.

Table 18-3 Goal-Directed Therapy for Septic Shock in Infants and Children[1,2]

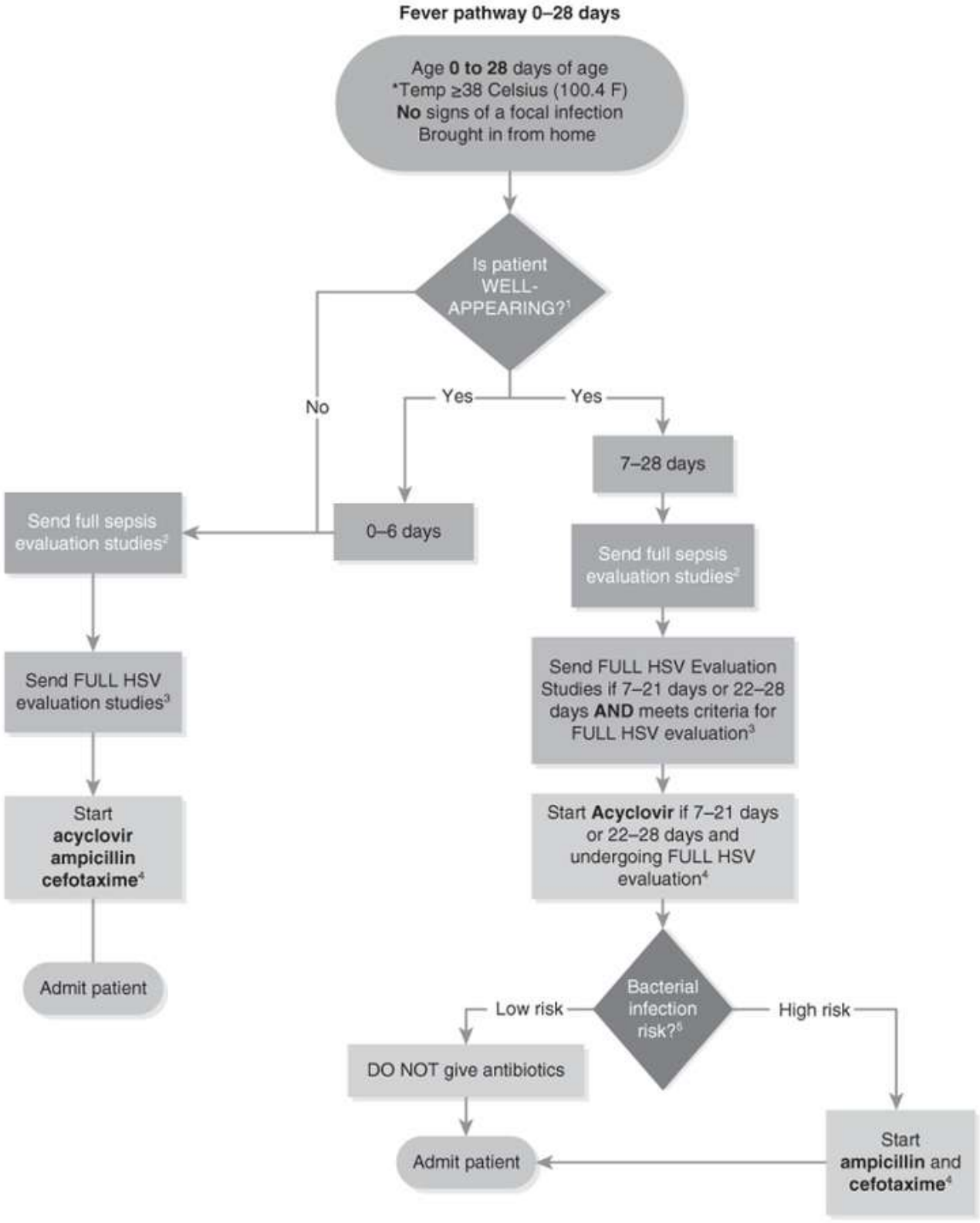


[1]**Definitions**: CR = capillary refill; LR = Lactated Ringers; NS = normal saline; SvO_2 = mixed venous oxygen saturation; PDE = phosphodiesterase inhibitor. **Inotropes:** Dopamine (5 to 10 mcg/kg/minute), dobutamine, milrinone, epinephrine(< 0.3 mcg/kg/minute or > 0.3 mcg/kg/minute with a vasodilator): use to ↑ cardiac index (CI/reverse shock if CI < 3.3 l/minute/m^2 after fluid resuscitation]. **Vasopressors:** Dopamine (≥ 10 mcg/kg/minute), norepinephrine, phenylephrine, epinephrine (> 0.3 mcg/kg/minute), or vasopressin: use to ↑ systemic vascular resistance (SVR) and reverse shock if SVR < 800 dyne-sec/cm^5/m^2 after fluid resuscitation]. **Vasodilators:** Nitroprusside or nitroglycerin to SVR if CI < 3.3 l/minute/m^2 and SVR > 1600 dyne-sec/cm^5/m^2 after fluid resuscitation. [2]Pulmonary artery catheters are not routine in pediatrics and are generally only placed in ICU setting by experts familiar with their use.

Modified from Carcillo, J. A., & Fields, A. I. Parâmetros de prática clínica para suporte hemodinâmico a pacientes pediátricos e neonatais em choque séptico. Jornal de Pediatria, 2002; 78(6). doi:10.1590/s0021-75572002000600004.

Modified from Carcillo JA, Fields AI; American College of Critical Care Medicine Task Force Committee Members. Clinical practice parameters for hemodynamic support of pediatric and neonatal patients in septic shock. *Crit Care Med*. 2002;30(6):1365-1378.

Table 18-4 Management of Febrile Neonates and Young Infants



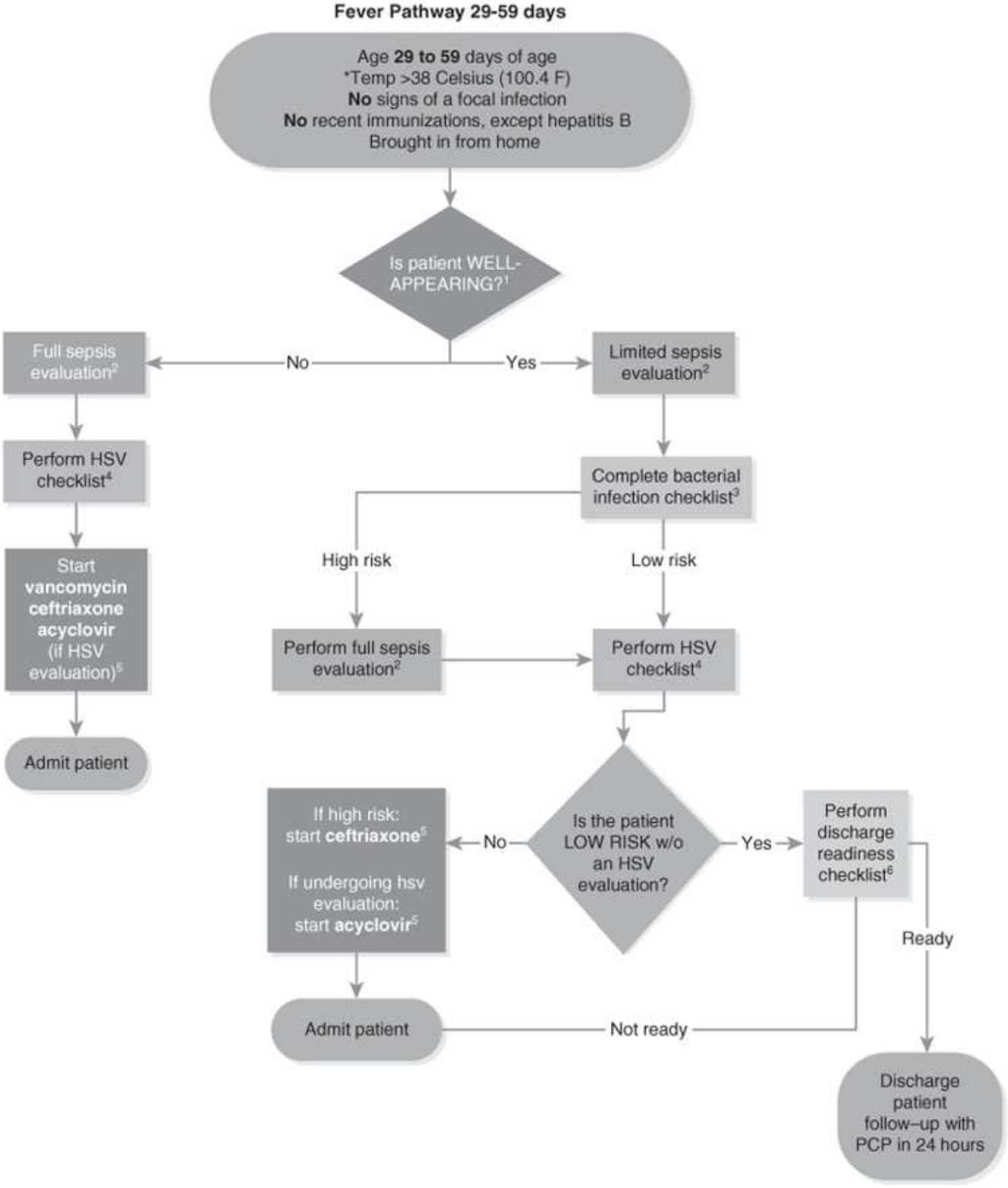
[1]Well-Appearing	• HR < 160 • RR < 60

Definition	• No oxygen requirement • Reassuring exam • Near baseline po intake • May tolerate occasional elevated HR/RR in setting of fever if not sustained. • Does not require warmer/isolette use. *Clinical judgement is to be used when determining well-appearing status.*

[2]Full Sepsis Evaluation Studies	• Catheterized urinalysis and urine culture • CSF bacterial culture, cell count, protein, glucose, Enterovirus PCR CSF, HSV PCR CSF • Blood Culture x 1 (min. 1.0 ml) • CBC with differential • Procalcitonin (IF 7–28 days) • Enterovirus PCR from plasma during peak season (June – Oct) or if CSF WBC > 13 • Chest x-ray (IF respiratory symptoms) • Respiratory viral testing (RPAN) (IF respiratory symptoms)
[3]Herpes Simplex Virus (HSV) FULL Evaluation Studies	FULL Evaluation Studies on all 0-21 days: • HSV PCR whole blood • HSV PCR CSF • HSV PCR swab of conjunctivae, nasopharynx, mouth, anus, and lesions (if present) • COMP (comprehensive metabolic panel) *If patient < 3 days of age then PCR swab will be changed to culture in the lab.* If 22–28 days old AND 1 of the following criteria: • Ill-appearing • Maternal active HSV lesions at time of delivery • Vesicles on skin exam (including scalp) • Hepatitis (elevated AST or ALT) if otherwise obtained • Abnormal neurologic status, seizure • CSF WBC > 13
[4]Medications	• Acyclovir (20 mg/kg/dose IV Q8) • Ampicillin (50 mg/kg/dose IV/IM Q6) • Cefotaxime (50 mg/kg/dose IV/IM Q8) • Consider cefepime (50 mg/kg/dose IV Q8) instead of cefotaxime if history of prolonged hospitalization (>72 hours). • Consider vancomycin (15 mg/kg/dose IV Q8) if history of MRSA.
[5]Bacterial Infection Checklist	If any Yes then considered High Risk (If lab not obtained then disregard question) • Born at less than 37 weeks gestation? • History of prior hospitalization? • Prolonged (>4 days) newborn nursery course? • Urinalysis positive for nitrites, leukocyte esterase, or WBC >5/HPF? • Is the procalcitonin elevated (>0.5 ng/mL)? • ANC > 4 K/uL?

	• CSF WBC > 13? • Does the child have a chronic illness? • Received antibiotics prior to this visit? • History of unexplained hyperbilirubinemia?

Pathway adapted from REVISE (Value in Inpatient Pediatrics Network, AAP) and Children s Mercy Hospital Guidelines. *Pathway based on data in febrile infants. Similar considerations may apply to hypothermic (<36C rectal) patients



[1]Well-Appearing Definition	• HR < 160 • RR < 60 • No oxygen requirement

	• No oxygen requirement • Reassuring exam • Near baseline po intake • May tolerate occasional elevated HR/RR in setting of fever if not sustained. • Does not require warmer/isolette use. *Clinical judgement is to be used when determining well-appearing status.*

[2]Sepsis Evaluation Studies	Limited Sepsis Evaluation Studies: • Catheterized urinalysis and urine culture • CBC with differential • Blood Culture x 1 (min 1.0 ml) • Procalcitonin (PCT) • Respiratory viral testing (RPAN) (IF respiratory symptoms) • Chest x-ray (IF respiratory symptoms) For Full Sepsis Evaluation, ADD: • CSF bacterial culture, cell count, protein, glucose, Enterovirus PCR CSF • Enterovirus PCR from plasma during peak season (June–Oct) or if CSF WBC >7
[3]Bacterial Infection Checklist	If any Yes then considered High Risk (If lab not obtained then disregard question) • Born at less than 37 weeks gestation? • History of prior hospitalization? • Prolonged (> 4 days) newborn nursery course? • Urinalysis positive for nitrites, leukocyte esterase, or WBC >5/HPF? • ANC > 4 K/µl? • Is the procalcitonin (PCT) elevated (>0.5 ng/ml)? • Does the child have a chronic illness? • Received antibiotics prior to this visit? • History of unexplained hyperbilirubinemia?
[4]Herpes Simplex Virus (HSV) Checklist	Perform HSV evaluation, see below, if 29–42 days old AND 1 of the following: • Ill-appearing • Maternal active HSV lesions at time of delivery • Vesicles on skin exam (including scalp) • Hepatitis (elevated AST or ALT) if otherwise obtained • Abnormal neurologic status, seizure • CSF WBC > 7 if otherwise obtained HSV Evaluation: • HSV PCR whole blood • HSV PCR CSF

	• HSV PCR CSF • HSV PCR swab of conjunctivae, nasopharynx, mouth, anus, and lesions (if present) • COMP (comprehensive metabolic panel) Up to clinician discretion to send HSV PCR CSF if > 42 days and concern for meningitis/encephalitis.
[5]Medications	• Ampicillin (50 mg/kg/dose IV/IM Q6) • Ceftriaxone (100 mg/kg x 1 in ED, then 12 hours later, start 50 mg/kg/dose IV/IM Q12) • Acyclovir (20 mg/kg/dose IV Q8) • Vancomycin (15 mg/kg/dose IV Q8) • Cefepime (50 mg/kg/dose IV Q8) Additional considerations: • If UTI is suspected, add ampicillin to cover for Enteroccocus. • If CSF WBC > 7, GP organisms on Gram stain or history of MRSA then add empiric vancomycin. • Consider cefepime instead of cefotaxime/CTX if history of prolonged hospitalization (>72 hours).
[7]Discharge Readiness Checklist	If any No admit the patient • Are the parents comfortable with monitoring their child at home? • Do the parents have reliable means of receiving communication from the hospital ED? • Can bacterial culture results be followed daily by the hospital/ED? • Can the patient follow up with their PCP in 24 hours? • Are they within 30 minutes of an ED?

Courtesy of University of Michigan--C.S. Mott Children's Hospital. Data from REVISE (Value in Inpatient Pediatrics Network, AAP); Kuppermann K, Dayan PS, Levine DA, et. al. A Clinical Prediction Rule to Identify Febrile Infants 60 Days and Younger at Low Risk for Serious Bacterial Infections. JAMA Pediatr. 2019;173(4):342-351.
*Pathway based on data in febrile infants. Similar considerations may apply to hypothermic (<36C rectal) patients.

Description

See viral disease/testing on pages 192–194.

BACTEREMIA

Table 18-5 Fever—Occult Bacteremia (OB)

Overview: Before Hib, pneumococcal vaccine era this was primarily a concern in those aged 3–36 months with fever ≥39°C. In the pre-vaccine era, approximately 3–10% of well-appearing children <3 years old with fever without a source were found to have occult bacteremia. Now, with widespread vaccination this number has fallen to <1%.	*Definition:* Positive blood culture with no infection and well appearance. *Pathogenesis: Enterococcus* spp., *N. meningitidis,* nontype B *H. influenza, E. coli, Moraxella catarrhalis, Salmonella* spp. and *S. aureus* *Testing:* Routine testing and empirical antibiotic administration is not warranted in well-appearing children 3–36 months with fever without a source. New studies suggest that CRP and procalcitonin may be more accurate at identifying serious bacterial infections including bacteremia than previous markers such at WBC and absolute neutrophil count.

Description

Modified from Bressan S, Berlese P, Mion T, et al. Bacteremia in feverish children presenting to the emergency department: a retrospective study and literature review. *Acta Paediatr*. 2012;101(3):271-277; Mahajan P, Grzybowski M, Chen X, et al. Procalcitonin as a marker of serious bacterial infections in febrile children younger than 3 years old. *Acad Emerg Med*. 2014;21(2):171-179; Hsiao AL, Baker MD. Fever in the new millennium: a review of recent studies of markers of serious bacterial infection in febrile children. *Curr Opin Pediatr*. 2005;17(1):56-61.

YALE OBSERVATION SCALE

Table 18-6 Yale Observation Scale (for Infants and Children Age 3–36 Months)[1]

Observation item	Normal (score 1 point)	Moderate impairment (score 3 points)	Severe impairment (score 5 points)
Quality of cry	Strong or none	Whimper or sob	Weak, moans, high pitch, hardly responds
Reaction to parents	Cries briefly, no crying, content	Cries off and on	Persistent cry with little response
State variation	Awake, or if asleep wakens quickly	Eyes close briefly, awake or wakens with prolonged stimulation	No arousal, falls asleep
Color	Pink	Pale extremities, acrocyanosis	Ashen, cyanotic, mottled, or pale
Hydration	Normal skin, eyes, mouth	Normal skin and eyes, mouth slightly dry	Skin doughy/tented, dry mouth, sunken eyes
Response overtures	Alert or smiles (consistently)	Alert or brief smile	No smile, anxious, dull no alerting to overtures

[1]Total ≤ 10 points = 2.7% probability of serious illness (SI); Total 11–15 points = 26% probability of SI; Total ≥ 16 points 92% probability of SI.

Description

NEISSERIA MENINGITIDIS

Occult bacteremia from *N. meningitidis*—Rare cause of occult bacteremia and is found in only 0.03% 3–36 months with fever ≥ 39°C. Temperature, WBC, and neutrophil count are useless at discriminating viral syndromes from *N. meningitidis* OB.

Meningococcemia is a symptomatic blood-borne infection; 71% have fever > 38°C, 4% are < 36.8°C, 71% have rash [59% purpura or petechiae, 10% maculopapular (possibly due to misdiagnosis of rash type), pustular/bullae 1%]. The mean WBC count is 14,000 cells/mm^3 while 21% have a WBC count < 5,000; 14% have platelets < 100,000 mm^3; 55% have meningitis, 11% arthritis, 8% pneumonia. If positive culture or suspicion *N. meningitidis*, admit, IV antibiotics spinal tap. See page 155 for antibiotics and treatment of exposed. Because of this disorder, consider adding "return if any new rash" to discharge instructions for febrile children.

Table 18-7 Evaluation of Petechial Rash[1]

Feature	Possible cause
Ill or toxic	Meningococcemia or Rocky Mountain Spotted Fever
Sick contacts	Meningococcemia, rubella, Epstein-Barr, enterovirus, hepatitis B, gonococcemia, rheumatic fever
Travel or local ticks	Rocky Mountain Spotted Fever, dengue, typhus, rat bite fever
Palpable purpura	Vasculitis and infectious
None of above	Thrombocytopenia (ITP, TTP) or other platelet disorder

Description

[1]Listed disorders are not exhaustive, and features may be absent in many with described possible causes of petechiae.

Table 18-8 Fever and Petechiae Etiology in 190 Children Presenting to a Pediatric ED[1,2]

Organism identified		No organism found—clinical diagnosis	
N. meningitidis	7%	Viral syndrome	45%
With meningitis	4%	Otitis media	13%
Without meningitis	3%	Aseptic meningitis	3%
S. pneumoniae/H. influenzae	1%	Pneumonia	3%
Streptococcus pyogenes pharyngitis	10%	Otitis media with pneumonia	2%
RSV infection	6%	Exudative pharyngitis, partially treated sepsis, or meningitis	1% each
Other hemabsorbing virus	6%		
Enterovirus or rotavirus GI tract	2%	Henoch-Schönlein purpura, Rocky Mountain Spotted Fever, ALL	0.5% each
Enteroviral meningitis	1%		
E. coli urinary tract infection	1%	MMR vaccine reaction	1%

[1]A toxic or ill child with fever and petechiae (or meningeal signs) requires emergent IV antibiotics (see page 154) and IV fluids with blood pressure support if needed. [2]In one study, if fever and petechiae were present, 2% had bacteremia or sepsis. Well-appearing children had a 0% (0–3%, 95% confidence interval [CI]) probability of serious infection (SBI). If they had a WBC of 5–15,000 they had a 0% (0–2%, 95% CI) probability of SBI, and if they had no purpura they had 0% (0–1% 95% CI) probability of SBI. Petechiae limited to face, neck, and chest above the nipples in well-appearing children also may not need further evaluation. Modified from Baker RC, Seguin JH, Leslie N, Gilchrist MJ, Myers MG. Fever and petechiae in children. Pediatrics. 1989;84:1051; Mandl KD, Stack AM, Fleisher GR. Incidence of bacteremia in infants and children with fever and petechiae. J Pediatr. 1997;131:398.

Description

One retrospective study proposes using the irritability, lethargy and low capillary refill (ILL) criteria for identifying children with serious bacterial infections in children who present with fever and petechiae with a sensitivity of 100% (95% CI, 48–100%); specificity 57% (37–76%).

Data from Brogan P, Raffles A. The management of fever and petechiae: making sense of rash decisions. Arch Dis Child. 2000;83(6):506–507.

Table 18-9 Pediatric Bacterial Meningitis Score

Predictors (Points)[1]	**Predictive value (PV) of total score[2]**	
Bacteria on gram stain (2)	Sensitivity (total score ≥ 1)	99.6–100%

CSF protein ≥ 80 mg/dl (1)		
Serum WBC count ≥ 10,000 cells/mm^3 (1)	Sensitivity (total score ≥ 2)	87%
Seizure at or before presentation (1)	Negative PV (total score = 0)	> 99%
CSF neutrophils ≥ 1000 cells/mm^3 (1)		

Description

[1]CSF—cerebrospinal fluid; WBC—white blood cell. [2]Total score = 2 points for gram stain, and 1 point for each of other listed predictors. Predictive value denotes ability to diagnose bacterial meningitis. If none of the criteria are present in a child with CSF pleocytosis, the risk of bacterial meningitis is 0.1%.

Modified from Nigrovic LE, Kuppermann N, Malley R. Development and validation of a multivariable predictive model to distinguish bacterial from aseptic meningitis in children in the post-Haemophilus influenza era. *Pediatrics.* 2002;110:712; Dubos F, De la Rocque F, Levy C, et al; Bacterial Meningitis Study Group. Sensitivity of the bacterial meningitis score in 889 children with bacterial meningitis. *J Pediatr.* 2008;152:378.

TICK-BORNE DISEASE

Table 18-10 Ehrlichiosis

Description	Features in pediatric HME	
Human monocytic and granulocytic ehrlichiosis (HME and HGE)—A febrile illness due to *Rickettsia* transmitted by Lone Star or wood tick especially in the southeast, south central, and Midwest United States; 90% occur from April to September. Deer, livestock—hosts. Incubation is 12–14 days. Diagnose—Wright stain, antibody titer (*CDC requires compatible Hx + ≥ 1:64 titer or a fourfold change between acute and convalescent titers*). *Treatment*—See page 147 for disease treatment recommendations.	• Fever • Known tick bite • Headache/Myalgia • ↑ Liver/Spleen • Rash trunk + extremity macule/papule/petechiae • ↑ LFT • ↓ Platelets • ↓ WBC/Lymphocytes • ↓ Sodium • Anemia	100% 82% 63% 41% 66% 89% 82% 69/80% 65% 39%

Table 18-11 Lyme Disease

Description	Features in children	
Inflammatory disease vs. multiple organs due to spirochete (*Borrelia burgdorferi*) transmitted by ticks (deer tick). Disease can be (1) *early local* 1–2 weeks (ECM/erythema chronicum migrans), red macule or papule expands to large size (mean 16 cm in adults) resolves over a week. (2) *Early disseminated* 2–12 weeks, carditis, early arthritis (mean 2.4 large joints; knee > ankle; 2 to 100,000 cells/mm^3, esp. eosinophils), meningitis, multiple EM lesions. (3) *Chronic* arthritis or neuro deterioration. Diagnose by ELISA or IFA followed by more specific Western immunoblot if equivocal or positive first test. *Treatment*—see page 152.	• ECM rash esp. at skin crease (mean adult size 16 cm) • Flulike symptoms • Arthritis/Arthralgia (40% > 1 joint) • Known tick bite • ECG changes esp. • first-degree AV block • Bell's palsy (seventh CN) • Aseptic meningitis • Myelitis/Neuropathy	68% 64% 59% 49% 29% 14% 4% 1%

Table 18-12 Rocky Mountain Spotted Fever (RMSF)

Description	Features in children
RMSF—vasculitis due to *R. rickettsii*—most cases occur in the south Atlantic, southeast, and south	

central United States, although disease is widespread. Wood and dog tick transmit. 90% occur from April to September with 2/3 < 15 years old. Incubation is 2–12 days. Tests are not positive until 7–10 days. The Weil-Felix test is inaccurate and no longer used to diagnose. Instead immunofluorescence assay (IFA) or ELISA testing is often used.	• Headache/Myalgias/Fever • + Abdomen pain, diarrhea. • Rash (95%)—starts on wrists and ankles and spreads centrally • Palm/Sole rash (50–75%) • NO tick bite reported (40%) • Seizures/Meningismus • DIC/Shock
Treatment—Mortality is rare if treated before fifth day of illness; therefore, observe in first 2–4 days if uncertain diagnosis and well appearing. Treat based on clinical picture and not lab tests. Doxycycline is drug of choice with little concern for tooth discoloration if used for < 7–10 days (see Table 18-2 for dose). Fluoroquinolones and chloramphenicol are possible alternatives. In endemic areas, many physicians treat empirically if combination of fever, headache, rash.	• WBC count normal or ↓ Platelets, ↓ Hb • ↓ Sodium, ↑ BUN, ↑ LFTs • Biopsy immunohistology IFA 70% sensitive/100% specific • ELISA/IF antibody tests turn + 7–10 days after onset

Description

Table 18-13 Southern Tick-Associated Rash Illness (STARI)

	Features in children
The exact cause of STARI is unknown, although it may be due to *Borrelia lonestari* with the Lone Star tick serving as a vector centralized to southeast, south central United States. Peak incidence is earlier than Lyme (May to June). Symptoms are similar to Lyme disease although less severe at the time of diagnosis and more rapid clearing of symptoms after treatment. Tests for Lyme disease are usually negative, and there is no definitive diagnostic test. *Treatment*: Many experts recommend doxycycline, amoxicillin, or cefuroxime treatment.	• Erythema chronicum migrans-like rash (smaller) • Rash: Less pruritus, less tender than Lyme • Regional lymph nodes • Flulike symptoms occur • Arthralgias are common • Late complications are uncommon (e.g., arthritis, neurologic deficits)

Description

TICK BITES

Tick bite—In one study, a single doxycycline dose given to those with tick bites in Lyme-endemic areas, decreased erythema migrans from 3.2% to 0.4%. *Dose:* 4 mg/kg PO (maximum 200 mg). Risks, benefits, side effects esp. in those ≤ 8 years must be considered.

Source: Data from Nadelman RB, Nowakowski J, Fish D, et al.; Tick Bite Study Group. Prophylaxis with single-dose doxycycline for the prevention of Lyme disease after and Ixodes scapularis tick bite. N Engl J Med. 2001;345(2):79-84.

Tick paralysis—A toxin produced by many different ticks (>60 species identified) inhibits presynaptic acetylcholine release. Exposure to tick occurs 5–10 days prior to symptoms. The most common tick locations are the scalp, behind an ear, neck, and groin. In the United States, 82% are younger than 8 years old, and 64% are females. Rapid ascending paralysis occurs over 12–36 hours. Bulbar (eye muscle) involved early. Focal weakness and pupil dilation are common in Australia (not US ticks). Fifty percent have paresthesias with normal sensory exam, and patients are often misdiagnosed as Guillain-Barré. In one series, all cases occurred from March to June (in the United States). Removal of tick is curative, although Australian form of disease may worsen more than 48 hours after removal and may be amenable to antitoxin.

Source: Data from Edlow JA, McGillicudy DC. Tick paralysis. *Infect Dis Clin North Am*. 2008;22(3):397-413.

Table 18-14 Tick Removal—Procedure

Description
• Apply gloves ± inject small wheal of lidocaine + epinephrine directly beneath tick. • Applying petroleum jelly, alcohol, fingernail polish, or hot match to underside of tick may cause regurgitation (of organisms) and should be avoided. • Using blunt tweezers, grasp the tick as close as possible to the skin. • Pull slowly in a firm perpendicular direction, do not squeeze or rotate tick. • Cleanse area thoroughly after procedure with disinfectant. • Person performing procedure should thoroughly wash hands afterward. • Place tick into alcohol or flush down the toilet.

Table 18-15 AAP-AAFP Acute Otitis Media (AOM) Guidelines

Certain diagnosis of AOM requires the following:		
• Presence of a middle ear effusion (MEE) AND one of the following • Moderate to severe bulging of the tympanic membrane or otorrhea not due to acute otitis externa OR • Mild bulging of the tympanic membrane with ≤48 hours otalgia OR intense erythema of the tympanic membrane		
Criteria for initial antibiotics or observation in children with AOM		
Age	**Severe Signs and Symptoms[1]**	**Mild Signs and Symptoms[2]**
<6 months	Antibiotics	Antibiotics
6 months–2 years	Antibiotics	Antibiotics if bilateral; if unilateral antibiotics vs. OBS[3]
≥2 years	Antibiotics	Antibiotics vs. OBS for either bilateral or unilateral disease[3]
Antibiotic recommendations		
First line if no antibiotics in the past 30 days and no concurrent purulent conjunctivitis OR if observation failure at 48–72 hours: Amoxicillin 80–90 mg/kg/day, OR if nontype I penicillin (PCN) allergy: Cefdinir 14 mg/kg/day or divided BID, cefuroxime 30 mg/kg/day divided BID, cefpodoxime 10 mg/kg/day divided BID OR if type I PCN allergy[4]: azithromycin, clarithromycin. *If antibiotic failure at 48–72 hours of treatment:* Augmentin 90 mg/kg/day, OR if nontype I PCN allergy, ceftriaxone 50 mg/kg IM × 3 days, OR if type I PCN allergy: clindamycin 10 mg/kg/dose three times per day *If recent antibiotics in the past 30 days or concurrent purulent conjunctivitis:* Augmentin 90 mg/kg/day, OR if nontype I PCN allergy, ceftriaxone 50 mg/kg IM × 1 to 3 days. *If antibiotic failure:* Ceftriaxone 50 mg/kg IM × 3 days, OR tympanocentesis plus clindamycin.		

Description

[1]Moderate/severe otalgia ≥ 48 hours; or T ≥ 39°C. [2]Mild otalgia, T < 39°C. [3]Observation based on shared decision making with 48- to 72-hour follow-up. [4]Type I allergy (hypersensitivity) = urticaria or anaphylaxis.

Modified from Lieberthal AS, Carroll AE, Chonmaitree T, et al. The diagnosis and management of acute otitis media. *Pediatrics.* 2013;131:e964; Schilder AG, Marom T, Bhutta MF, et al. Panel 7: Otitis media: treatment and complications. *Otolatyngol Head Neck Surg*. 2017;156:s88-s105.

Table 18-16 CDC/AAP Guidelines for Judicious Use of Antibiotics (Abx) in Pediatric Respiratory Infections

"Cold"	• Mucopurulent rhinitis alone is not indication for Abx. See sinusitis, which follows.
AOM and otitis media with effusion (OME)	• Diagnosis of AOM requires middle ear effusion and signs or symptoms of acute local or systemic illness. • Uncomplicated AOM may treat with 5–7 days of Abx if > 2 years old. • Abx are not indicated for OME unless effusion persists ≥ 3 months. • Abx prophylaxis is reserved for control of recurrent AOM (defined as ≥ 3 distinct/well-documented episodes in 6 months or ≥ 4 in 12 months).
Pharyngitis	• Guidelines recommend group A strep (GAS) testing with treatment decision based on results. • Testing should be performed on patients with ≥ 2 criteria (see table that follows). • Children under the age of 3 should not be routinely tested. • Empiric treatment may be considered for symptomatic children with confirmed GAS exposure.
Sinusitis	• Clinical diagnosis of bacterial sinusitis requires persistent or worsening upper respiratory signs and symptoms (e.g., rhinosinusitis/cough >10–14 days) or more severe features (temp ≥ 39°C, facial swelling or pain, and purulent discharge for ≥3 days). • Radiograph indications: recurrence, suspect complication, diagnosis unclear. CT is reserved if surgery is being considered. • See CDC antibiotic recommendations on Table 18-15.

Description

Modified from Hersh AL; AAP Committee on Infectious Disease. Principles of judicious antibiotic prescribing for upper respiratory tract infections in pediatrics. *Pediatrics.* 2013;132(6):1146-1154.

Table 18-17 Clinical Scoring for Group A Streptococcal Pharyngitis[1]

Individual clinical features	Individual points
Fever > 38.3°C (101°F)	1
Age 5–15 years	1
November–May presentation	1
Cervical adenopathy	1
URI absent (i.e., cough, rhinorrhea, congestion)	1
Pharyngitis (i.e., tonsillar erythema, hypertrophy, or exudate)	1

Description

[1]Total Points: 0–1 (0% group A strep), 2–3 (20% strep), 4 (42%), 5 (63%), 6 (75%). See treatment, page 157.

Modified from Wald ER, Green MD, Schwartz B, et al. A streptococcal score card revisited. *Pediatr Emerg Care.* 1998;14:109.

Bordetella pertussis mimics *Chlamydia pneumonitis*, but has a paroxysmal, inspiratory "whoop" (may be absent in children younger than 6 months). Prolonged coughing attacks may lead to cyanosis, emesis, hypoxia. In one study, the mean age was 55 days, mean WBC count was 20,000/µl while 90% having an absolute lymphocyte count > 9,400.[1] In another study, children with sicker disease had higher mean white blood cell counts (>30,000), higher heart rates and respiratory rates compared to children with less severe illness from pertussis.[2]

Data from [1]Guinto-Ocompo H, Bennett JE, Attia MW. Predicting pertussis in infants. *Pediatr Emerg Care*. 2008;24:16-20. [2]Murray EL, Nieves D, Bradley JS, et al. Characteristics of severe Bordetella pertussis infection among infants ≤90 days of age admitted to Pediatric Intensive Care Units-Southern California, September 2009-June 2011. *J Pediatr Infect Dis Soc*. 2013;2:1-6.

Chlamydia—3–16 weeks. First rhinorrhea, then staccato cough, tachypnea, rales, or wheeze. 95% afebrile, 50% have concurrent/prior conjunctivitis. *Mycoplasma*—low-grade fever, malaise, headache, nonproductive cough lasting weeks. It is responsible for 9–21% of school-aged pneumonia, may occur in epidemics with little seasonal variation. *Pneumococcus* and *H. flu* are typically associated with an abrupt onset of high fever and dyspnea, and may be preceded by a viral URI. *Tuberculosis* is associated with subacute cough, night sweats, and weight loss.

Table 18-18 Most Common Cause of Pneumonia Based on Age[1]

Age	Bacterial	Viral	Other
<3 weeks	Most common • Group B streptococcus • *E. coli* • *Listeria* Less common • *S. pneumoniae* • *S. aureus* • Anaerobes	• CMV • RSV • hMPV • HSV • Rubella	• *B. pertussis* • *C. trachomatis* • *Mycobacterium hominis* • *Treponema pallidum* • *Ureaplasma urealyticum*
3 weeks–3 months	• *S. pneumoniae* • *S. aureus* • *H. influenzae* (nontypable)	• RSV • hMPV • Parainfluenza • Adenovirus • Influenza	• *B. pertussis* • *C. trachomatis*
3 months–5 years	• *S. pneumoniae* • *S. pyogenes* • *S. aureus*	• RSV • hMPV • Parainfluenza • Adenovirus • Influenza	• *Mycoplasma pneumoniae* • *Chlamydia pneumoniae* • *Mycobacterium tuberculosis*
>5 years	• *S. pneumoniae* • *S. pyogenes* • *S. aureus*	• hMPV • Influenza • Adenovirus	• *M. pneumoniae* • *C. pneumoniae* • *M. tuberculosis*

[1]CMV–cytomegalovirus; RSV–respiratory syncytial virus; hMPV–human metapneumovirus; HSV–herpes simplex virus.

Description

No single physical exam finding can differentiate pneumonia from other respiratory illnesses. However, hypoxia < 96% and increased work of breathing (grunting, nasal flaring, or retractions) are more suggestive of pneumonia compared to respiratory rate, fever, or auscultatory findings.

Modified from Shah S, Bachur RG, Simel DL. The rational clinical examination. *JAMA*. 2017;318(5):462-471; Rambaud-Althaus C, Althaus F, Genton B, et al. Clinical features for diagnosis of pneumonia in children younger than 5 years: a systematic review and meta-analysis. *Lancet Infect Dis*. 2015;15:439-450.

Table 18-19 Pneumonia Admission Criteria—British Thoracic Society Guidelines[1,2]

Evaluation	Admit criteria
Pulse oximetry for all admissions	O_2 sat < 93% (some use < 91–92%)
CXR not routine if disease mild, uncomplicated[1]	RR > 60–70/minute (>45–50 child)
Labs not useful for bacteria vs. viral disease	Dyspnea, apnea, or grunting
Recommend blood culture if suspect bacteria[3]	Poor intake, significant dehydration
Obtain viral antigen studies < 18 months (inpatients)	Family can't observe/supervise
Reevaluate at 48–72 hours if fever persists	Premie infant, or age < 2–3 months

Description

[1]Guidelines for uncomplicated disease in healthy patients (judgment can override this); many US experts routinely obtain CXR. [2]See pages 158–159 for therapy, also consider admit if failed oral antibiotics. [3]Proven useless for uncomplicated community acquired disease, consider blood culture if immunocompromised or ill (e.g., ICU admit).

UTI

Table 18-20 Urinary Tract Infections (UTI) and Pyelonephritis

	Age	UTI risk[1]
Organisms in neonates: *E. coli* 74%, *Klebsiella* 7%, *Pseudomonas* 7%, *Proteus* 4%. In older infants/children: *E. coli* is most common. *Proteus* and *Pseudomonas* are more common if hospitalized, recurrent UTI, or male.	0–2 months 2–24 months 2–5 years	7.5% 4.1% 1.7%

Description

[1]If fever present.

Table 18-21 Risk Factors for UTI[1]

- Females < 2 years old
- Fever ≥ 2 days
- No alternate source for fever
- White/Caucasian
- Temperature ≥ 39° C
- Prior urinary infection or anatomic abnormality
- Males < 6 months old (or < 12 months, uncircumcised)

Description

[1]In females, the presence of ≥ 2 of the following five criteria identified 99% (94–100%) with a UTI: white race, age < 12 months, temperature ≥ 39°C, no other source for fever, or fever ≥ 2 days.

Data from Gorelick MH, Hoberman A, Kearney D, Wald E, Shaw KN. Validation of a decision rule identifying febrile young girls at high risk for urinary tract infection. *Pediatr Emerg Care.* 2003;19:162-164. doi:10.1097/01.pec.0000081238.98249.40.

Table 18-22 Predictive Value of Urinalysis (UA) in Detecting UTI[1]

Urinalysis feature	Sensitivity	Negative predictive value
Any WBC/high power field (hpf)	77%	97%
≥ 5 WBC/hpf	43–84%	90–98%

Any bacteria	86–93%	99%
Leukocyte esterase, nitrates, or ≥ 5 WBC/hpf	75–98%	85–99%
Positive gram stain for bacteria	94–99%	99%

Description

[1]93% of culture positive bag urines are false positives; therefore, catheterized urine is preferred for those still in diapers. A UA is insensitive for UTI; therefore, culture all aged < 3 years. Nitrate positive organisms = *E. coli*, *Proteus*, *Klebsiella*, *Enterobacter*, *Salmonella* (not *S. saprophyticus*, *Pseudomonas*, or *Enterococcus*).

Table 18-23 Management Options for Urinary Tract Infections

Admit	• ≤2–3 months old, obstruction, high-grade reflux, dehydration, vomiting, toxicity, nephrolithiasis, or immunocompromised
IV antibiotics	• Ceftriaxone 50–75 mg/kg/dose IV (do not use <28 days old) OR • Cefotaxime (neonates) 50 mg/kg/dose IV every 8 hours–every 12 hours OR • Gentamicin 2–2.5 mg/kg/dose IV every 8 hours + ampicillin 50 mg/kg/dose IV every 6 hours (esp. if gram-positive bacteria) OR piperacillin-tazobactam IV 240–300 mg/kg/day (piperacillin component) divided every 6 hours–every 8 hours (max 16 g/day)
Oral antibiotics	• Cephalexin 50–100 mg/kg/day PO divided every 6 hours –every 8 hours (max 4 g/day), OR cefixime 8 mg/kg/day PO divided every 12 hours–every 24 hours (max 400 mg/day), OR sulfamethoxazole-trimethoprim 6–12 mg/kg/day (trimethoprim component) PO divided every 12 hours (max 160 mg TMP/dose), OR amoxicillin-clavulanate 20–40 mg/kg/day PO divided every 8 hours, OR nitrofurantoin (Furadantin, Macrodantin) 5–7 mg/kg/day PO divided every 6 hours, nitrofurantoin (Macrobid-adolescents) 100 mg PO every 12 hours. Treat for 14 days if fever/toxic, 7–

	14 days if no fever and no toxicity; see Table 18-2
Urinary tract evaluation	• No clinical response in first 48 hours: urinary tract US/CT (to exclude abscess/obstruction) + voiding cystourethrogram (VCUG) or radionuclide cystography (RNC) at earliest convenience. VCUG preferred in males to assesses urethra for posterior valves. If nontoxic or doing well, VCUG or RNC at earliest convenience. • Continue antibiotics while awaiting the previously mentioned study. Radionuclide renal scans/DMSA and CT will identify acute changes from pyelonephritis or renal scarring. Their exact role in aiding management of a child with UTI is still undefined.

Description

Table 18-24 Cause of Acute Viral Respiratory Infections ≤ 5–7 Years

Virus	%	Virus	%
Rhinovirus (Picornavirus)	9–52	Influenza	2–7
Respiratory syncytial virus	7–60	Adenovirus	2–9
Human metapneumovirus	3–19	Coronavirus	3–16
Parainfluenza	3–11	Bocavirus	2–19
Multiple viruses	7–22		

Modified from Fillatre A, Francois C, Segard C, et al. Epidemiology and seasonality of acute respiratory infections in hospitalized children over four consecutive years (2012–2016). *J Clin Virol.* 2018;102:27-31; Arbefeville S, Ferrieri P. Epidemiologic analysis of respiratory viral infections mainly in hospitalized children and adults in a Midwest university medical center after the implementation of a 14-virus multiplex nucleic acid amplification test. *Am J Clin Pathol.* 2017;147:43-49; Wishaupt JO, van der Ploeg T, de Groot R, et al. Single and multiple viral respiratory infections in children: disease and management cannot be related to a specific pathogen. *BMC Infect Dis.* 2017;17:62; Berry M, Gamieldien J, Fielding BC. Identification of new respiratory viruses in the new millennium. *Viruses.* 2015;7:996-1019.

Description

Table 18-25 Comprehensive Respiratory Viral Panel[1] (6–78 hours turnaround time)

Virus	Sensitivity[2] (%)	Specificity (%)
Adenovirus	96.4	99.7
Coronavirus (299E)	82.4	100
Coronavirus (HKU1)	100	100
Coronavirus (NL63)	100	99.7

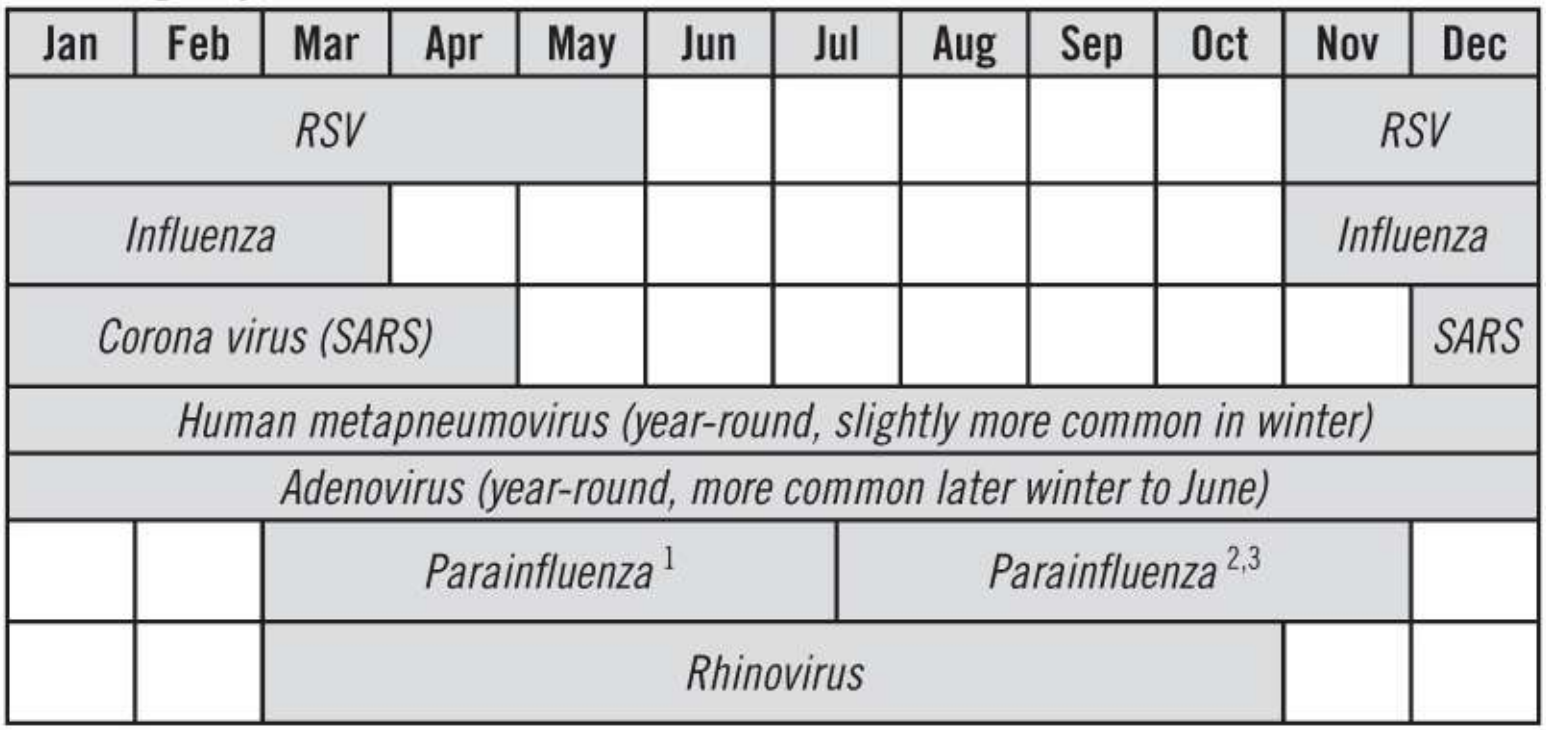
Coronavirus (OC43)	100	99.4
Influenza A	96.8	100
Influenza A (H1N1)	100	100
Influenza A (H1)	100	100
Influenza A (H3)	100	99.4
Influenza B	41	100
Metapneumovirus	93.3	100
Parainfluenza 1	93.3	100
Parainfluenza 2	63.6	100
Parainfluenza 3	100	100
Parainfluenza 4	100	100
Rhinovirus/Enterovirus	100	98
RSV A	100	99.7

RSV B	95.5	100

Description

[1]Data for the Luminex Molecular Diagnostics xTAG RVP Fast Assay. [2]Rapid tests for these viruses (esp. influenza and RSV) are < 50–90% sensitive.
Modified from Pabbaraju K, Wong S, Tokaryk KL, et al. Comparison of the Luminex xTAG Respiratory Viral Panel with xTAG Respiratory Viral Panel Fast for diagnosis of respiratory virus infections. *J Clin Microbiol*. 2011;49(5):1738-1744.

Table 18-26 Seasonal Variation in Respiratory Viruses (North America, Excluding Tropics)



Description

CORONAVIRUS (AND SEVERE ACUTE RESPIRATORY SYNDROME/SARS)

This is the second leading cause of the common cold after the rhinoviruses. Subtype caused 2002 outbreak of SARS. SARS incubation period is 2–7 days (max reported 14 days). In SARS, severe illness can occur with fever, hypoxia, cough, dyspnea, and pneumonia. Serum WBC often <3,500 cells/ml and lymphocytes <1,000 cell/ml. Diagnose via antibody testing, PCR, and viral culture. Low Na, K, and high CK, LDH, ALT, AST may occur. CXR = interstitial infiltrate or diffuse patchy consolidation; effusions, nodes are rare.

Treatment: Anecdotal reports indicate that steroids plus ribavirin, or Tamiflu, or lopinavir/ritonavir may be useful. Interferon may also have an anti-SARS effect.

INFLUENZA (FLU)

Influenza is a highly contagious viral infection. The prior season's subtypes of A: H1N1, H3N2, and influenza B are used to make the seasonal vaccine. Vaccination is 79–90% protective (within 2 weeks). One H1N1 subtype (formerly "swine" flu) caused most cases in 2009 with high mortality in the very young and unhealthy. H5N1 (bird flu) sporadically causes serious illness (esp. Asia).

Clinical: Compared to the common cold, flu has more abrupt onset, headaches, higher temps, severe cough, myalgias, chest pain, fatigue with less rhinorrhea, and sneezing. The triad of headache, cough, and pharyngitis in children predicts flu with 80% sensitivity, 81% specificity. If high-risk medical condition, pneumonia, respiratory distress, history of influenza B, admission is usually warranted. Vomiting and diarrhea are more common with H1N1 than seasonal influenza.

Table 18-27 Accuracy of Antigen-Based Rapid Diagnostic Assays—Influenza

Tests	Sensitivity[1]	Specificity
Direct fluorescent antibody	62%	98%
Indirect immunofluorescent antibody	50–75%	95–97%
Optical immunoassay	71%	82%

Description

[1]Sensitivity of rapid tests for H1N1 was only 10–70% in 2009.

Modified from Uyeki TM. Influenza diagnosis and treatment in children: a review on clinically useful tests and antiviral treatment for influenza. *Pediatr Infect Dis J.* 2003;22(2):164-177.

Diagnosis: CDC recommends diagnostic testing if hospitalized, or if results will aid in making decisions regarding clinical care, infection control, or managing close contacts. The most accurate is a real-time reverse transcription polymerase chain reaction (rRT-PCR), which can take days to receive results.

Complications: Severe viral pneumonia with hypoxia or bacterial superinfection 3–7 days after developing influenza can occur. Important bacterial pathogens are *S. pneumonia* (common in the 2009 season) and *S. aureus*. Meningitis and encephalitis can also occur. Myositis (esp. influenza B) causes severe calf pain and high CK levels. Rhabdomyolysis occurs in < 5% of myositis cases.

Source: Data from Agyeman P, Duppenthaler A, Heininger U, Aebi C. Influenza-associated myositis in children. Infection. 2004;32:199.

Treatment: See pages 151–152 for oral and IV antivirals and www.cdc.gov for updates. The CDC does NOT recommend relying on results of a rapid flu test for treating ill or high-risk patients. Treatment is generally indicated if the child is younger than 2 years (CDC states age younger than 5 years is high risk with the highest risk being in children under 2 years), adults 65 years and older, pregnant women up to 2 weeks before delivery, the chronically ill (asthma, heart failure, chronic lung disease), those with weak immune systems (diabetes, HIV, immunosuppressants), or those on long-term aspirin therapy (if younger than 19 years old). Also treat those who are admitted to the hospital.

RESPIRATORY SYNCYTIAL VIRUS (RSV)

The most common cause of bronchiolitis. See pages 267–268 for details regarding bronchiolitis management. Test high-risk patients (e.g., congenital heart disease, chronic lung disease, prematurity).

Table 18-28 Accuracy of Antigen-Based Rapid Diagnostic Assays in RSV[1]

Test	Sensitivity	Specificity
Direct/indirect fluorescent antibody	93–98%	92–97%
Enzyme linked immunoassay	59–97%	75–100%
Direct immunoassay	93%	91%
Optical immunoassay	88–95%	97–100%

Description

[1]Admitted ill patients might benefit from ribavirin (controversial). Prophylactic palivizumab (Synagis), if high risk during RSV season.
Modified from Henrickson K, Hall C. Diagnostic assays for respiratory syncytial virus disease. *Pediatr Infect Dis J.* 2007;26:S36.

19 ■ KAWASAKI DISEASE

Overview: Kawasaki disease (KD) is an acute vasculitis of unknown origin. It leads to cardiac complications in 25% of untreated cases and is the most common cause of acquired heart disease in children. The earliest sign is high fever (often ≥ 40°C) for up to 10 days. KD is characterized by an initial necrotizing arteritis, followed by subacute/chronic vasculitis, and finally luminal fibroblastic proliferation.

PHASES OF KAWASAKI DISEASE

- *Acute phase* (0–2 weeks from onset): Fever, rash, conjunctivitis, nodes, mucosal edema, ± myocarditis
- *Subacute phase* (2–8 weeks): Arthritis, epidermal desquamation (usually begins in periungual region), possibility of cardiac thrombi/aneurysm forming
- *Convalescent phase* (up to 2 years): Risk of coronary aneurysm

Table 19-1 Diagnostic Criteria[1,2]

Fever lasting at least 5 days without other source, and at least four of the following:

- Bilateral bulbar, nonexudative conjunctival injection (often spares limbus)
- Mucous membrane changes (e.g., injected pharynx, strawberry tongue or redness, fissuring, and crusting of lips)
- Edema or erythema of palms or soles (desquamation in subacute phase)
- Rash (polymorphous and truncal)
- Cervical adenopathy, with at least one node > 1.5 cm (least common feature)

Description

[1]Other *nondiagnostic* features: sleep disturbances (90%), urethritis and sterile pyuria (75%), uveitis/iritis (80%), arthralgias/arthritis (~30%), or hemolytic uremic syndrome (rare).
[2]*Incomplete or atypical KD*: If 2 or 3 criteria with fever ≥ 5 days OR infants with unexplained fever ≥ 7 days. Measure CRP and ESR, if CRP ≥ 3.0 mg/dl or ESR ≥ 40 mm/hour, then obtain serum albumin, CBC, serum transaminase and urine. If ≥ 3 of following labs are present, diagnose with KD plus treat and perform echocardiogram: albumin ≤ 3 g/dl, anemia (for age), WBC > 15,000/mm^3, high ALT, urinalysis ≥ 10 WBCs/hpf, platelets > 450,000/ mm^3 (> 7 days from onset); if < 3 labs are present, obtain echo. If echo+, treat as KD. If echo negative, consider serial examination and labs, repeat echo, or consult KD expert.
Modified from McCrindle BW, Rowley AH, Newburger JW, et al. Diagnosis, treatment, and long-term management of kawasaki disease: a scientific statement for health professionals from the American Heart Association. *Circulation*. 2017;135(17):e927-e999.

DIAGNOSTIC TESTS

- Elevated platelet count during (subacute) thrombosis stage, normal acutely
- Leukocytosis, with left shift, normochromic/normocytic anemia, CRP and ESR elevation
- Urine—Moderate sterile pyuria (avoid catheterization, can be urethral in origin), occasional bilirubinuria due to gallbladder hydrops
- CXR—Cardiomegaly in up to 30%, electrocardiogram (ECG) in first week: low voltage, ST depression; second to third week: PR and QT prolongation, ST elevation

TREATMENT

- *Gamma globulin*: Administer 2 g/kg IV over 10–12 hours as a single infusion (10–20% will be refractory to IVIG).
- *Aspirin*: 80–100 mg/kg/day PO or PR divided four times per day until 14th day of illness, then 3–5 mg/kg PO daily until 6–8 weeks after onset. If coronary artery aneurysm present on echocardiogram, continuation of aspirin > 8 weeks may be indicated.
- *Obtain echocardiogram and ECG* on presentation. Repeat in 14, 21, and 60 days.

20 ■ INBORN ERRORS OF METABOLISM

Table 20-1 Specific Inborn Errors of Metabolism (IEM), by Biochemical Features[1]

Metabolic acidosis	Serum NH_3	Glucose	IEM type
↔	↔	↔	Nonketotic hyperglycinemia
↔	↑	↔	*Citrulline normal* (transient hyperammonemia of newborn or hyperornithinemia, hyperammonemia, and homocitrullinuria [HHH]). **Urea cycle disorders** *low citrulline* (↓ ornithine trans-carbamylase or ↓ carbamyl phosphate synthetase), *mild* ↑ *citrulline* (↓ argininosuccinate lyase), ↑ *citrulline* (citrullinemia)
↑	↑	↓	**Fatty acid oxidation:** Carnitine transferase deficiencies (NK), medium/very long chain acyl CoA dehydrogenase deficiencies (NK). **Organic acidemia:** Glutaric acidemia type II (K), methylmalonic acidemia (K,L), propionic acidemia (K,L), congenital lactic acidosis (K,L)
↑	↑	↔	**Organic acidemia:** beta-ketothiolase deficiency (K)
↑	↑	↑	**Organic acidemias:** Isovaleric acidemia (K,L), methylmalonic acidemia (K,L), propionic acidemia (K,L)
↑	↔	↔	**Organic acidemia:** Isovaleric acidemia (K,L)
↑	↔	↓	**Carbohydrate metabolism**: Fructose 1,6 diphosphatase deficiency (K,L). **Glycogen storage type:** I (L), III (K). **Amino aciduria:** Maple syrup urine disease (early onset), glutaric aciduria type I

[1]*MA*: ↑ metabolic acidosis with anion gap vs. ↔ no metabolic acidosis; NH_3: ↑ hyperammonemia vs. ↔ normal ammonia; Glu: ↑ hyperglycemia vs. ↔ normoglycemia vs. ↓ hypoglycemia; K—ketotic; NK—nonketotic; L—lactic acidosis.

Description

TYPICAL PRESENTATIONS

Hyperammonemic disorders—Neonatal catastrophe, seizures, ↓ feeding, loss of tone, recurrent coma, vomiting, lethargy after high-protein food, FTT, ataxia, clinical improvement with IV fluids, developmental delay, growth failure

Organic acidemias—Neonatal catastrophe, recurrent coma, developmental delay, growth failure, liver failure after virus, distinctive odors (e.g., maple syrup, sweaty sock, musty)

Table 20-2 Management

Evaluation	• Blood—Glucose, CBC, electrolytes, Ca, LFTs, bilirubin, NH_3, quantitative amino acids, lactate, pyruvate, carnitine, fatty acids • Urine—Ketone bodies, reducing substances, protein, organic acids, galactose • CSF (undiagnosed neonates)—Glucose, protein, cell count, microscopy, lactate, amino acids
Catabolism	• Reverse catabolism with IV fluids (10% dextrose plus age appropriate electrolytes at 1.5× maintenance); intralipids for severe presentations
Precipitant	• Search for/treat precipitant (e.g., infection) and coexisting hypoglycemia
Acidosis	• Liberal $NaHCO_3$ due to ongoing acid production + dialysis • For specific organic acidemias: B_{12} 1 mg IM (methylmalonic acidemia) + biotin 10 mg PO or NG (multiple carboxylase deficiency), thiamine 25–100 mg PO (MSUD), folic acid 1–5 mg PO (methylmalonic acidemia with homocystinuria), vitamins C and K (primary lactic acidosis due to electron transport defect), glycine (isovaleric acidemia), and carnitine (↓ carnitine)
Hyperammonemia	• If urea cycle defect (NH_3 with no acids): (1) arginine HCl 6 ml/kg of 10% solution IV over 90 minutes (citrullinemia, argininosuccinic aciduria), (2) sodium benzoate and sodium phenylacetate (Ammonul) for (OTC/CPS deficiency) • Dialysis for severe/recalcitrant cases

Description

21 ■ NEPHROLOGY

RENAL DISORDERS

Key history: Unexplained fever, vomiting, and diarrhea (pre-renal), preceding history of streptococcal infection (pharyngitis, impetigo), strenuous exercise, bloody diarrhea (HUS), joint/rash (HSP), edema, medications, and foods.

Urinalysis: False + dipstick for blood occur with betadine and ascorbic acid. RBC casts or dysmorphic RBCs suggest *glomerular disease*. Infants younger than 3 months old cannot concentrate urine well; therefore, specific gravity is unreliable at this age.

CAUSES OF RED URINE

Hematuria, alcaptonuria, bilirubinemia, phenazopyridine, phenothiazines, ibuprofen, L-dopa, phenolphthalein, methyldopa, adriamycin, deferoxamine, phenytoin, quinine, sulfa, chloroform, naphthalene, oxalic acid, anilines, food color, beets, blueberries, rhubarb, fava beans, hemoglobinuria or myoglobinuria (heme + dipstick with no RBCs), porphyrins, red diaper syndrome (*Serratia*), tyrosinosis

DIFFERENTIAL DIAGNOSIS OF HEMATURIA

- **Extrarenal disorders:** Coagulation disorders, salicylates, sickle cell disease/trait
- **Renal**
  - **Extraglomerular:** Hemorrhagic cystitis, trauma, nephrolithiasis, familial hypercalciuria, nephritis, hydronephrosis, polycystic kidneys, renal vein thrombosis, papillary necrosis, hemangiomas, tumor (e.g., Wilm's), foreign body, posterior urethral valves, ureteropelvic junction obstruction, renal tuberculosis
  - **Glomerular:** Glomerulonephritis (acute, rapidly progressive, recurrent macroscopic, chronic and post-streptococcal), IgA nephropathy, Alport's syndrome, exercise, familial benign hematuria, focal glomerulosclerosis
- **Systemic:** Allergy, hepatitis B antigenemia, endocarditis, cardiac shunt or valve, HSP, HUS, polyarteritis

Table 21-1 Normal Bladder Volume and Normal Plasma Creatinine (PCr)

Bladder volume estimate	• < *1 year old*: Weight (kg) × 10 ml • > *1 year old*: (age in years + 2) × 30 ml
Plasma creatinine estimate	• *Males:* PCr (mg/dl) = 0.35 + (0.025 × age in years) • *Females:* PCr (mg/dl) = 0.35 + (0.018 × age in years)

Description

Table 21-2 Differentiating Between Causes of Renal Failure

Test	Prerenal	Renal	Postrenal
Urine sodium	< 20	> 40	> 40
Fractional excretion of sodium (FE_{Na})[1]	< 1	> 2	> 2
Renal failure index (RFI)[2]	< 1	> 2	> 2
Urine osmolality	> 500	< 300	< 400
Urine/serum creatinine ratio	> 40	< 20	< 20
Serum BUN/creatinine ratio	> 20	< 10–20	< 10–20
Renal size by ultrasound	Normal	Normal	Normal or ↑hydronephrosis or obstruction
Radionuclide renal scan	↓Uptake ↓excretion	Uptake OK ↓excretion	Uptake OK ↓excretion

[1]FE_{Na} = 100 × (urine Na^+/plasma Na^+)/(urine creatinine/plasma creatinine). Normal FE_{Na} is 1–2%, except under 2 months when FE_{Na} up may be to 5%. [2]RFI = (urine Na^+)/(urine creatinine/serum creatinine).

Description

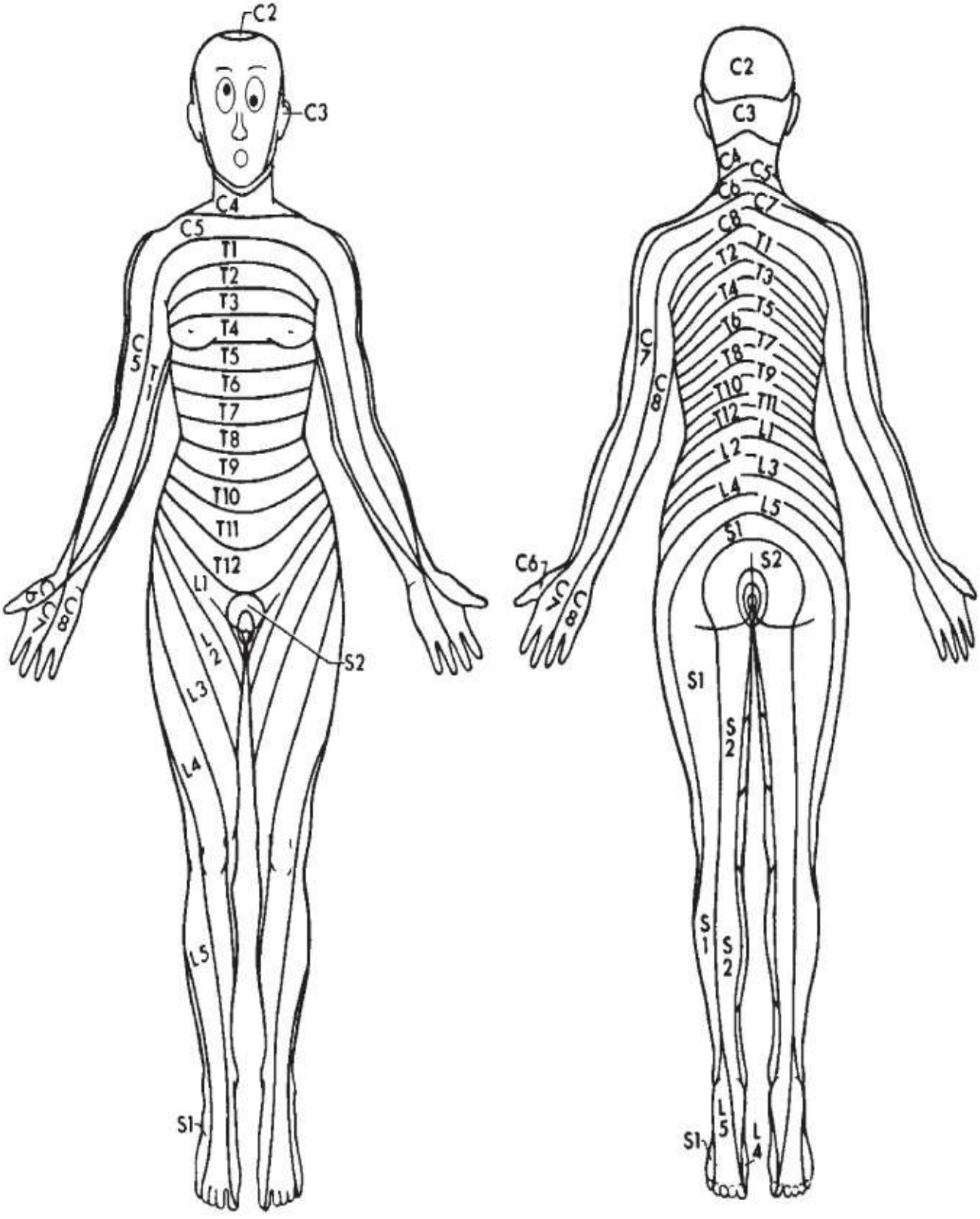


Figure 22-1 Neurology
Description

Motor level	Motor function

C4	Spontaneous breathing
C5	Shoulder shrug
C6	Elbow flexion
C7	Elbow extension
C8/T1	Finger flexion
T1–T12	Intercostal and abdominal muscles

Motor level	Motor function
L1/L2	Hip flexion
L3	Hip adduction
L4	Hip abduction
L5	Great toe dorsiflexion
S1/S2	Foot plantar flexion
S2–S4	Rectal tone

Table 22-1 Assessment of Coma and Altered Level of Consciousness

Differential diagnosis of coma and altered LOC, mnemonic TIPS-AEIOU	Trauma or tumor Infection/intussusception Poisons Sepsis, seizure, or shock	Abuse or alcohol Encephalopathy, endocrine, or electrolytes Insulin/hypoglycemia or inborn metabolic error Opiates Uremia

Description

TREATMENT OF INFANT/CHILD WITH AN ALTERED MENTAL STATUS

- Assess airway and breathing (immobilizing cervical spine if possible trauma).
- Consider endotracheal intubation if poor or labored respiratory effort, diminished airway reflexes, suspicion of elevated ICP, or severe hypoxemia.
- Assess pulse oximetry, and administer 100% oxygen.
- Obtain rapid glucose measurement, or administer glucose (dosage, Table 11-3).
- Consider naloxone 0.1 mg/kg/dose; repeat every 2–3 minutes if needed (children younger than 5 years or <20 kg). Dose 2 mg/dose; repeat every 2–3 minutes if no response (children older than 5 years or >20 kg).
- Measure child's length to facilitate dosing and sizing of equipment (pages 5–6).
- Complete vital signs: Temperature (obtained rectally), respirations, pulse, and BP. Perform complete exam.
- Direct further evaluation based on the previous measures, history, and examination.

Table 22-2 Normal Neonatal/Infant Reflexes Appearance/Disappearance

Reflex (description)	Appears	Disappears
Moro—Lift head 30° and let fall to neutral. A positive test = arm extension and abduction, then arm adduction.	Birth	1–3 months
Palmar grasp—Object in hand causes flexion/grasping.	Birth	4 months
Root response—Stroking cheek causes mouth to turn in direction of stimulus.	Birth	3–4 months
Tonic neck—Turn head to side while child is supine, with ipsilateral arm and leg extending and opposite arm/leg flexing. Normal infant tries to break reflex position.	Birth	5–6 months
+*Babinski*—Stroking lateral border of sole, to big toe. A positive reflex causes big toe dorsiflexion, and fanning of other toes.	Birth	1–2 years

Description

Table 22-3 Most Common Etiologies of Headache in Children Presenting to a Pediatric Emergency Department

Viral illness	39%	Brain tumor	2.7%
Migraine	18%	Intracranial hemorrhage	1.3%
Sinusitis	9%	Postconcussive	1.3%
Strep throat	9%	Other[1]	10.3%
Viral meningitis	9%		

[1]Includes VP shunt malfunction (2%), postictal headache (1.3%), and undetermined causes (7%).

Modified from Lewis, D. W. and Qureshi, F. Acute Headache in Children and Adolescents Presenting to the Emergency Department. Headache: *The Journal of Head and Face Pain*, 2000; 40: 200-203.

Description

Table 22-4 Practice Parameter: Evaluation of First Nonfebrile Seizure > 1 Month Old

Lab tests[1]	• Order labs (CBC, glucose, electrolytes) based on clinical circumstances (e.g., vomiting, diarrhea, dehydration, failure to return to baseline status). ↓Na and ↓Ca (most common unrecognized Δ) are rare—more common if ≤ 6 months. • Consider UA, NH_3, blood gas (arterial or venous), lactate. • Consider toxicology screen if any question of exposure.[3]
Lumbar puncture[1]	• Perform only if suspect CNS infection/subarachnoid bleed.
EEG[2]	• Perform on all first nonfebrile seizures (usually outpatient).
Neuroimaging[1] MRI is preferred to CT for identifying etiology; CT is more available acutely and excludes life threats: bleed or mass effect.	• Perform emergent neuroimaging if postictal focal deficits or altered mental status does not resolve rapidly. • *Nonurgent* MRI should be seriously considered in any child with (1) significant cognitive or motor impairment of unknown etiology, (2) abnormal exam, (3) focal seizure without secondary generalization, (4) EEG that does not represent a benign partial epilepsy of childhood or primary generalized epilepsy, or (5) age ≤ 1 year.

Description

[1]Options: Not necessary in all. [2]Standard: Recommended in all. [3]See Table 31-2 for drugs/toxins causing seizures.

Modified from Hirtz, D., Ashwal, S., Berg, A., Bettis, D., Camfield, C., Camfield, Shinnar, S. Practice parameter: Evaluating a first nonfebrile seizure in children: Report of the Quality Standards Subcommittee of the American Academy of Neurology, the Child Neurology Society, and the American Epilepsy Society. *Neurology*, 2000; 55(5): 616-623

Febrile seizures—Seizures between 6 months and 5 years with fever, but without evidence of intracranial infection or cause. Specific infections/agents associated with causing febrile seizures including human herpes virus 6 (HHV-6; roseola infantum), HHV-7, influenza A, adenovirus, enteroviruses, *Shigella*, MMR vaccine (1–2 weeks after vaccination), DTaP vaccination within 24 hours of vaccination.

Simple febrile seizures are generalized, last > 15 minutes, occur only once in 24 hours, and associated with a normal post-seizure neurologic exam/mental status; 25–33% reoccur especially if first-degree relative with seizure, complex features, age younger than 1 year (50% recurrence) or lower temperature at onset. Manage by identifying and treating the cause of the fever. A lumbar puncture is primarily indicated if there are signs of meningitis, or the exam is unreliable (on antibiotics, very young, persistent irritability).

Complex febrile seizures last > 15 minutes, are focal, occur more than once in 24 hours,

or have an abnormal neurological exam after seizure. Consider CT, LP and labs, EEG. Serious CNS infections (bacterial meningitis, herpes) are rare (without signs of meningitis) in complex febrile seizures, and LP is not mandatory.

Sources: Seltz LB, Cohen E, Weinstein M. Risk of bacterial or herpes simplex virus meningitis/encephalitis in children with complex febrile seizures. *Pediatr Emerg Care*. 2009;25(8):494-497; Callegaro S, Titomanlio L, Donegà S. Implementation of a febrile seizure guideline in two pediatric emergency departments. *Pediatr Neurol*. 2009;40(2):78-83.

French guideline recommends (1) *antibiotics and lumbar puncture* if altered mental status pre-seizure, GCS < 15 (>1 hour after onset), petechiae, neck stiff, or bulging fontanelle; (2) 2 hours *observation* for meningitis if complex features; (3) admit first-time seizures younger than 12 months (US experts DO NOT use age cutoff for admission if within defined age for febrile seizure); (4) low threshold for LP if younger than 12–18 months; (5) *urinalysis* in all (see page 190–191, UA recommendation); (6) short-term observation if no infection focus; (7) no blood tests for a simple febrile seizure if no concern regarding serious infection.

Source: Callegaro S, Titomanlio L, Donegà S. Implementation of a febrile seizure guideline in two pediatric emergency departments. Pediatr Neurol. 2009;40(2):78-83.

STATUS EPILEPTICUS

Table 22-5 Most Common Etiologies of Status Epilepticus in Children Younger Than 16 Years Old

Fever/Infection	36%	Anoxia	5%
Med Change	20%	Infection	5%
Unknown	9%	Trauma	4%
Metabolic	8%	Stroke	3%
Congenital	7%	Ethanol/Drugs	2%

Modified from Haafiz A, Kissoon N. Status epilepticus: current concepts. *Pediatr Emerg Care*. 1999;15(2):119-129. Comparable to recent evidence in Singh RK, Stephens S, Berl MM, et al. Prospective study of new-onset seizures presenting as status epilepticus in childhood. *Neurology*. 2010;74(8):636-642.

Description

Table 22-6 Evaluation (Guidelines) and Management of Status Epilepticus

- Protect airway, administer O_2, start IV, cardiac monitor, pulse oximeter.
- Perform stat bedside glucose test and send electrolytes and drug levels.
- IV glucose if hypoglycemia (Table 11-3), and pyridoxine 50–100 mg IV if neonate.
- Intravenous drug therapy (see sequence in table that follows).
- Treat fever/infection and correct sodium, calcium, or magnesium abnormalities.
- Evaluation guidelines (*Am Acad Neurol*): Obtain antiseizure drug levels for all on antiepileptics. Obtain blood cultures and LP only if clinical suspicion of bacteremia, serious infection, or meningitis. Obtain CT/MRI after stabilization if clinical indication or unknown cause. Consider a toxicology screen, metabolic panel for inborn errors if no cause is found or other clinical indicators present.

Description

Modified from Riviello JJ Jr, Ashwal S, Hirtz D, et al. Practice parameter: diagnostic assessment of the child with status epilepticus (an evidence-based review): report of the Quality Standards Subcommittee of the American Academy of Neurology and the Practice Committee of the Child Neurology Society. *Neurology*. 2006;67(9):1542-1550.

Table 22-7 Drug Therapy for Status Epilepticus (A–E Preferred Order)

	Drug	Dose and route	Maximum rate	Special features
A	Lorazepam **or** midazolam **or** diazepam	0.05–0.1 mg/kg IV 0.2 mg/kg nasal/buccal 0.5 mg/kg PR	<0.5–1 mg/minute *Quicker onset than rectal diazepam*	May repeat every 5 minutes ×2 May repeat every 5 minutes ×2 May repeat 1/2 dose ×1
B	FosphenytoinPE[1] **or** phenytoin	10–20 mg/kg IV 10–20 mg/kg IV	≤3 mg/kg/minute ≤1 mg/kg/minute	Monitor closely Monitor closely
C	Phenobarbital[2]	15–20 mg/kg IV	<1 mg/kg/minute	Monitor closely
D	Midazolam	0.05–2 mg/kg IV/IM	Bolus 0.2 mg/kg (max 10 mg) over 2–5 minutes, with initial infusion at 100 mcg/kg/hour. Titrate as needed by 50–100 mcg/kg/hour (max 400–2,000 mcg/kg/hour).	
E	Pentobarbital (coma)[3]	5 mg/kg IV load 0.5–3 mg/kg/hour	Over 10–30 minutes and <50 mg/minute	Intubation required; vasopressors as needed

Alternates (not all are FDA approved for all ages or for this indication/dose; however, international studies available):

- Levetiracetam (*Keppra*) 60 mg/kg IV load. (Maximum dose 2,500 mg.)
- Valproic acid 40 mg/kg IV load. (No maximum dose.) Do not use valproic acid in patients younger than 2 years, those with hepatic failure or mitochondrial disease.

[1]PE—Phenytoin equivalents: All doses and rates are in phenytoin equivalents. [2]May ↑ to total 40 mg/kg or 1 g max. [3]Attach EEG if possible.

Modified from Kirmani BF, Crisp ED, Kayani S, Rajab H. Role of intravenous levetiracetam in acute seizure management of children. *Pediatr Neurol*. 2009;41(1):37-39; Abend NS, Monk HM, Licht DJ, Dlugos DJ. Intravenous levetiracetam in critically ill children with status epilepticus or acute repetitive seizures. *Pediatr Crit Care Med*. 2009;10(4):505-510.

Description

SHUNTS (CEREBROSPINAL SHUNT INFECTION AND MALFUNCTION)

Table 22-8 Shunt Failure/Shunt Obstruction—Predictive Score[1,2]

Early presenters (within 5 months of surgery)		Late presenters (> 9 months to 2 years since surgery)	
Clinical feature	**Points**	**Clinical feature**	**Points**
Fluid tracking around shunt	1	Nausea and vomiting	1
Headache	1	Loss of developmental milestones	1
Irritability	1		
Fever	1	↑Head circumference	1
Bulging fontanelle	2	Fluid tracking around shunt	1
Erythema at surgery site	3	↓LOC	3
↓LOC	3		

Early shunt score (total points above)	Shunt failure probability	Late shunt score (total points above)	Shunt failure probability
0 points	4%	0 points	8%
1 point	50%	1 point	38%
2 points	75%	≥ 2 points	100%
≥ 3 points	100%		

[1]Features not found to be *independent* predictors of shunt failure included inability to depress or refill CSF reservoir, papilledema, cranial nerve palsy, abdomen pain/mass, meningismus, and peritonitis. [2]A more recent prospective study found that 88% of infants/children older than 2 months old at shunt insertion with failure had irritability, vomiting, or headache. The absence of these features indicated a <7% probability of shunt failure.

Modified from Garton HJ, Kestle JR, Drake JM. Predicting shunt failure on the basis of clinical symptoms and signs in children. *J Neurosurg*. 2001;94(2):202-210; Piatt JH Jr, Garton HJ. Clinical diagnosis of ventriculoperitoneal shunt failure among children with hydrocephalus. *Pediatr Emerg Care*. 2008;24(4):201-210; Boyle TP, Kimia AA, Nigrovic LE. Validating a clinical prediction rule for ventricular shunt malfunction. *Pediatr Emerg Care*. 2018;34(11):751-756.

Description

Table 22-9 CSF Shunt Infections—Presenting Features in Children[1]

Feature	V-P shunt[2]	V-A shunt[2]	Most common organisms	
Fever	95%	100%	*Staphylococcus epidermidis* (SE)	32–57%
Shunt malfunction	57%	14%	*Staphylococcus aureus* (SA)	4–38%
Abdominal pain	48%	0	SA + *Streptococcus viridans*	4–15%
Meningismus	29%	0	Gram negatives ± SE	15% (3%)
Headache	14%	14%	SE + *Enterococcus*	7%
Irritability	19%	43%	SE + *Streptococcus pyogenes*	4%
Nephritis	0	14%	*Enterococcus/Candida*	4%

[1]95% of shunt infections occur <6 months after surgery. [2]V-A—ventriculoatrial; V-P—ventriculoperitoneal.

Modified from Kontny U, Höfling B, Gutjahr P, Voth D, Schwarz M, Schmitt HJ. CSF shunt infections in children. *Infection*. 1993;21(2):89-92; Davis SE, Levy ML, McComb JG, Masri-Lavine L. Does age or other factors influence the incidence of ventriculoperitoneal shunt infections? Pediatr Neurosurg. 1999;30:253-257; Piatt JH Jr, Garton HJ. Clinical diagnosis of ventriculoperitoneal shunt failure among children with hydrocephalus. *Pediatr Emerg Care*. 2008;24(4):201-210.

Description

MANAGEMENT OF SHUNT MALFUNCTION/INFECTION

- Apply cardiac telemetry and pulse oximeter (risk of apnea, bradycardia).
- Head-to-toe examination with emphasis on shunt tract and neurologic exam.
- AP/lateral films of skull, torso where shunt located, CT scan of the head (up to 24% will have CT read as unchanged/normal/smaller ventricles or negative). Some institutions may have a fast-protocol MRI available.
- Consult neurosurgeon if suspect infection/failure of shunt even if normal CT.
- Shunt tap (by neurosurgeon) for pressure assessment, cell count, culture (do not perform LP in ED due to risk of herniation and ↑rate of missed infection).
- Shunt failure requires surgery. Treat impending herniation as needed. Infection usually requires external ventricular drainage or shunt externalization, and empiric antibiotics until culture results return (see drug dosing Page 168).

WEAKNESS AND ATAXIA

Upper motor neuron (UMN) lesions cause damage to the cortex (e.g., stroke), brain stem, or spinal cord. Lower motor neuron (LMN) lesions damage the anterior horn cells (e.g., poliomyelitis), the neuromuscular junction (e.g., myasthenia gravis, botulism toxin), peripheral nerves (e.g., Guillain-Barre), or muscle (e.g., muscular dystrophies).

Table 22-10 Differentiation of Upper Motor Neuron from Lower Motor Neuron Disease

Category	UMN disease	LMN disease
Muscular deficit	Muscle groups	Individual muscles
Reflexes	Increased	Decreased/Absent
Tone	Increased	Decreased
Fasciculations	Absent	Present
Atrophy	Absent/Minimal	Present

Description

ATAXIA

Ataxia is the incoordination of movement with normal strength. Disorders of the cerebellar hemispheres cause ipsilateral limb ataxia, while disorders of the vermis cause truncal ataxia. Other causes of acute ataxia include cerebral cortex disorders (frontal ataxia), peripheral sensory nerve and spinal cord disorders (sensory ataxia), labyrinth disorders (vestibular ataxia), and metabolic and toxin-induced ataxia.

SPECIFIC DISEASES CAUSING ATAXIA

- *Acute cerebellar ataxia*—The most common cause of acute ataxia in children. This is a post-viral autoimmune ataxia typically occurring in 1- to 3-year-olds 1–3 weeks after viral infection. This disorder causes a sudden onset of ataxia, paroxysmal vertigo, nystagmus in 50%, possibly elevated CSF protein and mild CSF pleocytosis (but commonly CSF

normal), and frequently dysarthria. Ataxia may persist for weeks to a year in up to a third of patients. The majority recover within 30 days.

- *Drug ingestion*—Common drugs causing ataxia include phenytoin (and most anticonvulsants), alcohol, tricyclic antidepressants, hypnotics, sedatives, heavy metals (e.g., lead), insecticides, and drugs of abuse (e.g., PCP).
- *Neuroblastomas*—Occult neuroblastomas can cause a classic triad of symptoms with acute ataxia, opsoclonus (jerky, random eye movements), and myoclonus.
- *Posterior fossa tumors*—Direct cerebellar involvement or hydrocephalus.
- *Diseases causing weakness* easily mistaken for ataxia include Guillain-Barre, transverse myelitis, tick paralysis, and myasthenia gravis.
- *Other causes* include head trauma, stroke, acute disseminated encephalomyelitis (ADEM), cerebral vein thrombosis, vasculitis, and congenital disorders such as inborn errors of metabolism.

EVALUATION OF ATAXIA

If unexplained ataxia: CBC, electrolytes, toxin/drug screens (alcohol, drug level for antiseizure medicines), CT, or MRI (MRI more sensitive for brain stem lesions). Consider EEG, lumbar puncture, and more in depth metabolic evaluation (e.g., ammonia, ketones, lactate, amino acids) and neurological consultation.

Sources: Thakkar K, Maricich SM, Alper G. Acute ataxia in childhood: 11-year experience at a major pediatric neurology referral center. J Child Neurol. 2016;31(9):1156-1160; Ryan MM, Engle EC. Topical review: acute ataxia in childhood. J Child Neurol. 2003;18(5):309-316.

23 ■ NUTRITION AND FEEDING

NUTRITION

Energy requirements—A child younger than 12 months of age requires 105–115 kcal/kg/day. Overfeeding exceeds this amount and often provides volumes that can lead to reflux/vomiting. Breast milk or commercially prepared formulas are usually the sole source of energy and nutrients in the first few months of life. Semisolid foods (e.g., cereals and purees) are usually introduced into the diet at 4 to 6 months of age and soft table foods at 9 to 12 months.

Breast milk—The American Academy of Pediatrics (AAP) recommends exclusive breastfeeding until approximately 6 months of age for several reasons. The composition of breast milk changes to meet the changing nutritional needs of the growing infant. In addition, breastfeeding may be protective against some illnesses and diseases. Contraindications to breastfeeding include (1) a diagnosis of classic galactosemia in the infant, (2) untreated brucellosis in the mother, (3) maternal infection with HTLV-1/2 or Ebola virus, (4) certain maternal medications, and (5) maternal use of illicit drugs. In the developed world, mothers who are positive for HIV also should not breastfeed. Furthermore, mothers should temporarily refrain from breastfeeding or provide expressed breast milk, if they have an active, untreated TB infection; an active HSV lesion on the breast; a varicella infection 5 days before or 2 days after delivery; or H1N1 influenza infection with fever. Mastitis is not a contraindication. Breastfed babies should receive supplemental vitamin D 400 IU daily unless they are consuming ~1 l of vitamin D–fortified formula or whole milk daily.

Infant formulas—Most commercially prepared infant formulas supply 19 to 20 calories per ounce. Their nutritional content is established by legislative mandate (the Infant Formula Act of 1980) that prescribes the minimum concentration of 29 nutrients. The AAP strongly recommends iron-fortified formulas to help prevent anemia as iron stores in the body become depleted. Infant formulas are available in powdered, liquid concentrate, or ready-to-feed formulations. As formula powder is now recognized as a potential source of *Cronobacter* infection, the CDC recommends that powered formula for young infants younger than 3 months be prepared with boiled water that has been cooled to no less than 158°F/70°C, and then allowed to cool to a safe drinking temperature. If fluoridated drinking water is not available, fluoride supplementation is recommended for all infants older than 6 months.

Table 23-1 Summary of Different Types of Common Infant Formulas and Uses[1]

Infant Formula Type	Brand Examples	Details
Cow milk protein	Earth's Best Organic Enfamil Infant Similac Advance Similac Non-GMO	Most commonly used and most do well on this type Contains: choline, DHA, ARA May contain: prebiotics (gluco-oligosaccharides)
Partially hydrolyzed protein	Gerber Good Start Similac Sensitive	May be easier to digest
Extensively hydrolyzed	Enfamil Nutramigen	Proteins broken down into

protein or hypoallergenic	Gerber Extensive HA Similac Alimentum	small peptides Lactose free Uses: infants with food protein allergies (cow milk protein, allergic proctocolitis)
Amino acid	Alfamino Elecare Neocate Puramino	Proteins broken down into amino acids Uses: infants with food protein allergies (cow milk protein, allergic proctocolitis)
Soy protein	Enfamil Prosobee Gerber Good Start Soy Similac Isomil	Lactose-free Uses: vegetarians, metabolic disorders (e.g., galactosemia) Contains: soy protein, DHA, ARA
Low-lactose or lactose-free*	Enfamil Gentlease Similac Sensitive	Less casein than whey Whey may be partially broken down
Premature	Enfamil Premature Similac Neosure *Hospital only:* Enfamil Enfacare Similac Special Care	More calories per ounce Higher levels of protein, minerals, and electrolytes

Description

[1]GMO, genetically modified organism; DHA, docosahexaenoic acid; ARA, arachidonic acid; HA, hypoallergenic

*Primary lactose intolerance is rare in children. Most children will be able to tolerate traditional formulas even with transient lactose intolerance following gastroenteritis.

NUTRITIONAL DISORDERS

Failure to thrive (FTT)—Inadequate growth commonly defined as weight ≤ third or fifth percentile for age or crossing two or more major percentile lines on an appropriate growth chart. FTT should not be a stand-alone diagnosis as there are a multitude of interrelated causes of FTT that must be investigated.

Bovine milk allergy—Bovine milk allergy is due to sensitivity to the primary protein in cow milk, β-lactoglobulin. Infants with cow milk protein allergy usually present during the first 6 weeks of life with diarrhea, mucous or blood in stools, and occasional respiratory symptoms. Treatment is aimed at eliminating bovine milk protein from the diet and substituting soy-based (e.g., Pregestimil) or hydrolyzed casein formulas (e.g., Nutramigen).

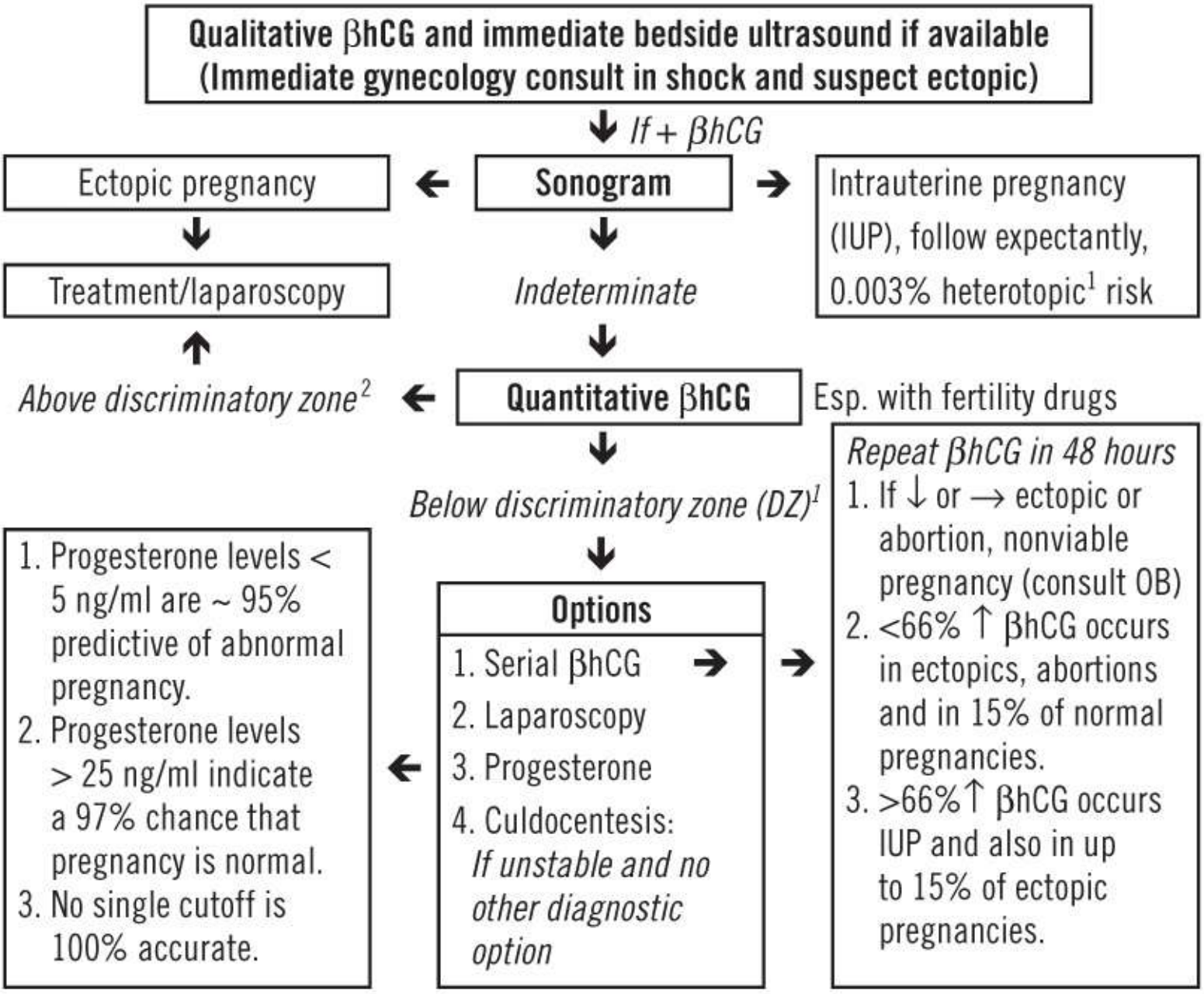
Table 23-2 Approximate Feeding Schedule for the First Year After Birth

Age	Newborn (full-term)	1 month old	2–4 months old	4–6 months old	6–8 months old	8–12 months old	Over 12 months old
Formula amount	2 oz	3–4 oz	3–6 oz	4–6 oz	6–8 oz	7–8 oz	16–24 oz whole milk
Frequency	Every 3–4 hours	Every 3-4 hours	5–8 times per day	4–6 times per day	3–5 times per day	3–4 times per day	Per day
Breastfeeding frequency	Every 2–3 hours (on demand), or 8–12 times per day	Every 2-4 hours (on demand), or 7-8 times per day	5–8 times per day (on demand)	4–6 times per day	3–5 times per day	3–4 times per day	1–2 up to multiple times per day, as long as both mom and baby desire

Data from: DiMaggio DM, Cox A, Porto AF. Updates in infant nutrition. *Pediatr Rev.* 2017;38(10):449-462.

Description

Table 24-1 Diagnosis of Ectopic Pregnancy in Clinically Stable Patients



[1][Concurrent IUP + ectopic]. [2]DZ is 1,000–1,500 mIU/ml for transvaginal ultrasound (US) and 6,500 mIU/ml for transabdominal US.

Description

Table 24-2 Ultrasound (US) Findings[1] and Quantitative βhCG in IUP[2,3]

Intrauterine pregnancy (IUP)	Time	mIU/ml
1. Decidual reaction		

2. Gestational sac seen at 4.5 weeks with βhCG > 1,000–1,400 via transvaginal US or 6 weeks with βhCG > 6,500 via transabdominal US
3. Yolk sac: Seen at 5.5 weeks (βhCG > 7,200)
4. Fetal pole/heartbeats are seen at 5.5 to 7 weeks (βhCG > 10,800–17,200)

<1 week	<5–50
1–2 weeks	40–300
2–3 weeks	100–1000
3–4 weeks	500–6,000
1–2 months	5,000–200,000
2–3 months	10,000–100,000
2nd trimester	3,000–50,000
3rd trimester	1,000–50,000

Ectopic pregnancy (% with finding)

1. Empty uterus, decidual reaction, or pseudosac (10–20%)
2. Cul-de-sac fluid (24–63%): echogenic = blood
3. Adnexal mass (60–90%)
4. Echogenic halo around tube (26–68%)
5. Fetal heart activity (8–23%)

Description

[1]Transvaginal sonography unless otherwise stated. [2]Time from conception. [3]Median time for βhCG to turn negative after spontaneous abortion is 16 days (30 days for elective).

Table 24-3 Ovarian Torsion

Overview: Ovarian torsion is usually due to an enlarged ovary with or without a mass (usually benign) that alters its center of	**Clinical features**	
	Mean age (years) peds studies	10–13

gravity causing it to twist on its axis and compress the venous drainage first, then the arterial flow later. Following venous compression, pressure rises within the ovarian capsule. Eventually, ischemia and necrosis occur.
Evaluation: A βHCG is mandatory. Diagnose by US (color Doppler best)— abnormalities are usually seen on CT.
Management: Surgical detorsion may salvage many ovaries even if prolonged symptoms (>3 days).

Abdomen pain (≥ sudden)	86–100%
Mean days pain pre-ED visit	3–6 days
Vomiting	67–91%
Fever (late finding)	18–57%
Abdomen tenderness	88–100%
Palpable ovarian mass	10–64%
Peritoneal signs	23%
Lab/radiologic features	
WBC count > 12,000 cells/mm^3	32–51%
Plain radiography mass	26%
CT ovarian mass	95–100%
CT enlarged fallopian tube	~75%
Ultrasonography (see tables that follow)	

Description

Modified from Anders JF, Powell EC. Urgency of evaluation and outcome of acute ovarian torsion in pediatric patients. *Arch Pediatr Adolesc Med*. 2005;159(6):532-535; Rha SE. CT and MR imaging features of adnexal torsion. *Radiographics*. 2002;22:283; Anders JF. Ovarian torsion in the pediatric emergency department: making the diagnosis and the importance of advocacy. *Clin Pediatr Emerg Med*. 2009;10(1):31-37.

Table 24-4 Ultrasonographic Findings in Ovarian Torsion

Ultrasonographic Findings	Frequency
Enlarged ovary or ovarian mass	95–100%
Absent venous flow (earlier than arterial flow obstruction)[1]	67–93%
Absent arterial flow (persistent flow esp. if dual blood supply)[1]	46–73%
Twisted vascular pedicle or whirlpool sign (circular/coiled vessels)	>75%
Ovary with ground glass appearance	26%
Free fluid within abdomen	21%

Description

[1]Use color Doppler.

Modified from Chang HC, Bhatt S, Dogra VS. Pearls and pitfalls in diagnosis of ovarian torsion. *Radiographics*. 2008;28:1355-68; Garel L, Dubois J, Grignon A, Filiatrault D, Van Vliet G. US of the pediatric female pelvis: a clinical perspective. *Radiographics*. 2001;21:1393-407; Shadinger LL, Andreotti RF, Kurian RL. Preoperative sonographic and clinical characteristics as predictors of ovarian torsion. *J Ultrasound Med*. 2008;27:7-13.

Table 24-5 Common Gynecologic Conditions

Vulvovaginitis	*Overview:* Common gynecologic problem in prepubertal girls. Most cases are nonspecific and related to normal vaginal flora. Candidal vulvovaginitis is rare in prepubertal girls. Symptoms include vaginal discharge, irritation, pain, dysuria, and redness.

	Diagnosis is made by history and physical exam.
	Management: Reassurance, stressing importance of good perineal hygiene, use of hypoallergenic soaps, use of cotton underwear. Avoidance of irritants such as bubble baths, synthetic-fabric underwear, tight clothing.
Labial adhesions	*Overview:* Usually asymptomatic and seen in infants. Occasionally can lead to urinary dribbling and vulvar irritation. Not indicative of sexual abuse.
	Management: Can resolve spontaneously. Topical estrogen cream can also be used, typically once daily applied on the midline for 4–6 weeks.
Imperforate hymen	*Overview:* Abnormality of the vagina leading to hematocolpos. Symptoms can range from asymptomatic amenorrhea to cyclic abdominal/pelvic pain, urinary retention, back pain.
	Management: Diagnosis is made on physical examination or ultrasound demonstrating hematocolpos. Treatment is surgical (hymenectomy).
Urethral prolapse	*Overview:* Occurs in prepubertal girls due to the hypoestrogenic state. Repeated Valsava maneuvers are usually the precipitating cause. Symptoms that prompt evaluation include dysuria, blood in the diaper or underwear, vaginal mass, or concern for sexual abuse. Diagnosis is made by visualization of a circular, red, friable mass around the urethral meatus.
	Management: Conservative measures include sitz baths, topical estrogen, and treating the precipitant (i.e., constipation causing repeat Valsalva maneuvers). Surgical excision is a possibility if conservative measures fail.

Description

Modified from Ritchie, Joanne K., et al. The paediatrician and the management of common gynaecological conditions. *Archives of disease in childhood*, 2018; 103(7):314-375. doi:10.1136/archdischild-2017-314375.; Eyk, N. V., Allen, L., Giesbrecht, E., Jamieson, M. A., Kives, S., Morris, M., Fleming, N. Pediatric Vulvovaginal Disorders: A Diagnostic Approach and Review of the Literature. *Journal of Obstetrics and Gynaecology Canada*, 2009; 31(9): 850-862. doi:10.1016/s1701-2163(16)34304-3.

Table 24-6 Causes of Vaginal Bleeding in Specific Patient Populations

Prepubertal females	• Vulvovaginitis

	• Vaginal foreign body • Urethral prolapse • Straddle injury/genital trauma • Precocious puberty • Dermatoses (lichen sclerosus, atopic dermatitis) • Sexual abuse • Neoplasm
Postpubertal females	• Anovulatory cycles • Infections (e.g., cervicitis) • Foreign body • Laceration/trauma • Sexual abuse • Polyp/Fibroid/Myoma • Hematologic conditions (bleeding disorder like Von Willebrand disease, platelet dysfunction, or coagulation defects; thrombocytopenia) • Thyroid disorders • Ectopic pregnancy • Miscarriage • Medication side effects
Pregnancy	• Ectopic pregnancy • Implantation bleeding • Placental abnormalities (previa, accreta, abruption) • Abortion (threatened, spontaneous, missed) • Infections

Description

Modified from Deligeoroglou, E., Karountzos, V., & Creatsas, G. Abnormal uterine bleeding and dysfunctional uterine bleeding in pediatric and adolescent gynecology. *Gynecological Endocrinology*, 2012; 29(1):74-78. doi:10.3109/09513590.2012.705384; Howell JO, Flowers D. Prepubertal Vaginal Bleeding: Etiology, Diagnostic Approach, and Management. *Obstet Gynecol Surv*. 2016; 71(4):231-42. doi: 10.1097/OGX.0000000000000290.

Table 24-7 Sexually Transmitted Infections

Infection/condition	Recommended treatment	Special considerations
Bacterial vaginosis	Metronidazole 500 mg PO bid for 7 days	
Cervicitis	Azithromycin 1 g PO in a single dose	Consider treatment for both gonorrhea and chlamydia given prevalence of

		coinfection is high.
Chlamydial infections, adolescents and pregnant patients	Azithromycin 1 g PO in a single dose	
Gonococcal infections (cervix, urethra, rectum, pharynx)	Ceftriaxone 250 mg IM in a single dose PLUS Azithromycin 1 g PO in a single dose	
Genital herpes simplex—first episode	Acyclovir 400 mg PO three times daily for 7–10 days	Alternate regimen: valacyclovir 1 g PO twice daily for 7–10 days.
Genital herpes simplex—recurrent episode	Acyclovir 400 mg PO three times daily for 5 days	Alternate regimen: valacyclovir 1 g PO once daily for 5 days.
Syphilis	Penicillin 2.4 million units IM in a single dose	Latent syphilis, neurosyphilis, and congenital syphilis are treated with different dosing of penicillin.
Trichomoniasis	Metronidazole 2 g PO in a single dose	
Pelvic inflammatory disease	Ceftriaxone 250 mg IM in a single dose PLUS Doxycycline 100 mg twice a day for 14 days WITH OR WITHOUT Metronidazole 500 mg twice a day for 14 days	Multiple treatment regimens exist (oral and parenteral).

Description

Modified from Workowski KA, Bolan GA. Sexually transmitted diseases treatment guidelines, 2015. *MMWR*. 2015;64(3).

25 ■ OPHTHALMOLOGY

Table 25-1 ED Ophthalmologic Exam

<table>
<tr><td>Chemical exposure (known or any suspicion of)</td><td colspan="2">• STOP examination
• Irrigate immediately</td></tr>
<tr><td>Obtain visual acuity
• Make sure patient is wearing his or her correction</td><td colspan="2">Snellen Chart
• 20 feet
• Each eye separately—completely occlude but not compress each eye
• Record smallest line the patient can read for each eye
• Give credit for a line if the patient misses up to one letter
Picture Chart
• 2–4 years and moderately mentally impaired
Tumbling E chart
• 3–5 years and mute, illiterate or mildly mentally impaired
• More accurate than picture chart</td></tr>
<tr><td>External exam</td><td colspan="2">Assess lids, skin, conjunctiva, cornea for obvious foreign body, lacerations, disruption; palpate periorbital area for bony step-offs; assess for proptosis, enophthalmos</td></tr>
<tr><td rowspan="2">Corneal light reflex (CLR)
• Assesses ocular alignment</td><td>Position of reflex</td><td>Ocular alignment</td></tr>
<tr><td>Symmetric
Outward displacement
Inward displacement
Downward or upward displacement</td><td>Normal
Esotropia
Exotropia
Hypertropia</td></tr>
<tr><td rowspan="3">Cover, uncover test
• Also assesses ocular alignment
• More accurate than CLR
• Requires greater patient cooperation</td><td colspan="2">• Patient fixates on object 15–20 feet away
• Cover right eye quickly with hand and observe left eye for movement
• Repeat quickly to other side</td></tr>
<tr><td>Eye movement</td><td>Ocular alignment</td></tr>
<tr><td>None
Outward
Inward
Downward or upward</td><td>Normal
Esotropia
Exotropia
Hypertropia</td></tr>
</table>

Pupillary response

Assesses:

Pupils

Equal

Round and reactive to light

No relative afferent pupillary defect (RAPD)

Exam

1. Have patient fix on object 10 feet in distance
2. Lights on: Check that pupils are equal in size
3. Lights off: Check that pupils are still equal in size
4. Lights off: Check that each eye has a direct response to light
5. Lights off: Check swinging light test to assess for RAPD

Detailed exam

1. **Assess pupil size in light and dark**
   - Have patient fixate on object 10 feet away throughout exam to avoid normal constriction with convergence and accommodation (e.g., the “near reflex”)
   - Fixating in distance, in the dark makes the pupils as large as possible and pupil reaction easier to see when you shine the light
   - Assess that pupils are equal in light and dark
   - Normal: Pupils symmetric
   - Abnormal: Pupils asymmetric = anisocoria (see the following)
2. **Assess pupil to direct light**
   - Shine penlight directly into each eye
   - Normal: Pupils constrict briskly and completely, relax a little, then dilate again after the light is removed
   - Abnormal: Pupils constrict slowly and incompletely or not at all
3. **Swinging light test in dimmest light possible**
   - A comparative test of the 2 optic nerves
   - Assesses for RAPD
   - RAPD = Margus Gunn pupil
     - Patient fixates on object 10 feet away in the dark
     - Shine a bright light directly into the right eye 2–3 seconds
     - Note if it constricts, then relaxes just a little
     - Swing the light quickly back and forth over the bridge of the nose to each eye, holding 2–3 seconds each time, assessing pupil response
     - Normal: The pupil will have just started to dilate when the light hits, causing a small constriction followed by mild relaxation
     - Abnormal: If one pupil consistently dilates as the light is shined on it, there is an afferent pupil defect (Marcus Gunn pupil) in the eye that

	dilates • Sign of unilateral optic nerve damage • Seen in optic neuritis, optic nerve compression • One optic nerve is functioning poorly compared to the other
Extraocular movements	
Visual fields	
Red reflex	• Using ophthalmoscope dioptric power 0 • 1 foot in front of the patient • Normal: Symmetric red glow • Abnormal: Beet red, gray, black, asymmetry
Fundoscopic exam	Assess retina, blood vessels, and optic nerve
Fluorescein exam	• Tetracaine (onset of action <1 minute) • Then measure visual acuity • Access cornea with a penlight for uneven light reflection, cloudiness, or foreign body • Stain with fluorescein • Assess with Wood's lamp or cobalt blue light after repeat blinking looking for persistent green stain • Evert lid to assess for the foreign body
Slit lamp exam	To assess the anterior chamber and cornea for cloudiness/foreign body
Dilated eye exam	Facilitates slit lamp exam to view the posterior globe—the retina, optic nerve, blood vessels, and macula
CT scans	Radiologic study of choice in ophthalmologic emergencies

Description

Table 25-2 The Red Eye

Signs and symptoms	Distinguishing features	Condition and pearls	Management/treatment
• Lid swelling • Lacrimal gland swelling OR • Proptosis	Gritty, burning sensation of lids • Matting of eye when awaken • Redness, swelling, irregular contour to lid margin • Scaly, flaky debris to lid margins • Mild to moderate conjunctival injection • Reduced tear secretion	**Chronic blepharitis** **Anterior blepharitis** • Common in atopy • Usually *Staphylococcus aureus* • Infection of skin, cilia, accessory glands of eye	• Lid margin hygiene bid • Warm, moist washcloth over closed lids 5–10 minutes • Wipe away with soft cloth • Moisten cotton tip in 3 oz water with 3 drops baby shampoo—scrub lids • Rinse • Brush off any dry debris • Apply bacitracin or erythromycin ointment nightly ×2 weeks
		Posterior blepharitis • Common in rosacea or seborrheic dermatitis of scalp and face • Inflammation of meibomian sebaceous glands	• Lid hygiene as above • PO tetracycline 0.5 to 1 g/day four times per day OR • doxycycline 50–100 mg PO bid
	• Painful, tender focal swelling to anterior eyelid margin • "Pimple" • Develops over several days	**Stye = Hordeolum** External stye • Anterior lid margin • Focal inflammation of ciliary follicles or accessory glands Internal stye • Posterior lid margin • Due to plugged meibomian glands from inflammation	• Warm compresses to affected eye bid • Hard-boiled egg or boiled potato cooled to touch holds heat and facilitates reheating • Topical antibiotics are useless
	• Lump in eyelid • No to mild tenderness • May have previously	**Chalazion** • Due to scarring in the healing process of stye or internal hordeolum	• Observe for several months for regression • Surgical resection if fails to regress, alters vision, or cosmetically unfavorable
	• Tender swelling to medial lower lid overlying the lacrimal sac • Excessive tearing • Discharge from punctum, which increases with pressure to the swollen area • Red conjunctiva	**Dacrocystitis** • Most often seen in infants with nasolacrimal duct obstruction • Due to bacterial infection in area of the obstruction	• Mild cases: Amoxicillin • Severe: IV cefuroxime • If progressive inflammation or not improving in 24 hours → urgent ophthalmology referral for imaging to rule out abscess
	• Periocular pain • +/– fever • Violaceous discoloration with tender swelling to upper and lower lids • Mild diffuse conjunctival injection	**Orbital cellulitis** • Diffuse bacterial infection of periocular tissue • Usually from paranasal sinusitis, carried to orbit by emissary veins • Less likely due to skin infection Preseptal • Infection is located in the soft tissue anterior to orbital septum (anterior 1/3 of the orbit) Postseptal = orbital cellulitis	• Sino-orbital CT scan to rule out sinusitis, orbital subperiosteal abscess, tumor • Young children younger than 9—gram+ coverage cefuroxime • Older children and adults add clindamycin, or metronidazole for anaerobic coverage • Consult ophthalmology, ENT for concerns, subperiosteal infection, or failure to improve in 24 hours

• Subnormal visual acuity • Foreign body sensation • Severe pain OR • Ciliary flush (red rim around cornea)	• Blurred vision • Photophobia • Periocular pain • "Sand in eye" foreign body sensation • Ciliary flush • Corneal opacification	**Keratitis** • Inflammation of the cornea • Usually due to infection, trauma, dry eye, ultra-violet exposure, contact lens overwear, or autoimmune disorders • Prompt recognition imperative to avoid permanent vision loss • Can start with surface breakdown of epithelium • Can start in deeper layers of cornea, thus fluorescein can be normal	• Do not attempt treatment • Immediate ophthalmology referral
	• Periocular pain • Photophobia • Blurred vision (sometimes) • Ciliary flush • Small or irregular pupil due to adherence of iris to anterior lens or posterior corneal surface	**Anterior uveitis** • Inflammation of the iris and ciliary muscle autoimmune reaction (isolated or part of seronegative spondyloarthropathies, sarcoidosis, herpes simplex, herpes zoster, or Behcet's)	• Index of suspicion • Requires slit lamp exam • Immediate ophthalmology referral
	• Periocular pain • Vision loss • Conjunctiva very red • Swollen eyelids • Hazy cornea • Possible layered pus bottom of anterior chamber	**Endophthalmitis** • Infection inside the eye • Can be introduced from outside by corneal infection, trauma, surgery, or via the blood stream • May be mistaken for severe keratitis, conjunctivitis, uveitis	• Immediate ophthalmology referral • Ophthalmologic emergency
• Focal conjunctival redness	• Blotchy bulbar conjunctival redness • Extravascular redness • No pain	**Subconjunctival hemorrhage** • Due to sudden increase in intrathoracic pressure such as a cough, sneeze, straining with stooling; can occur with rubbing eye, after vaginal delivery	• No treatment • Usually resolves in 1 week
• Purulent drainage	• Ocular pain • Diffuse, marked redness, and swelling purulent discharge	**Bacterial conjunctivitis** • Most common pathogens: *Staphylococcus, Streptococcus, Haemophilus influenzae* • Less likely *Neisseria gonorrhoeae, Pseudomonas aeruginosa* • Contact lens wearer—low index of suspicion for virulent pathogen such as *P. aeruginosa* or *Acanthamoeba*	• If pus is present on exam, refer all of the following to ophthalmology urgently due to concern of virulent pathogen: neonates, extended or inappropriate contact lens wear, immunocompromised hosts, hx of trauma or foreign body • Mild non-neonate and immunocompetent, treat with topical erythromycin or trimethoprim • Refer if worsens after 3 days of txt or not improve in 7 days
• Itching	• Prominent itching • Eyelid edema • Diffuse boggy edema (chemosis) especially lower fornix • Diffuse conjunctival redness • Watery discharge • Bilateral but can be asymmetric	**Allergic conjunctivitis** • Usually seasonal, IgE-mediated immediate hypersensitivity to pollens • Usually accompanied by other allergy symptoms	• Oral antihistamines • OTC topical vasoconstrictor-antihistamine • Topical H1 blocker-mast cell stabilizer

• Topical ocular medication use • Cosmetic use • Environmental pollutants	• Red, leathery thickening, and scaling of the periorbital skin	**Contact dermatoconjunctivitis** • Delayed hypersensitivity reaction to topically applied medications or cosmetics • Most common eye meds are aminoglycosides and cycloplegics	• Discontinue offending agent • Consider topical corticosteroid • Ophthalmology referral if not improved in 14 days
	• Mild but persistent ocular discomfort • Sticky eyelids upon awakening • Mild diffuse redness	**Chemical conjunctivitis** • May be confused with chronic infectious conjunctivitis, uveitis, scleritis, or blepharitis	• Discontinue offending agent • Ophthalmology referral if not improved in 14 days
• Watery discharge	• Watery, thin, mucoid discharge • Diffuse conjunctival redness with follicles • +/– tender preauricular nodes • Monocular or binocular involvement	**Viral conjunctivitis** • Most common cause of acute red eye • Usually self-limited, can be isolated or part of a URI • Most often due to adenovirus	• Do not treat with antimicrobials • Wash hands frequently • Avoid touching eyes • Do not share towels • Avoid work, school, day care until discharge resolves • Refer in 48 hours if worsens or concern for keratitis

Description

Table 25-3 Ocular Trauma

Presentation	Pearls	Management
Chemical exposure		
Alkaline Household cleaners Fertilizers Pesticides Lye Cement cleaner Sparklers Firecracker products **Acid** Car battery fluid	• Vision threatening • Conjunctiva may be normal in face of severe injury due to blood vessel destruction • Immediate irrigation • Do not spend time taking history if known or suspected chemical contact • Acid burns → Coagulation necrosis and denature surface proteins but usually do not penetrate the eye • Alkali burns worse: Cause rapid penetration through cornea and anterior chamber → combine with cell membrane lipids causing liquefaction necrosis	• Remove debris • Topical anesthetic • Immediately irrigate with LR for 30 minutes to pH 7 (inferior fornix) • Evert lids • Inspect for corneal opacification and conjunctival swelling Visual acuity • Fluorescein • Do not patch—increases risk of infecting devitalized tissue Emergent referral • Acid or alkaline burn • ↓Visual acuity • Severe conjunctival swelling • Corneal clouding

Blunt ocular trauma		
• Direct blow to the eye	• Increased risk severe injury if ↓visual acuity, diplopia, severe pain. +LOC, “saw stars” • May not produce significant signs	• Assess for severity of impact with assessment of ocular pain, ↓visual acuity • Diplopia, irregular pupil, hyphema • Eye shield • Do not patch • Emergent ophthalmology referral
Hyphema		
• Blood filling lower part of the anterior chamber • Usually blunt, projectile, or penetrating trauma • Pain • Decreased VA • Injected conjunctiva • Irregular pupil • Usually less than 50% of the chamber is filled	• Increased concern for vision threatening contusion to globe even if not apparent • Rebleeding can occur in up to 30% of cases—likely due to lysis and retraction of clot and fibrin aggregates, usually first 5 days • Increased risk of rebleed in younger ages • Rebleeding can cause severe increase in intraocular pressure leading to blindness	• Elevate head of bed 30–45 degrees • Eye shield • No NSAIDs (antiplatelet effect) • Immediate ophthalmology evaluation • Topical cycloplegic • Topical miotics lower intraocular pressure and increase surface area of iris aiding hyphema resorption • Likely antifibrolytics (aminocaproic acid) • Topical steroids decrease associated iritis and synechiae development • Reduced physical activities • Frequent re-exam over 5 days • Consider admit if child
Open globe		
• Obvious perforation or penetrating FB	• 5–10% of penetrating injuries at risk for	• Emergent ophthalmology referral

• Usually pain, decreased vision, diplopia • Teardrop or irregular pupil • Increased or decreased depth anterior chamber • Vitreous extrusion • Intraocular structure prolapse • Corneal or scleral tenting at puncture site	endophthalmitis, which leads to vision loss	• Visual acuity counting fingers • External ocular movement, assess for entrapment • Place eye shield • Avoid increased intraocular pressure (antiemetics) • NPO • Broad spectrum antibiotics (Cefazolin, Ceftazidime, vancomycin) • Avoid eye manipulation • Tetanus prophylaxis
Protruding FB		
• Orbital or intraocular • High-velocity missiles • Metal bits released by drilling, hammering, shotgun, BB pellets • “Sudden impact” to eyelids or eye	• High index suspicion—PE findings can be mild • Can penetrate globe without severe pain • Vision threatening especially if copper or iron	• Visual acuity • Inspect for small lacerations to eyelids, corneal or scleral lacerations, hyphema, irregular pupil, absent red reflex • Leave FB in place, do not manipulate • Immediate ophthalmology referral
Eyelid laceration		
	• Increased risk severe ocular injury if ↓VA, diplopia. Severe pain. +LOC, “saw stars” • May not produce significant signs • Incorrectly repaired lid lacerations can cause cosmetic deformity, dry cornea with persistent pain or vision loss	• Complex lacerations are deep, long, involve lid margin, levator palpebrae muscle (ptosis) or canalicular system and require emergent repair by ophthalmology • Tetanus prophylaxis • If simple, repair skin with 6–0 suture

Orbital wall fracture		
Blunt trauma to face or eye • Auto accidents • Falls • Combat • Eyelid swelling and ecchymosis • Enophthalmos (“sinking in” of affected eye) • Ptosis • Diplopia • Anesthesia of ipsilateral cheek (infraorbital nerve injury) • Impaired upward gaze	• Increased risk of traumatic brain injury • Most common sites are floor (maxillary roof = “blow out” fracture) and medial wall (lamina papyracea of ethmoid)	• Diplopia? • Numbness of ipsilateral cheek? (infraorbital nerve damage) • Assess for signs of severe contusion, rupture, laceration, irregular pupil, hyphema • Assess for limited upward or downward gaze—suggests entrapment of inferior rectus muscle at fracture site or contusion of the muscle • Upward gaze—nausea • Limited lateral gaze suggests medial rectus entrapment • CT • Tetanus prophylaxis • Possible surgical repair required if persistently reduced eye movement after 10–14 days as this may resolve spontaneously • Antibiotics if sino-orbital fracture • No nose blowing
Conjunctival foreign body		
• Bulbar (ocular surface) • Palpebral (Inside surface of lid) • Scratching sensation	• Palpebral conjunctival FB gets stuck on inside upper lid in the tarsal sulcus	• Visual acuity • Evert both lids • Remove FB rolling a moistened cotton tip applicator across the conjunctival surface • Fluorescein • Topical antibiotic • Pain control • Ophthalmology follow up

		48 hours to confirm epithelial healing without infection
Corneal abrasion		
• Usually confined to epithelium • Pain, tearing, photophobia • Typically from fingernails, hairbrush bristles, branches/bushes, airborne particles, poor contact lens technique or overwear, sun-lamp treatments	• Sun lamp–associated symptoms typically develop several hours after exposure • Most corneal abrasions heal spontaneously within 48 hours • Infection rare • If no clear history of trauma to the eye, consider infection or dry eye • Repeated topical anesthetic is toxic to the cornea	• Topical anesthetic for exam only • VA • Inspect cornea with light and magnification for uneven light reflection, cloudiness, or foreign body • Assess depth of anterior chamber (shallow indicates perforation) • Fluorescein • Evert lids • Topical antibiotic • And/or cycloplegic for pain relief • Narcotic prn for 24 hours • No topical anesthetic • No patching in children • Follow up with ophthalmology in 48 hours to ensure healing without infection

Description

Table 25-4 Neonatal Conjunctivitis

Onset: During first month of life
Signs: Conjunctival injection with watery or purulent discharge
Causes: Infection, irritation, or blocked tear duct

Differential	Hx and PE	Dx	Txt	Pearls
Chemical conjunctivitis	Onset: Within 6–8 hours of instillation of topical prophylaxis at birth Presentation: Mildly red eyes and some swelling of the eyelids	• Hx	• No treatment • Resolves spontaneously within 36–96 hours	• Prophylaxis (erythromycin ophthalmic ointment) reduces but does not eliminate risk of gonococcal conjunctivitis • Does not cover *C. trachomatis.*
Chlamydia trachomatis ~40%	Onset: 5–14 days postpartum • Possibly earlier if premature rupture of membranes Presentation: Variable, minimal to severe • Conjunctival injection • Lid swelling • Watery discharge becoming mucopurulent	• Gold standard: NAAT* • Conjunctival swab with epithelial cells from everted eyelid (is obligate intracellular organism)	• Systemic, due to high rate of nasopharyngeal infection and pneumonia First line: • PO erythromycin ethylsuccinate ×14 days • Effective up to 90% conjunctivitis and 80% pneumonia	Consider if: • <1 month of age with conjunctivitis AND • Hx of untreated maternal *C. trachomatis* infection • If mother had no prenatal care OR • There was a maternal hx of *N. gonorrhoeae* infection
	• Bloody discharge • Possible pseudomembrane formation	• Nasopharynx swab • Test for *N. gonorrhoeae* due to a high rate of coinfection	• May repeat course if needed Alternative: • Azithromycin 3 days • Topical treatment not effective • Treat parents	• Up to 50% of newborns with chlamydial conjunctivitis also develop pneumonia • Conjunctiva usually heals without complications with treatment • Untreated infection can persist and cause conjunctival and corneal scarring • Erythromycin in neonates < 2 weeks associated with HPS,** counsel parents on risks, signs, symptoms
N. gonorrhoeae ~< 1%	Onset: 2–5 days postpartum • Possibly earlier if premature rupture of membranes Presentation: • Acute • Severe eyelid edema • Conjunctival injection • Chemosis • Profuse purulent exudate	• Gram stain for gram-negative diplococci • Culture of conjunctival exudate plus oropharyngeal, and rectal sites on modified Thayer-Martin medium	First line: • Ceftriaxone 50 mg/kg IV or IM to max 125 mg single dose • Treat 14 days if disseminated disease • Do not use if hyperbili or on Ca containing IV fluids	Consider if: • Abrupt onset after day one of life • Apparent severe or persistent chemical conjunctivitis • Hx of untreated maternal *N. gonorrhoeae* infection

	• Possible indolent and delayed onset due to ophthalmic prophylaxis, size of inoculum, or variation in virulence	• Test for *C. trachomatis* due to a high rate of coinfection	Alternative: • Cefotaxime • OK for hyperbili or if receiving Ca containing fluids • Frequent saline irrigation of eyes prevents secretions from adhering • Topical meds are ineffective • Test and treat mother and sexual partner(s)	• No prenatal care OR • Maternal hx *C. trachomatis* infection • Test and treat asymptomatic neonate if untreated maternal infection • Treat empirically after obtaining cultures before confirmatory tests available • Untreated may result in corneal ulcerations, scarring, and blindness • Can be associated with bacteremia and meningitis • Admit to observe for response to therapy and for disseminated disease
Staphylococcus, Streptococcus, Gram-negative bacteria ~30–50%	Onset: • Variable • Usually 4 days up to several weeks postpartum Presentation: • Mucopurulent discharge	Culture and sensitivity	Gram-positive and *Haemophilus*: • Erythromycin ointment 6× daily Gram-negative organisms: • Topical gentamicin every 2 hours	• Can be associated with sepsis • Can cause corneal perforation
HSV 1 and 2 ~< 1%	Onset: Usually 5–10 days of life Presentation: • Watery discharge • Lid swelling • Conjunctival injection • Excessive tearing • Painful eye symptoms • Choroiditis • Keratoconjunctivitis	Viral Cx from: • Surface swabs of conjunctiva, mouth, nasopharynx, • Skin scrapings of vesicles or surface lesions • CSF HSV PCR • Whole blood or plasma HSV PCR Additionally: • CBC with differential, LFTs, bilirubin, ammonia, BUN, Cr, CSF studies, blood and CSF cultures, EFG	First line: • Acyclovir × 14–21 days depending on pattern of illness and response to therapy First-line alternative: Ganciclovir If eye disease: Systemic acyclovir plus topical ophthalmic treatment (trifluridine 1%, idoxuridine 0.1%, or ganciclovir 0.15%)	• Suppressive therapy during pregnancy markedly reduces but does not eliminate risk • Can occur as isolated infection, or with disseminated or CNS infection • Do full workup even in apparent isolated diseases because clinical findings may be absent early in course

		• CXR and brain MRI if HSV infection suspected or identified • Ophthalmology exam: Dendritic keratitis is pathognomonic		• Indications for empiric are not standardized, but most experts agree indicated for any clinical features suggestive of HSV infection • Outcome depends on clinical pattern • HSV infection is lifelong even with appropriate therapy • Recurrence of eye disease and other forms may occur • Those with ocular involvement are at risk for long-term complications including vision loss, requiring close follow-up, and oral suppressive therapy is recommended for up to 1 year

*NAAT—nucleic acid amplification test.

**HPS—hypertrophic pyloric stenosis.

Description

ORTHOPEDICS—ARTHRITIS AND JOINT FLUID AND INFECTIONS

Table 26-1 Analysis of Joint Fluid

	Noninflammatory	Inflammatory	Septic	Hemorrhagic
Clarity	Clear	Cloudy	Purulent/Turbid	Bloody
Color	Yellow	Yellow	Yellow	Red/Brown
WBC/ml	< 200–2000	200–100,000	> 50,000	< 200[2]
PMN (%)	< 25%	> 75%	> 75%	< 25%
Glucose[1]	95–100%	80–100%	< 50%	100%
Culture	Negative	Negative	Positive > 50%	Negative
Disease	Degenerative joint disease, trauma, rheumatic fever, osteochondritis	Crystal, spondylo-arthropathy, Lyme, Reiter's, TB, fungi, viral, RA[3]	Septic arthritis	Trauma, bleeding diathesis, neoplasm

[1]Joint/Serum glucose × 100%. [2]Pure blood, joint = serum WBC. [3]Rheumatoid arthritis.

Description

Table 26-2 Etiology of Arthritis Based on Number of Involved Joints[1]

Monoarthritis (1 joint)	Trauma, tumor, septic, gout, or pseudogout	Lyme disease, avascular necrosis, osteoarthritis (acutely)
Oligoarthritis (2–3 joints)	Lyme, Reiter's, rheumatic fever	Gonococcal, ankylosing spondylitis, gout (polyarticular)
Polyarthritis (> 3 joints)	Rheumatoid, lupus, viral (rubella, hepatitis)	Serum sickness, septic (neonate, immunocompromised)

Description

[1]Migratory arthritis causes: Gonococcal, viral, rheumatic fever, Lyme, lupus, subacute endocarditis, mycoplasma, histoplasmosis, coccidioidomycosis, Henoch-Schönlein purpura, serum sickness (esp. cefaclor), sepsis (*Staphylococcus aureus*, *Streptococcus*,

Meningococcus).

Table 26-3 Septic Arthritis

Overview—Neonatal = Group B strep, *S. aureus*, gram-negative > 2 months *S. aureus*, Strep. gram-negative, *Neisseria*, *Salmonella* (esp. sickle cell), *Pseudomonas* (metal nail puncture through rubberized sole of shoe) 90% in 1 joint (knee > hip > ankle), multiple if neonate. Pseudoparalysis and irritability occur in young, and pain/↓ ROM older. Joint usually held in position max. distention. ↑ resistance to movement. US—effusion in 85% septic hips (also trans. synovitis). Joint culture + in 50–80% *Management*—(1) IV antibiotics (see page 162), (2) repeat aspiration, (3) surgical drainage if (a) hip, (b) ↑ debris, fibrin, loculation in joint space, or (c) no improvement within 3 days of IV antibiotics	***Presenting Features*[1]**	
	Average age	4 years
	Age < 2 years	46–69%
	Median duration symptoms	3 days
	Recent URI/*trauma*	53/*31%*
	Associated osteomyelitis	22%
	Temperature > 101°F	~75%
	↑ Sedimentation rate (ESR)	60–90%
	Average ESR (mm/hour)	36–56
	↑ C-reactive protein	82–95%
	↑ Serum WBC	46–60%
	X-ray normal (except neonate, hip subluxation)	~80%
	Abnormal Technetium scan	70–90%
	Abnormal MRI (better than US at telling septic joint vs synovitis)	88%

Description

[1]See Table 26-17 for algorithm discriminating between septic and transient synovitis of hip. Modified from Luhmann JD, Luhmann SJ. Etiology of septic arthritis in children: an update for the 1990s. *Pediatr Emerg Care*. 1999;15(1):40-42; Bonhoeffer J, Haeberle B, Schaad UB, Heininger U. Diagnosis of acute haematogenous osteomyelitis and septic arthritis: 20 years experience at the University Children's Hospital Basel. *Swiss Med Weekly*. 2001;131(39-40):575-581; Welkon CJ, Long SS, Fisher MC, Alburger PD. Pyogenic arthritis in infants and children: a review of 95 cases. *Pediatr Infect Dis J*. 1986;5(6):669-676; Dagan R. Management of acute hematogenous osteomyelitis and septic arthritis in the pediatric patient. *Pediatr Infect Dis J*. 1993;12(1):88-92. DOI: 10.1097/00006454-199301000-00018; Kallio MJT, Unkila-Kallio L, Aalto K, Peltola H. Serum C-reactive protein, erythrocyte sedimentation rate and white blood cell count in septic arthritis of children. *Pediatr Infect Dis J*. 1997;16:411-413; Barton LL, Dunkle LM, Habib FH. Septic arthritis in childhood. A 13-year review. *Am J Dis Child*. 1987;141(8):898-900; Del Beccaro MA, Champoux AN, Bockers T, Mendelman PM. Septic arthritis versus transient synovitis of the hip: the value of screening laboratory tests. *Ann Emerg Med*. 1992;21(12):1418-1422; Greenspan A, Tehranzadeh J. Imaging of infectious arthritis. *Radiol Clin North Am*. 2001;39(2):267-276; Sundberg SB, Savage JP, Foster BK. Technetium phosphate bone scan in the diagnosis of septic arthritis in childhood. *J Pediatr Orthop*. 1989;9(5):579-585.

Most common causes of bacterial arthritis in children according to age[1]

Age group	Most common bacteria
<3 months	*Staphylococcus aureus* (MSSA and MRSA)
	Group B *Streptococcus* (*Streptococcus agalactiae*)
	Gram-negative bacilli
	Neisseria gonorrhoeae
3 months–3 years	*S. aureus* (MSSA and MRSA)
	Kingella kingae
	Group A *Streptococcus* (*Streptococcus pyogenes*)
	Streptococcus pneumoniae
	Haemophilus influenzae type b (Hib) (in incompletely immunized children in regions with low Hib immunization rates)
>3 years	*S. aureus* (MSSA and MRSA)
	Group A *Streptococcus*
	S. pneumoniae
	N. gonorrhoeae (in sexually active adolescents)

Description

[1] MSSA—methicillin-susceptible *S. aureus*; MRSA—methicillin-resistant *S. aureus.*

Suggested doses of parenteral antibiotics commonly used in the treatment of osteoarticular infections in infants and children

Intravenous agent	Dose for infants 8–28 days	Dose for children > 28 days
Ampicillin	150 mg/kg per day divided in 2 doses	200–400 mg/kg per day divided in 4 doses Max dose 12 g/day
Cefazolin	100–150 mg/kg per day divided in 3 doses	100–150 mg/kg per day divided in 3 doses

		Max dose 6 g/day
Cefepime	60–100 mg/kg per day divided in 2 doses	100–150 mg/kg per day divided in 3 doses Max dose 6 g/day
Cefotaxime	150–200 mg/kg per day divided in 3 doses	150–200 mg/kg per day divided in 3–4 doses Max dose 8 g/day
Ceftazidime	150 mg/kg per day divided in 3 doses	125–150 mg/kg per day divided in 3 doses Max dose 6 g/day
Ceftriaxone	50–75 mg/kg per day in 1 dose	75–100 mg/kg per day divided in 1–2 doses Max dose 4 g/day
Clindamycin	20–30 mg/kg per day divided in 3 doses	25–40 mg/kg per day divided in 3–4 doses Max dose 2.7 g/day
Daptomycin	—	1–6 years: 12 mg/kg per day in 1 dose 7–11 years: 9 mg/kg per day in 1 dose 12–17 years: 7 mg/kg per day in 1 dose
Gentamicin	7.5 mg/kg per day divided in 3 doses	7.5 mg/kg per day divided in 3 doses
Linezolid	30 mg/kg per day divided in 3 doses	< 12 years: 30 mg/kg per day in 3 doses ≥ 12 years: 600 mg twice per day
Nafcillin	100 mg/kg per day divided in 4 doses	150–200 mg/kg per day divided in 4 doses Max dose 12 g/day
Oxacillin	100 mg/kg per day divided in 4 doses	150–200 mg/kg per day divided in 4–6 doses Max dose 12 g/day
Penicillin	150,000 units/kg per day divided in 3 doses	250,000–400,000 units/kg per day divided in 4–6 doses

		Max dose 24 million units per day
Vancomycin	Loading dose of 20 mg/kg followed by maintenance dose according to serum creatinine: • < 0.7 mg/dl: 15 mg/kg every 12 hours • 0.7–0.9 mg/dl: 20 mg/kg every 24 hours • 1.0–1.2 mg/dl: 15 mg/kg every 24 hours • 1.3–1.6 mg/dl: 10 mg/kg every 24 hours • > 1.6 mg/dl: 15 mg/kg every 48 hours	45–60 mg/kg per day divided in 3–4 doses Max dose 4 g/day

Description

Data from: American Academy of Pediatrics. Antibacterial drugs for newborn infants: Dose and frequency of administration. In: *Red Book: 2009 Report of the Committee on Infectious Diseases,* 28th ed, Pickering LK (Ed), American Academy of Pediatrics, Elk Grove Village, IL 2009. p.745. American Academy of Pediatrics. Tables of antibacterial drug dosages. In: *Red Book: 2018 Report of the Committee on Infectious Diseases*, 31st ed, Kimberlin DW, Brady MT, Jackson MA, Long SS (Eds), American Academy of Pediatrics, Itasca, IL 2018. p.914. Cubicin (daptomycin for injection). United States Prescribing Information. Revised September, 2017. US Food and Drug Administration. Available online at http://www.accessdata.fda.gov/scripts/cder/drugsatfda/index.cfm (accessed August 3, 2018).

Table 26-4 Osteomyelitis (see Table 26-8 for Vertebral Osteomyelitis)

Overview—In neonate, Group B strep, *S. aureus*, gram-negative In neonate, most common features are pseudoparalysis (64%), tenderness (55%), fever (32%), red (32%), and irritability (36%). Infants may have paradoxical irritability (pain ↑ with holding). If older, *S. aureus* > Strep > gram-negative Most common sites: femur > tibia > foot > humerus > pelvis. *Management*—(1) IV antibiotics (see page 156), (2) Surgery may be indicated for (a) abscess formation, (b) bacteremia beyond 72 hours of IV antibiotics, (c) sinus tract, or (d) sequestra presence.	*Presenting features (exclude neonate)*	
	Average age	5.9 years
	Age < 5 years	50%
	Complaint of pain/*swelling*	65/*54*% 1/3 each
	Local tender/warmth/red	75–85%
	Fever by hx or exam	89–92%
	↑ Sedimentation rate (ESR)	42–61 98%
	Average ESR (mm/hour)	31–43%
	↑ C-reactive protein	< 5%
	↑ Serum WBC	42%
	Normal WBC and ESR	82–95%
	X-ray normal (esp. first 10 days)	88–100%

	Abnormal Technetium scan Abnormal MRI	

Description

Modified from Faden H, Grossi M. Acute osteomyelitis in children. Reassessment of etiologic agents and their clinical characteristics. *Am J Dis Child*. 1991;145(1):65-69; Unkila-Kallio L, Kallio MJ, Eskola J, Peltola H. Serum C-reactive protein, erythrocyte sedimentation rate, and white blood cell count in acute hematogenous osteomyelitis of children. *Pediatrics*. 1994;93(1):59-62; Brook I. Microbiology of human and animal bite wounds in children. *Pediatr Infect Dis J*. 1987;6(1):29-32; Mustafa MM, Sáez-Llorens X, McCracken GH Jr, Nelson JD. Acute hematogenous pelvic osteomyelitis in infants and children. *Pediatr Infect Dis J*. 1990;9(6):416-421; Dagan R. Management of acute hematogenous osteomyelitis and septic arthritis in the pediatric patient. *Pediatr Infect Dis J.* 1993;12(1):88-92. DOI: 10.1097/00006454-199301000-00018; Oudjhane K, Azouz EM. Imaging of osteomyelitis in children. *Radiol Clin North Am*. 2001;39(2):251-266; Scott RJ, Christofersen MR, Robertson WW Jr, Davidson RS, Rankin L, Drummond DS. Acute osteomyelitis in children: a review of 116 cases. *J Pediatr Orthop*. 1990;10(5):649-652; Schneeweiss S, Lalani A. Chapter 42: Osteomyelitis and septic arthritis. In *The Hospital for Sick Children Handbook of Pediatric Emergency Medicine*. Jones and Bartlett; 2008:331-338.

Clinical features associated with bacterial pathogens that cause acute hematogenous osteomyelitis in children

Features	
Gram-negative bacteria	
Bartonella henselae	• Exposure to cats • Bones affected: vertebral column, pelvic girdle • Multifocal infection possible
Brucella	• Endemic areas • Consumption of unpasteurized dairy
Haemophilus influenzae type b (Hib)	• Children who are incompletely immunized in area with low Hib immunization coverage
Kingella kingae	• Children 6-36 months old • Slow onset with oral ulcers prior to musculoskeletal findings • May affect nontubular bones
Mycobacterium tuberculosis	• Contact with endemic area

Nonsalmonella gram-negative bacilli (Escherichia coli, Serratia)	• Ages birth-3 months old • Children with sickle cell disease or immunocompromised • History of instrumentation of gastrointestinal or urinary tract
Nontuberculous mycobacteria	• Associated with: underlying immunodeficiency (HIV infection, chronic granulomatous disease), surgery or penetrating injury
Pseudomonas aeruginosa	• Injection drug use
Salmonella species	• Exposure to reptiles or amphibians • Children with gastrointestinal symptoms, sickle cell disease or similar hemoglobinopathies, or in developing countries
Gram-positive bacteria	
Actinomyces	• Bones affected: face, pelvis, vertebral bodies
Coagulase-negative staphylococci	• Affects: children with indwelling vascular catheters; neonates in intensive care
Group A Streptococcus	• Children younger than 4 years old • Potential complication of varicella-zoster virus infection
Group B Streptococcus	• Typically ages 2-4 weeks old, up to 3 months old
Staphylococcus aureus	• Any age • Skin or soft tissue infection possible • Venous thromboembolism and pulmonary disease possible with methicillin-resistant Staphylococcus aureus
Streptococcus pneumoniae	• Children who are incompletely immunized (younger than 2 years old) or with underlying medical conditions (older than 2 years old)

Polymicrobial infection	• Likely resultant from direct inoculation (e.g., penetrating trauma) or spread of infection from adjacent tissue

Description

Data from Krogstad P. Hematogenous osteomyelitis in children: Evaluation and management. UpToDate. https://www.uptodate.com/contents/hematogenous-osteomyelitis-in-children-evaluation-and-diagnosis. Accessed February 22, 2019.

Table 26-5 Etiology of Back Pain

Etiology[1,2] (n = 225)	**<12 years**	**≥12 years**
Musculoskeletal (trauma, strain)	57%	43%
Infection [viral, pneumonia, UTI (5%)][1]	13%	17%
Idiopathic	12%	13%
Sickle cell disease	14%	13%
Psychogenic	2%	2%
Other (gallstones, pancreas, renal)	2%	13%

Description

[1]If fever, 36% had source (meningitis, lung, pharyngitis, PID, UTI), 32% virus, 18% sickle crisis. See the following text and pages 243–245 for discitis, vertebral osteomyelitis, epidural abscess. [2]If fever with bilateral radicular pain, weakness, bowel/bladder dysfunction, or perineal anesthesia (or suspect spinal cord infection or lesion), MRI spine or consult neurosurgery.

Data from Selbst SM, Lavelle JM, Soyupak SK, Markowitz RI. Back pain in children who present to the emergency department.*Clin Pediatr (Phila)*. 1999;38(7):401-6. DOI: 10.1177/000992289903800704

Table 26-6 Discitis

Overview—Intervertebral disc infection due to hematogenous spread to vascular channels in cartilage of intervertebral disc space that disappear later in life. 1/3 of patients have + cultures (blood or disc) for *S. aureus*. Most are culture negative. X-rays are abnormal in 76%.[1]	***Presenting features***	
	Age ≤ 2.5 years	75%
	Refuse/Difficult walking	56%
	Back/Neck pain (100% > 3 years)	25–42%
	Abdominal pain	3–22%
	Average symptom	5–22 days
		28–47%

MRI is diagnostic procedure of choice. *Management*—(1) Exclude more serious disease (osteomyelitis, abscess, tumor, or other peritoneal, retroperitoneal abscess). (2) Antibiotic use debatable; if used, treat MRSA (page 147).	duration Hx fever or T > 100.3°F Tender back Lumbosacral involvement Serum WBC > 10,500 Average ESR (mm/hour) Abnormal bone scan Abnormal MRI	50% 78–82% 50% 39–42 72–90% 90–100%

Description

[1]↓ Disc space, eroded vertebral end plates.

Modified from Fernandez M, Carrol CL, Baker CJ. Discitis and vertebral osteomyelitis in children: an 18-year review. *Pediatrics*. 2000;105(6):1299-1304; Crawford AH, Kucharzyk DW, Ruda R, et al. Diskitis in children. *Clin Orthop Relat Res*. 1991;266:70-79.

Table 26-7 Epidural Abscess (Spinal)

	Presenting features	
Overview—Abscess in spinal epidural space usually involves posterior aspect of epidural space (86%), especially lumbar region extending to 7 vertebral levels. *S. aureus* is cause in 79%, Strep. in 8%, followed by gram-negatives/mixed flora. Occasionally, *Mycobacterium tuberculosis* is cause. Source is hematogenous in 1/2, seeded by skin or soft tissue site. 1/4 had spine trauma precipitant. *Management*—(1) IV antibiotics (see osteomyelitis treatment on page 156). Ensure that MRSA is covered, AND (2) neurosurgical consult with surgical drainage.	Average age Average symptom duration Limb weakness Fever Back pain Complete paralysis Partial paralysis Sphincter disturbance Spine tenderness Sensory level Abnormal plain films[1] Cerebrospinal fluid WBC count elevated Elevated serum WBC Abnormal myelogram Abnormal MRI	8 years 8–9 days 78% 63% 54% 45% 33% 38% 27% 24% 14–50% 37% 85% 100% 92–100%

Description

[1]Most commonly loss of intervertebral disc height.

Modified from Kaufman DM, Kaplan JG, Litman N. Infectious agents in spinal epidural abscesses. *Neurology*. 1980;30(8); Mermel LA, Farr BM, Sherertz RJ. Guidelines for the management of intravascular catheter-related infections. *Clin Infect Dis*. 2001;32(9):1249-1272; Rubin G, Michowiz SD, Ashkenasi A, Tadmor R, Rappaport ZH. Spinal epidural abscess in the pediatric age group: case report and review of literature. *Pediatr Infect Dis J*. 1993;12:1007-1011; Sexton DJ, Sampson JH. Spinal epidural abscess. *UpToDate*. July 18,

2018.

Table 26-8 Vertebral Osteomyelitis

Etiology—S. aureus > *S. epidermidis*, gram-negatives, *Bartonella*. Infection occurs when organisms settle in low-flow vasculature near subchondral plate. Patients are generally older and more ill-appearing than those with discitis. Recent trauma is noted in 14%. *Management*—Diagnose by MRI, although technetium scanning may be more useful in very young with nonlocalized pain. IV antibiotics (see osteomyelitis, page 156). Surgery may be indicated for (a) abscess formation, (b) bacteremia or systemic illness beyond 48–72 hours on IV antibiotics, (c) sinus tract, (d) sequestra presence, (e) progressive neurologic deficit, (f) progressive vertebral body collapse or kyphosis.	***Presenting features***	
	Median age	6–8 years
	Age ≤ 2.5 years	14%
	Average symptom duration	33 days
	History fever	54–79%
	Back/Neck pain (all ages)	64%
	Prior infection (lung, skin)	29%
	Back trauma	21%
	Limp	14%
	Abdominal, shoulder, rib pain, or incontinence	7% each
	Hip or flank pain	8%
	Temperature > 102°F	79%
	Paraspinal mass	11%
	Average WBC (cells/mm^3)	12,600
	WBC > 11,000 (cells/mm^3)	64%
	Average ESR (mm/hour)	46
	Abnormal X-ray	46%
	Abnormal bone scan	85–95%
	Abnormal MRI	96–100%

Description

Modified from Fernandez M, Carrol CL, Baker CJ. Discitis and vertebral osteomyelitis in children: an 18-year review. *Pediatrics*. 2000;105(6):1299-304. DOI: 10.1542/peds.105.6.1299; Correa AG, Edwards MS, Baker CJ. Vertebral osteomyelitis in children. *Pediatr Infect Dis J*. 1993;12:228-233. *Pediatr Infect Dis J.* 1993;12:228.

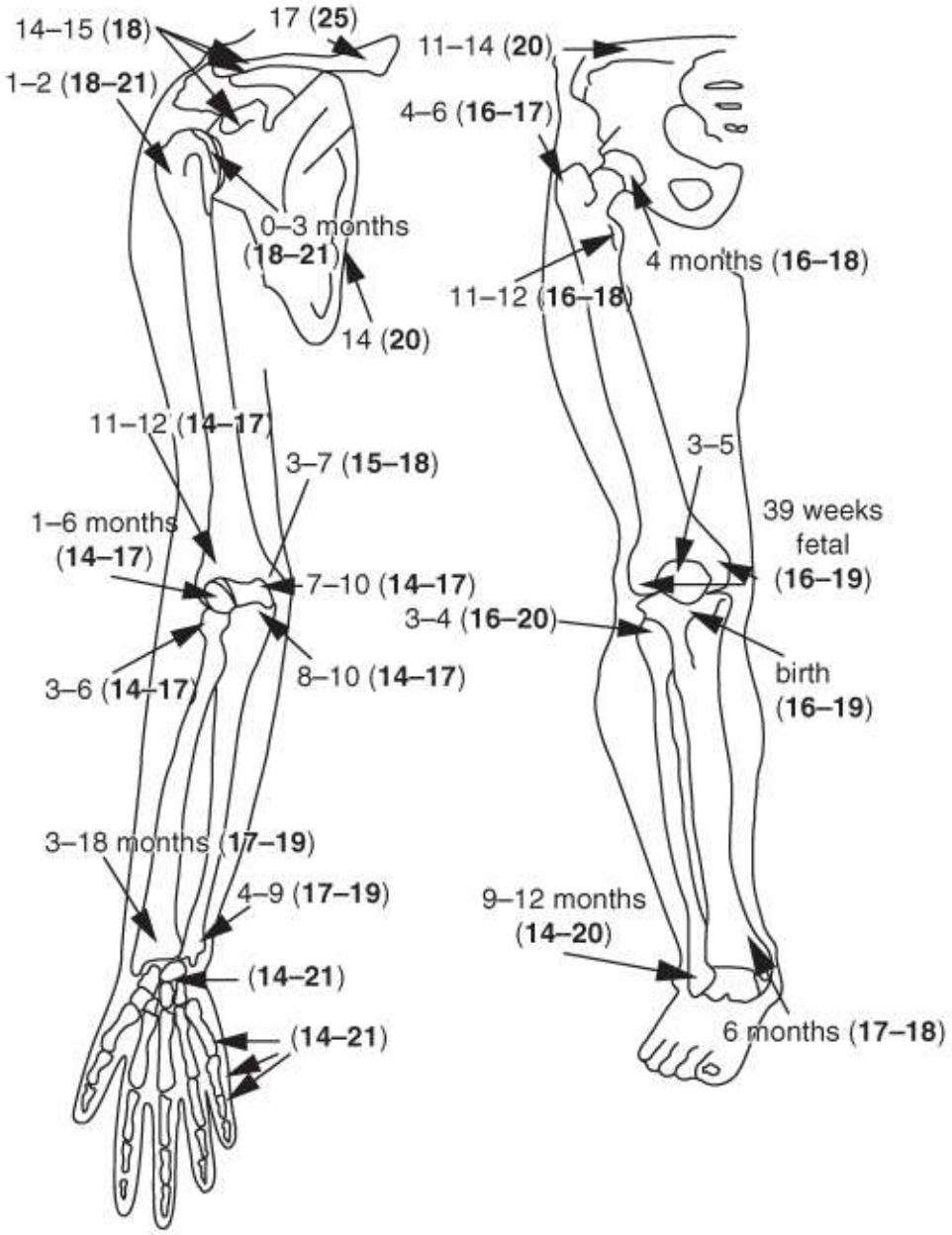


Figure 26-1 Age of Onset of Ossification Centers and Physeal Closure.

Normal type—Age of onset of secondary ossification centers. **Bold type in parentheses**—Age of physeal closure. All ages are in years unless otherwise specified.
https://www2.aofoundation.org

GROWTH PLATES

Salter I	Complete separation of the epiphysis and most of physis from metaphysis due to shearing force. Usually no long-term growth problems (except distal/proximal femur, proximal radius, and proximal tibia—can prematurely close with growth arrest)
Salter II	Fracture line extends along physis into metaphysis. Usually > 10 years. Generally have good prognosis.
Salter III	Fracture line extends from physis through epiphysis to articular surface. Most will require exact reduction and orthopedic consult.
Salter IV	Fracture at articular surface crosses epiphysis to metaphysis. Most will require exact reduction and orthopedic consult.
Salter V	Longitudinal compression of growth plate.
Ogden VI	Peripheral shear to borders of growth plate.
Ogden VII	Intra-articular epiphyseal injury, ligament pulling off distal epiphysis.
Ogden VIII	Fracture through metaphysis with circulation disruption.
Ogden IX	Fracture with loss of periosteum.

Description

EMNote.org. *Ossification Centers of the Elbow*. Retrieved from https://www.emnote.org/emnotes/ossification-centers-of-the-elbow

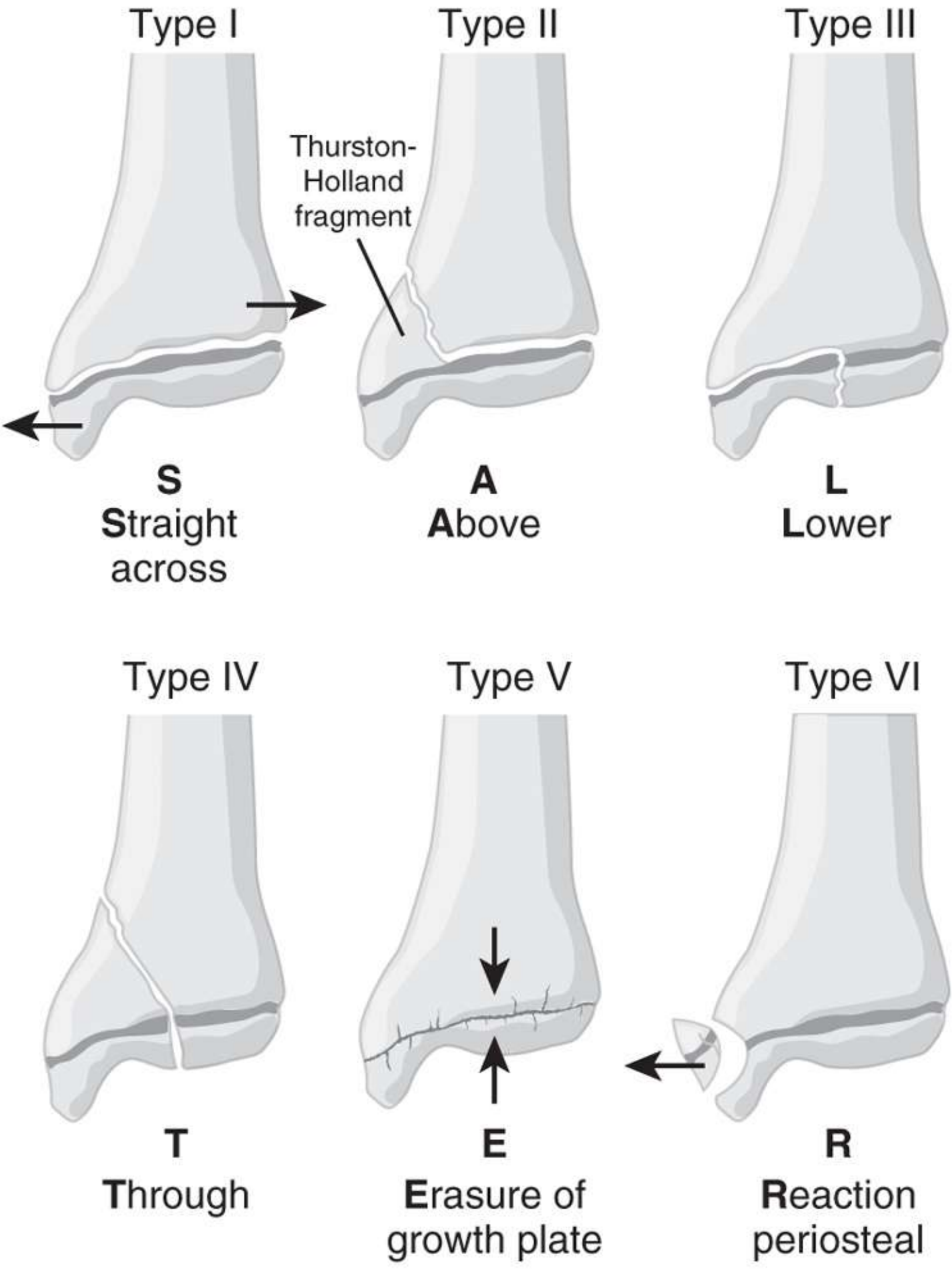


Figure 26-2 Salter-Harris/Ogden-Harris Physeal Fracture Classification.
Description

Table 26-9 Management (If Closed, No Neurovascular Injury, No Rotational Deformity)

Shoulder clavicle	
Scapula fracture *Requires high trauma to break (consider chest CT)*	• 75% have other serious injuries with mortality up to 14% • Surgery if body fracture displaced > 10 mm, neck + clavicle fracture, displaced coracoid fracture + distal clavicle or AC joint injury, acromial fracture + subacromial narrowing, glenoid neck fracture + > 10 mm or ≥ 40°, displacement, glenoid rim + shoulder sublux/instability, or glenoid fossa displaced > 3–5 mm • *Splinting*—Sling or shoulder immobilizer
Clavicle fracture	• *Middle 3rd*—Nonoperative. *Medial 3rd*—Usually a Salter-Harris I or II injury and mimics a sternoclavicular dislocation. If posterior-displacement, exclude mediastinal injury. Reduce under general anesthesia. *Distal 3rd*—Immobilize nondisplaced as per middle 3rd. Grossly displaced (types IV–VI) require surgery (esp. > 13 years or if significant tenting of skin). • *Splinting*—Sling arm. A figure of 8 is rarely used.
Humerus/Elbow	
Proximal fracture *(80% of humerus growth occurs here)*	• Proximal humeral ossification cannot be seen on X-ray until 6 months, greater tuberosity at 1–3 years, lesser tuberosity by 4–5 years. • Salter I—Most < 5 years. Salter II occurs in older. III/IV rare. • Majority of severely displaced fractures should be treated by sling and swathe immobilization. Acceptable displacement for closed management (if patient has open physis or is within 1–2 years of physeal closure) is (1) complete displacement, (2) ≤ 3 cm of overriding, and (3) ≤ 60° of angulation. Surgery if (1) open fracture, tenting of skin, displacement greater than (1–3) above, or neurovascular injury. • *Splinting*—Long arm handing cast, coaptation splint, or sling/swathe.
Little League shoulder	• Osteochondrosis/Traction apophysitis proximal humerus. Overuse from throwing. X-ray—Normal or wide physis. Generally treat with rest.

Humeral shaft fracture	• Radial nerve injury most common at distal/mid 3rd. 78–100% recovery. • ≤ 3 years old, accept 45° of angulation. Treat with sling and swathe or Velpeau bandage. • > 3 years old, accept complete displacement and ≤ 2 cm shortening. If proximal shaft, 25–30° of angulation is acceptable. If mid-shaft, 20° of angulation is acceptable. If distal 1/3 shaft, 15–20° of angulation is acceptable. • *Splinting*—Long arm handing cast, coaptation splint, sling/swathe.
Supracondylar fracture *Gartland classification and also denote if extension (95% of cases) or flexion injury*	• Splint undiagnosed/unreduced in 30° of flexion. Posterior-laterally displaced fracture may injure radial nerve. Medially displaced fracture (more common) may injure brachial artery and median nerve. • *Type I—Nondisplaced + normal Baumann angle* (angle physeal line lat. condyle/humeral shaft = 75–80°) = Ia. • Ib = comminution, collapse, minimal angulation. • Treatment—mobilization. • *Type II—Displaced, intact posterior cortex.* Treatment: Closed reduction with pin fixation for most. • *Type III—Completely displaced or no cortical contact*. 10–20% have absent pulse. Treatment: pinning/surgery. • *Splinting*—Splint undiagnosed elbow injuries with elbow at 20–30° until radiography completed. For type I fractures—Long arm splint with elbow at 90° flexion and forearm/wrist neutral or pronated.
Transphyseal	• Closed reduction and pin fixation required for most.
Lateral condyle fracture	• *Milch I*—Extend to capitellum ossification center. • *Milch II*—Medial to trochlea. • *Stages*—Articular surface: (I) intact, (II) disrupted, (III) displaced/rotated. • *Nondisplaced*—No surgery. • *Displaced* ≥ 2–4 mm—Reduction and surgery. • *Splinting* (for nondisplaced)—Posterior splint with elbow flexed 90°, and neutral or supinated forearm.
Medial epicondyle	• Ulnar nerve injury rate is 10–16%. If associated elbow dislocation, up to 50% may have an ulnar nerve injury. • Displaced < 5 mm—posterior splint, long arm cast or sling. • Displaced ≥ 5 mm, intra-articular fragment, incarcerated fragment, ulnar nerve injury, or late instability may require

	surgery. • *Splinting*—Posterior splint or long arm cast with elbow at 90°.
Medial epicondyle apophysitis	• Little League elbow: Pain/tender medial elbow from repeat valgus stress. Generally, treat with rest, displacement may need surgery.
Radius (R)/Ulna	
Radial head subluxation (Nursemaid's elbow)	• Injury in 6 months to 5 years old from annular ligament slipping over radial head becoming caught between radial head and capitellum. X-ray unnecessary if classic history and exam. • Treat by (1) flex elbow 90° and supinate forearm or (2) hyperpronate wrist/forearm followed by elbow flexion.
Olecranon fracture	• *Nondisplaced*—Immobilization/splinting. • *Displaced—>* 3 mm + extra-articular, closed reduction/immobilization. If displaced > 3 mm + intra-articular or if comminuted requires surgery. • *Splinting*—Posterior splint with elbow partially extended at 75–80°.
Radial head fractures	• Ossification of radial head epiphysis begins at 5 years. The radial head is largely cartilaginous and rarely injured. 50% have another associated fracture or dislocation involving the elbow. • *Minimally displaced* (< 30°) and no translation—sling/splint. • *Angulation > 30*°—Closed reduction, flexion-pronation technique. • *Angulation > 45*°—Closed reduction OR percutaneous pin. • *Angulation fixed > 40°, translation > 3 mm with < 60° supinate-pronation, head completely displaced*—Wire or open reduction. • *Splinting*—Sling or posterior splint with elbow 90°/neutral forearm.
Radial neck fractures	• 50% of radial neck fractures have other associated fractures or injury. Most are Salter-Harris I and II injuries. • *If < 10 years old*, accept ≤ 30° of angulation, and < 33% displacement (translation). Up to 45° may be acceptable if able to supinate and pronate 60–70°. *If >10 years old*, accept ≤ 30° of angulation and ≤ 3 mm displacement (translation). • If they don't meet the previous criteria, closed or open

	reduction may be needed. • *Splinting*—Posterior splint with elbow 90° and neutral forearm.
Radioulnar (both bones) fracture	• ± Entrapped median, anterior interosseous nerve (FPL, lat. FDPs, pronator quadratus), superficial radial nerve (sensory dorsal web thumb). • *Plastic deformation* (bowing fractures). Treat by reducing plastic deformation under general anesthesia if ≥ 20° (esp. > 4 years), reduction needed to align associated fracture, or unable to fully rotate if > 4 years. • *Greenstick fracture* (complete disruption of only one cortex with plastic deformation of the other cortex; rotation and angular deformity present). Treat by closed reduction by reversing the deforming forces (after appropriate anesthesia). If *apex volar* (distal fragment dorsally angulated), pronate forearm and apply volar surface pressure to fracture apex. If *apex dorsal* (distal fragment is volarly angulated), supinate forearm and apply dorsal surface pressure to fracture apex. Sugar tong or bivalved long arm cast. • *Complete shaft fracture*—Closed reduction. If ≤ 8 years, ≤ 15° of prox/midshaft angulation and 30–45° angulation is acceptable. If ≥ 9 years, ≤ 10° mid and prox. shaft angulation. 9- to 14-year-old female and 9- to 14-year-old male, < 20–30° malrotation acceptable. • *Splinting*—Fractures with the apex of fracture in volar position and distal fragment angulated dorsally: splint in pronation with sugar tong splint encompassing elbow and wrist. Fractures with apex of the fracture in dorsal position and distal fragment angulated volarly splint in supination via sugar tong splint encompassing elbow and wrist. Unstable fractures require splint of elbow in extension.
Monteggia fracture (fracture of proximal ulna with radial head dislocation); *Bado classification*	• 25% posterior interosseous nerve injury (wrist extensors, not ECRL). • *Type I*—Anterior dislocation radial head, fracture ulnar diaphysis. • *Type II* (associated with ulnar nerve injury)—Postdislocation radial head, ulnar diaphyseal or metaphyseal fracture + posterior angulation. • *Type III*—Lat. or anterolat. dislocation radial head, ulnar metaphyseal fracture. • *Type IV*—Anterior dislocation radial head with ulnar/radial fracture at same levels or with radial fracture distal to ulnar

	fracture. • Manage primarily based on ulnar fracture. If ulna plastic deformation or incomplete ulnar fracture (greenstick/buckle), closed reduction with up to 10° angle acceptable followed by radial head reduction. Pinning or surgery may be needed if complete transverse, oblique, or comminuted fracture of ulna or unable to reduce radial head. • *Splinting*—Long arm splint with elbow flexed up to 110–120° with forearm mid-supination or neutral.
Proximal and mid-radius fracture	• In general follow principles of managing both bones (greenstick, plastic, complete), Monteggia, Galeazzi fracture depending on injury. • *Splinting*—Generalities may not always be appropriate depending on associated fractures and initial injury. *Proximal radius*—Long arm cast or sugar tong with forearm supinated. *Middle radius*—Long arm cast or sugar tong with forearm neutral. *Distal radius*—Sugar tong with forearm pronated. For each of these fractures make sure that the distal fragment is immobilized in the degree of rotation so that it is aligned with the bicipital tuberosity.
Distal radius fracture	• *Physeal*—If nondisplaced, immobilization. If displaced or neurovascular compromise, closed reduction and pinning. Open reduction if irreducible, open, displaced Salter-Harris III/IV fracture, compartment syndrome or acute carpal tunnel syndrome. • *Metaphyseal*—If nondisplaced, torus/buckle immobilize. Reduction to following goals is required if displaced fracture. Age 4–9 years, sagittal angulation 20° male, 15° female, frontal 15° (both) Age 9–11 years, sagittal angulation 15° male, 10° female, frontal 5° (both) Age 11–13 years, sagittal angulation 10° male, 10° female, frontal 0° (both) Age > 13 years, sagittal angulation 5° male, 0° female, frontal 0° (both) Open reduction is reserved for fractures that are irreducible/open. • *Splinting*—Sugar tong with forearm pronated.
Galeazzi fractures	• Fracture distal radius with distal radioulnar disruption. • *Type I*—Dorsal displaced distal radius.

	• *Type II*—Volar displaced distal radius. • *Treat/Splint*: Closed reduction and above elbow cast/full supination.
Carpal-metacarpal-phalangeal	
Scaphoid	• *Splint* long arm thumb spica if nondisplaced. If displaced, open reduction and internal fixation.
Metacarpal fractures	• (1) *Epiphyseal/Physeal*—Many are irreducible or unstable requiring pin or surgery. (2) *Neck*—Most can be reduced and splinted in "safe position." (3) *Shaft*—Closed reduction for most. (4) *Base*—Many are high energy with ↑ tissue disruption. Fractures/dislocations usually require surgery. • *Splinting—Neck fracture:* "Safe position" is maximum MCP flexion + extend IP joint. *Shaft fracture:* "Beer can" position, wrist extended 10–15°, MCP flexed 70°, IP extended.
Thumb metacarpal fractures	• Head/shaft—Closed reduction unless intra-articular or complex. • Base—*Type A* (metaphyseal). *Type B* (Salter II + metaphyseal piece on medial side and lateral angulation of shaft). *Type C* (Salter II with metaphyseal piece on lateral side + medial angulation shaft). *Type D* (Salter III – pediatric Bennett fracture). • Type A/B usually can be treated with closed reduction. Many Type C and most (± all) Type D + Salter IV require open reduction. • *Splinting*—Thumb spica.
Proximal and mid-phalanx	• *Physeal fractures*—Most common fractures of the proximal phalangeal base. Surgery indicated if irreducible or open fractures. *Shaft fractures* <10 years, up to 20–25° angulation in the plane of motion is acceptable. If > 10 years, < 10–15° angulation in the plane of motion is acceptable. If above these angles or if spiral, oblique wires/surgery indicated. *Phalangeal neck fractures*—Often unstable and displace due to persistent attached collaterals to the distal fragment. Surgery is usually needed. *Intra-articular fractures*—All displaced intra-articular fractures require pinning or surgery.
Distal phalanx	• (1) *Extraphyseal fractures* usually require splint alone unless very proximal or comminuted. Evacuate subungual hematoma that is > 50% of nail plate ± nail bed repair. (2) *physeal fracture* may cause mallet deformity with DIP in

	flexed position. An avulsion of insertion of the FDP at the DIP can cause a “jersey finger” or reverse mallet with inability to flex finger at DIP. • *Splinting—mallet finger:* Apply volar or dorsal splint to keep finger extended. Unacceptable reduction of mallet or open fracture require surgery. *Jersey finger/reverse mallet* requires surgery.

Description

Modified from Fernandez M, Carrol CL, Baker CJ. Discitis and vertebral osteomyelitis in children: an 18-year review. *Pediatrics.* 2000;105(6):1299-304. DOI: 10.1542/peds.105.6.1299; Correa AG, Edwards MS, Baker CJ. Vertebral osteomyelitis in children. Pediatr Infect Dis J. 1993;12:228-233. *Pediatr Infect Dis J*. 1993;12:228.

Table 26-10 Classification of Pediatric Pelvic Fractures[1]

Torode and Zieg classification[2]		Tile and Pennal classification	
Type I	Avulsion fracture	Type A	Stable fractures
Type II	Iliac wing fracture	A1	Avulsion fractures
IIa	Separated iliac apophysis	A2	Nondisplaced wing/ring fracture
IIb	Fracture bony iliac wing	A3	Transverse fracture of sacrum or coccyx
Type III	Simple ring fractures		
IIIa	Pubis fracture, disrupted symphysis Posterior structures stable	Type B	Partially unstable fracture
		B1	Open book injury
IIIb	Acetabular fracture, no ring fracture	B2	Lat. compress (triradiate)
Type IV	Fracture with unstable segment Ring disruption fracture	B3	Bilateral type B injuries
		Type C	Unstable pelvic ring
IVa	Bilateral sup/inferior rami	C1	Unilateral fractures
IVb	Anterior rami or symphysis + posterior fracture (e.g., sacrum)	C1-1	Ilium fracture
		C1-2	Dislocation ± fracture SI joint
IVc	Fracture—unstable piece between ant. ring pelvis/ acetabulum	C1-3	Sacral fracture
		C2	Bilat fracture (1 type B/1 type C)
		C3	Bilateral type C fractures

Torode class	Mortality	GU injury	Other fractures[3]	Neuro. injury	Abd surgery
II	0%	6%	39%	61%	11%
III	3%	26%	49%	57%	13%
IV	13%	38%	56%	56%	40%

[1]Once triradiate cartilage closed, adult classification (Tile) and treatment is used. [2]Class does not include acetabular fracture. [3]Nonpelvic.
Data from Torode I, Zieg D, Pelvic fractures in children. *J Pediatr Orthop*. 1985;5:76; Silber JS, Flynn JM. Changing patterns of pediatric pelvic fractures with skeletal maturation: implications for classification and management. *J Pediatr Orthop*. 2002;22:22.

Description

Table 26-11 Avulsion Fractures of Pelvis/Proximal Femur[1]

Location (relative frequency)	Mechanism
Ischial tuberosity (38–54%)	Forceful hamstring contraction—jumping
Ant sup. iliac spine (19–32%)	Forceful sartorius contraction—kicking/sprint
Ant inf. iliac spine (18–22%)	Forceful rectus femoris contraction—kicking
Lesser trochanter (9%)	Forceful psoas contraction—sprint, jump, kick, skate
Iliac crest (1–3%)	Contract abdomen/obliques—kicking twisting rotate
Symphysis pubis (0–3%)	Contraction leg adductors—swim, kick, jump, run

Description

[1]*Management*—Rest, no weight bear for ≥ 3–7 days, then gradual weight with crutches, then limited exercise for 2–4 weeks. Surgery if displaced > 2 cm, chronic pain + excess callus (esp. ischial).
Data from Minnock W, Minnock C, Leetch AN. *Pediatric Emergency Medicine Reports: A Review of the Limping Child and Painful Hip*. August 2016, Vol. 21, no. 8.

Table 26-12 High-Yield Criteria for Knee, Ankle, and Pelvic Radiographs in the ED

Pelvic criteria[1]	Painful or tender/abraded/contused pelvis, GCS < 15 or distracting injury.
Knee criteria[2]	(1) Unable to flex 90° or (2) unable to bear weight (4 steps) in the ED.
Ankle criteria[3]	(1) Unable to bear weight immediately after injury or (2) unable to take 4 steps in the ED or (3) tender along inferior or posterior edge of malleolus.

Description

[1]Pelvic criteria were 99–100% sensitive. [2]Knee criteria were 92–100% sensitive. [3]Ankle criteria were 100% sensitive.

Data from Junkins EP, Furnival RA, Bolte RG. The clinical presentation of pediatric pelvic fractures. *Pediatr Emerg Care*. 2001;17:15; Cohen DM, Jasser JW, Kean JR, Smith GA. Clinical criteria for using radiography for children with acute knee injuries. *Ped Emerg Care*. 1998;14:185; Khine H, Dorfman DH, Avner JR. Applicability of Ottawa knee rule for knee injury in children. *Ped Emerg Care*. 2001;17:401; Gravel J, Hedrei P, Grimard G, Gouin S. Prospective validation and head-to-head comparison of 3 ankle rules in a pediatric population. *Ann Emerg Med*. 2009;54(4):534-540.e1; Bulloch B, Neto G, Plint A. Validation of the Ottawa Knee Rule in children: a multicenter study. *Ann Emerg Med*. 2003;42(1):48-55; Konan S, Zang TT, Tamimi N, Haddad FS. Can the Ottawa and Pittsburgh rules reduce requests for radiography in patients referred to acute knee clinics? *Ann R Coll Surg Engl*. 2013;95(3):188-191.

Table 26-13 Acetabulum/Femur

Acetabulum	• *Type I*—Small fragments ± hip dislocate; *(II)*—Linear fracture ± pelvic fracture not displaced; *(III)*—Linear fracture, hip unstable; *(IV)*—Central fracture dislocation. • Nondisplaced/minimally displaced/stable (≤ 1 mm): Bed rest, nonweight-bearing. Traction or surgery if unstable or displaced > 1 mm.
Hip fracture *Delbet classification*	• *Type I* —Transepiphyseal ± acetabular dislocation. *Type II* —Transcervical (femoral neck). *Type III*—Cervicotrochanteric (base femoral neck). *Type IV*—Intertrochanteric. Management consists of reduction if needed, and spica cast or surgery depending on patient age and specific injury.
Femur shaft	• Classify based on location (prox, mid, distal 3rd), configuration (spiral, oblique, transverse), angle, degree of communication, shortening (unacceptable if > 3 cm), open or closed. • Depending on injury and age, Pavlik harness, spica, traction, surgery.
Distal femur	• Peroneal nerve and rare popliteal artery injury. 23–38% have ligament injuries (usually anterior cruciate). Classify via (1) Salter-Harris (60% type II), (2) displacement [med, lat, ant, post (↑ popliteal artery injury)], and (3) age [infant and juvenile (↑ risk growth disturbance), adolescent]. • If nondisplaced, long leg cast with knee at 15–20° with molding forces opposite to injury mechanism and intact

	periosteal hinge tightened. • If distal femoral metaphyseal/physeal fracture, closed reduction (general anesthesia) in sagittal plane to < 20° if < 10 years and less if > 10 years. Varus/valgus alignment should be < 5° with no rotation. Irreducible type II and most displaced type III, IV, and V fractures require open reduction.

Description

Table 26-14 Knee

Patella and patellar sleeve	• *Patella*—If nondisplaced, intact retinaculum, immobilization. • Surgery indicated if > 4 mm articular displacement, articular step off > 3 mm or comminution. • *Sleeve fracture*—Avulsion distal pole patella with sleeve or articular cartilage, periosteum, and retinaculum (esp. 8–12 years). Often missed on X-ray. Need MRI to diagnose. Treat surgically. • *Splinting*—Long leg splint with knee nearly fully extended.
Tibial tuberosity *Ogden classification*	• *Type I*—Distal to junction of ossification of prox tibia and tuberosity. *Type II*—Junction of ossification of prox tibia and tuberosity. *Type III*—Extend to joint, associated with displaced ant. fragment + discontinuation joint surface. • Surgery is indicated for all except type I with minimal displacement.
Tibial spine *Meyers-McKeever classification*	• *Type I*—Minimally displaced, slight ant. margin elevation. *Type II*—Anterior 3rd to 1/2 of avulsed fragment elevated. *Type III*—Avulsed fragment completely elevated with no bony apposition remaining. • *Type 1*—Immobilization, (if tense hemarthrosis, ± needle aspiration). *Type II*—Closed reduction. *Type III*—Open reduction. • *Splinting*—Long leg splint/cast, knee 10–20°.
Osgood-Schlatter	• Tibial tubercle apophysitis—Traction apophysitis of ant. tibial tubercle, in early puberty. Treat with rest, hamstring stretch and quad strengthening.
Jumper’s knee	• Sinding-Larsen-Johansson = apophysitis inferior pole patella. Pain if run, jump. Treat—Rest, patellar tendon straps may be tried.
Osteochondritis dissecans	• Medial epicondyle of femur. Occurs in males > females

of femur	aged 12–16. • Osteochondral bone separates from healthy bone. Progressive, joint pain. Immobilize most, surgery if loose body, or not better after 6 months.

Description

Table 26-15 Tibia/Fibula/Ankle/Foot

Proximal tibial physis	• Popliteal artery injury in 3–7%. Compartment syndrome also occurs. • Nonoperative if non- or minimally displaced. If reduced, general anesthesia. • *Splint*—Long leg splint with knee in full extension.
Tibia and fibula shaft fracture	• Associated—Compartment syndrome of lower extremity. • Proximal metaphyseal/distal tibia fractures can cause anterior tibial artery injury. • Prox tibia fracture—If nondisplaced, long leg splint/cast with knee nearly full extension + varus mold. If displaced, admit + closed reduction in OR. • Diaphyseal—Displaced, closed reduction. Surgery: unstable, shortening uncorrected by closed treatment, displaced fracture in skeletally mature. • *Splinting*—Long leg splint with knee bent 30–40°.
Toddler's fracture	• History minor trauma, in child <5 years (average age 27 months). • Nondisplaced oblique/spiral distal tibia fracture, may require oblique X-ray to identify. • *Splinting*—Long leg splint with knee bent 30–40°, Jones wrap.
Distal tibia and fibula fractures	• Group I: Low-risk injuries including avulsion fractures, and minor epiphyseal separations (e.g., Salter-Harris I and II). Usually managed by closed reduction and casting. • Group II: High-risk injuries including fractures through the epiphyseal plate (Salter-Harris III, IV, and V), and transitional fractures (occur during time of physeal closure —adolescence). Examples of transitional fracture: (1) *Juvenile Tillaux* (Salter III lateral tibia fracture due to external foot rotation) and (2) triplanar (appears as juvenile Tillaux seen on AP X-ray + Salter II fracture distal tibia primarily seen on lateral X-ray). Group II injuries are usually intra-articular with joint instability. Treat most Group II

	injuries by open reduction internal fixation to achieve accurate anatomic reduction. • *Splinting*—Initial long leg cast/splint with knee 0–5°, ankle neutral or slightly plantar flexed if recurvatum deformity (backward angle).
Talus fracture	• Neck fracture common. Surgery if ≥ 3 mm dorsal displace or ≥ 5° varus rotate • *Splinting*—Long leg cast knee flexed so no weight-bearing ankle 90°.
Calcaneus fracture	• Immobilize most without reduction of weight-bearing. If severe displacement/intra-articular ± surgery (not needed as often as in adults).
Sever's disease	• Calcaneal apophysitis. Pain at Achilles' insertion. Chronic heel pain. Treat—1 cm heel pad, stretching, resolves as apophysis fuses ~12 years.
Kohler disease	• Avascular necrosis of tarsal navicular from repeated trauma to maturing epiphysis. Most common at 4–7 years. Treat with rest or immobilization.
Metatarsal (MT) fracture	• Compartment syndrome can occur if marked trauma/swelling. • *Shaft/Neck*—Immobilize in short leg walking cast. Wire fixation/surgery may be required if unstable (esp. 1st and 5th MT). *5th MT base*—(1) Avulsion fracture of tuberosity: extra-articular requiring immobilization/NSAIDs. (2) Prox metaphyseal-diaphyseal (Jones) fracture: nondisplaced immobilize; Ortho follow-up, if displaced ± surgery. (3) Diaphyseal stress fracture.
Freiberg's infraction	• Osteochondrosis of 2nd MT head. 75% female esp. > 13. MT pad, short leg cast. Surgery if persistent pain, MT deformed or MT ↓ ROM.

Description

Table 26-16 Differential of Painful Hip

Features	Toxic synovitis	Legg-Calvé-Perthes	Septic arthritis	Slipped capital femoral epiphysis
Age (years)	1.5–12	4–9	< 2, but any age	8–16
Sex (M:F)	3:2	5:1	1:1	2:1
History	Prior URI	Minimally painful	Fever, ± prior URI	Obesity in 88%
Physical exam	↓ Hip abduction and rotation	Limited hip abduction	Hip often held flexed, abducted	Trendelenburg gait, hip external rotation with flexion
X-rays	Enlarged medial joint space	Subchondral lucency femur	↑ Joint space, femur head is laterally subluxed	Line fem. neck crosses < 10% epiphysis
Ultrasound	Effusion ~90%	No effusion	Effusion	No effusion
WBC/ESR	Normal	Normal	Elevated	Normal

Description

Table 26-17 Differentiating Septic Arthritis from Transient Synovitis of Hip

Clinical features	Probability of septic arthritis	
• History fever > 101.3°F (38.5°C) • No weight bearing • ESR ≥ 40 mm/hour[1] • Serum WBC > 12,000 cells/mm^3	No listed features Any one feature Any two features Any three features All four features	0.2% 3% 40% 93.1% 99.6%

Description

[1]Sedimentation rate.

Modified from Kocher MS, Zurakowski D, Kasser JR. Differentiating between septic arthritis and transient synovitis of the hip in children: an evidence-based clinical prediction algorithm. *J*

Bone Joint Surg Am. 1999;81(12):1662-1670; Caird MS, Flynn JM, Leung YL, Millman JE, D'Italia JG, Dormans JP. Factors distinguishing septic arthritis from transient synovitis of the hip in children. A prospective study. *J Bone Joint Surg Am*. 2006;88(6):1251-1257.

NECK PAIN (TORTICOLLIS—“TWISTED NECK”)

Table 26-18 Diagnosis in 170 Children Presenting to an ED with Neck Pain or Stiffness[1]

Classification	Diagnosis	Total (%)
Trauma[2]	Neck contusion and “whiplash”	67 (39%)
	False movement	28 (16%)
	Mild traumatic brain injury with neck involved	9 (5%)
	C1–C2 rotary subluxation	1 (< 1%)
Infection	Viral infections of airway and respiratory tract	15 (9%)
	Streptococcal and non-strep. pharyngitis (angina)	13 (8%)
	Retropharyngeal abscess	3 (2%)
	Parotitis and post-tonsillectomy pain (1 case each)	2 (1%)
Unknown	Spontaneous onset with no trauma or infection found	30 (18%)
Other	Congenital and osteoid osteoma (1 case each)	2 (1%)

Description

[1]Excluded cases of obvious meningitis, major trauma (e.g., MVC). [2]See pages 324–325, for discussion regarding cervical spine radiography in trauma.

Modified from Pharisa C, Lutz N, Roback MG, Gehri M. Neck complaints in the pediatric emergency department: a consecutive case series of 170 children. *Pediatr Emerg Care*. 2009;25(12):823-826.

SELECT IMPORTANT CAUSES OF TORTICOLLIS

Atlantoaxial rotary subluxation (AARS)—Subluxation of C1 on C2 can occur after trauma, upper respiratory infections (Grisel's syndrome), or surgery due to laxity of ligaments. Patients with Down syndrome are at risk. The head tilts *away* from the affected sternomastoid muscle (SCM); "cock robin" position). The head rotates opposite to the facet dislocation and laterally flexes in the opposite direction. SCM spasm and neck pain/tenderness occur on the same side as the head rotation. During head rotation, C2 spinous process normally is contralateral to head rotate (but same side if AARS). Diagnose via dynamic CT. Need immobilization/surgery.

CNS tumors, bleeding or pressure—Posterior fossa tumors may cause a head tilt (to compensate for diplopia), neck stiffness, or torticollis. Intracranial bleeding, pressure, and cervical tumors may cause neck pain or nuchal rigidity.

Epidural abscess or vertebral osteomyelitis—See details, pages 244–245.

Inflammatory (local) and congenital muscular torticollis The spastic, tender SCM is opposite to the direction of the head rotation (reverse is true for AARS).

Retropharyngeal abscess (RPA)—RPA can occur at any age, but is most common at or younger than 5 years. Most children have a sore throat and many have fever, neck stiffness, neck swelling, and poor oral intake. Stridor is rare (<5%). Nearly 1/2 have limited neck *extension*, 1/3 have torticollis, and 1/10 have limited neck *flexion*. While plain X-rays are usually abnormal (see stridor, page 272), CT is more accurate. *Treat*: IV antibiotics and surgical drainage (not always needed). Modifed from Craig FW, Schunk JE. Retropharyngeal abscess in children: clinical presentation, utility of imaging, and current management. *Pediatrics*. 2003;111(6 Pt 1):1394-1398.

Sandifer syndrome—Gastroesophageal reflux causing abnormal posturing, including torticollis in infants. Torticollis is intermittent, alternates sides, and associated with wheeze, cough, failure to thrive, anorexia. *Treat*: Anti-reflux therapy.

Table 27-1 Disorders That Alter End Tidal CO_2 ($ETCO_2$) Concentrations[1]

Increasing $ETCO_2$	• *Equipment/Mechanical*—Faulty exhalation valve, tourniquet release, reperfusion of an ischemic limb, transient seizure, contamination of sensor or optical bench (↑ baseline and $ETCO_2$) • *Cardiovascular*—Return of spontaneous circulation, ↑ cardiac output • *Pulmonary*—Hypoventilation, respiratory depression, obstructive disease, rebreathing (increases baseline $ETCO_2$) • *Metabolic*—Hyperthermia (including malignant), $NaHCO_3$ (onset within 1 minute, lasts < 2 minutes), shivering
Decreasing $ETCO_2$	• *Equipment/Mechanical*—Circuit leak, partial airway obstruction, ventilator disconnection • *Cardiovascular*—Cardiac arrest, shock (↓ cardiac output), high-dose epinephrine administration • *Pulmonary*—Hyperventilation, bronchospasm, and upper airway obstruction can ↓ steepness of respiratory upstroke: ↓ slope of waveform, mucous plugging, massive pulmonary embolism • *Metabolic*—Hypothermia, $ETCO_2 \leq 31$ is associated with serum bicarbonate ≤ 15 mEq/l (76% sensitive, 96% specific) in children with gastroenteritis

Description

[1]Assuming waveform present (if absent capnographic waveform, assume dislodged ET tube). Modified from Nagler J, Wright RO, Krauss B. End-tidal carbon dioxide as a measure of acidosis among children with gastroenteritis. *Pediatrics*. 2006;118:260-267.

Table 27-2 Reference Values (PEFR[1]) for Spirometry

Age		6 years		8 years		10 years		12 years		14 years	
Sex		M[2]	F[3]	M	F	M	F	M	F	M	F
Height (inches)	44	99	149	119	168	139	186	159	205	178	224
	48	146	179	166	197	186	216	206	235	226	254
	52	194	208	214	227	234	246	254	265	274	283
	56	241	235	261	256	281	275	301	295	321	314
	60	289	268	309	287	329	305	349	324	369	343
	64	336	297	356	316	376	335	396	354	416	373
	68	384	327	404	346	424	365	444	384	464	403
	72	431	357	451	376	471	395	491	414	511	432

[1]PEFR—peak expiratory flow rate. [2]M—male. [3]F—female.
Modified from Knudson RJ, Lebowitz MD, Holberg CJ, Burrows B. Changes in the normal maximal expiratory flow-volume curve with growth and aging. *Ann Rev Respir Dis*. 1983;127:725.

Description

Table 27-3 Severity of Acute Asthma Exacerbation[1]

	Features	Initial PEFR or FEV1	Course
Mild	SOB with activity	≥70% of predicted or personal best	Care at home, quick relief with inhaled SABA
Moderate	SOB limits usual activity	40–69% of predicted or personal best	Office or ED visit usual, relief with frequent inhaled SABA with some symptoms for 1–2 days after treatment started; oral steroids often needed
Severe	SOB with rest or with talking	<40% of predicted or personal best	ED visit usual, likely hospital admit, partial relief with frequent inhaled SABA with some symptoms for >3 days after treatment is started; oral steroids in all, other adjuncts may be used
Life threatening	Cannot speak Diaphoresis	<25% of predicted or personal best	Hospitalization in all cases, some require ICU admission, minimal to no relief with frequent inhaled SABA, IV steroids, adjuncts are used

[1]PEFR—peak expiratory flow rate (see table on Table 27-2); FEV1—forced expiratory volume in 1 second; SOB—dyspnea or shortness of breath; SABA—short-acting β-agonist. Modified from National Institutes of Health Asthma Guidelines. *Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma.* National Heart, Lung, and Blood Institute, 2007.

Description

Table 27-4 Pediatric Asthma Severity Score (PASS) for use ≥ 2 Years Old[1]

Finding	0	1	2
Respiratory rate	Normal rate	Tachypnea	—
Wheezing	None or mild	Moderate	Severe or absent
Work of breathing[2]	None or mild	Moderate	Severe
Prolonged expiration	Normal or mildly prolonged	Moderate prolonged	Severely prolonged

[1]A total PASS ≥ 5 (after treatment) or use of > 3 nebulizer treatments (or > 1 hour continuous) predicted admission with 82% sensitivity/84% specificity. A pretreatment O_2 saturation < 94% was not associated with admission *independent* of PASS and use of > 3 nebulizer treatments. A posttreatment O_2 sat. < 94% is a frequently quoted criterion for admittance (others use < 92%). [2]Use of accessory muscles, retractions, or in-breathing.
Modified from Gorelick MH, Stevens MW, Schultz TR, Scribano PV. Performance of a novel clinical score, the Pediatric Asthma Severity Score (PASS), in the evaluation of acute asthma. *Acad Emerg Med*. 2004;11(1);10-18; Gorelick M, Scribano PV, Stevens MW, Schultz T, Shults J. Predicting need for hospitalization in acute pediatric asthma. *Pediatr Emerg Care*. 2008;24(11):735-744.

Description

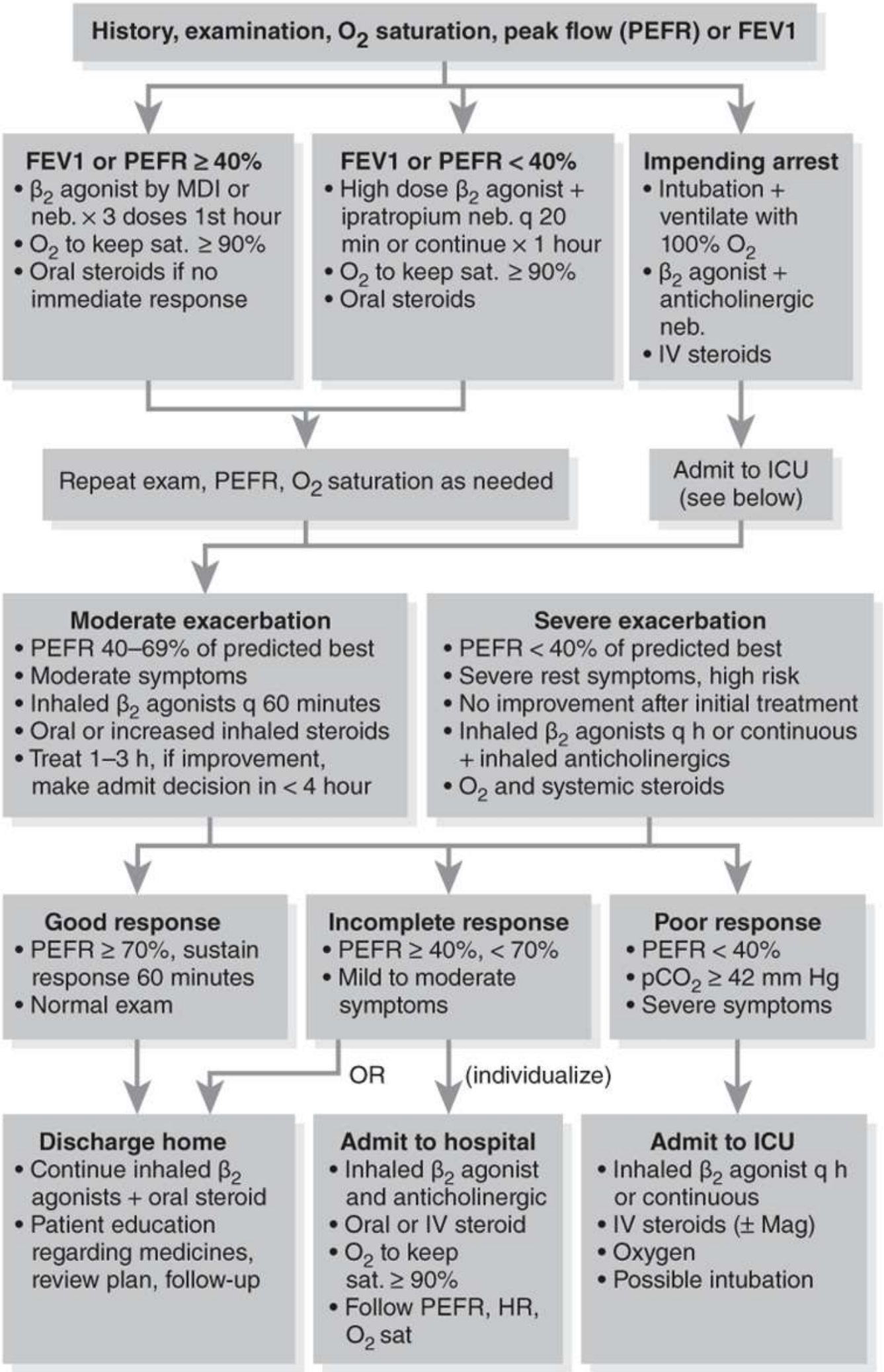
Table 27-5 Risk Factors for Asthma-Related Death

- Prior severe episode (ICU admit, intubation), chest tube
- ≥ 2 admissions, or > 3 ED visits in past year
- Use > 2 canisters of short-acting β-agonist per month
- Difficulty perceiving airway obstruction or the severity of worsening asthma
- Low-socioeconomic status, inner-city residence
- Illicit drug use, major psychiatric/psychosocial problems
- Comorbidity: cardiovascular or chronic lung disease

Description

Modified from National Institutes of Health Asthma Guidelines. *Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma.* National Heart, Lung, and Blood Institute, 2007.

Table 27-6 Guidelines for ED Management of Asthma


History, examination, O_2 saturation, peak flow (PEFR) or FEV1
FEV1 or PEFR ≥ 40%
• β_2 agonist by MDI or neb. × 3 doses 1st hour
• O_2 to keep sat. ≥ 90%
• Oral steroids if no immediate response
FEV1 or PEFR < 40%
• High dose β_2 agonist + ipratropium neb. q 20 min or continue × 1 hour
• O_2 to keep sat. ≥ 90%
• Oral steroids
Impending arrest
• Intubation + ventilate with 100% O_2
• β_2 agonist + anticholinergic neb.
• IV steroids
Repeat exam, PEFR, O_2 saturation as needed
Admit to ICU (see below)
Moderate exacerbation
• PEFR 40–69% of predicted best
• Moderate symptoms
• Inhaled β_2 agonists q 60 minutes
• Oral or increased inhaled steroids
• Treat 1–3 h, if improvement, make admit decision in < 4 hour
Severe exacerbation
• PEFR < 40% of predicted best
• Severe rest symptoms, high risk
• No improvement after initial treatment
• Inhaled β_2 agonists q h or continuous + inhaled anticholinergics
• O_2 and systemic steroids
Good response
• PEFR ≥ 70%, sustain response 60 minutes
• Normal exam
Incomplete response
• PEFR ≥ 40%, < 70%
• Mild to moderate symptoms
Poor response
• PEFR < 40%
• pCO_2 ≥ 42 mm Hg
• Severe symptoms
OR
(individualize)
Discharge home
• Continue inhaled β_2 agonists + oral steroid
• Patient education regarding medicines, review plan, follow-up
Admit to hospital
• Inhaled β_2 agonist and anticholinergic
• Oral or IV steroid
• O_2 to keep sat. ≥ 90%
• Follow PEFR, HR, O_2 sat
Admit to ICU
• Inhaled β_2 agonist q h or continuous
• IV steroids (± Mag)
• Oxygen
• Possible intubation

National Institutes of Health Asthma Guidelines *Nat Heart Lung Blood Inst* 2007

Description

Table 27-7 Parenteral Agents for Treating Acute Asthma

Agent	Dose (max dose)	Frequency	Comments
Epinephrine 1:1,000	0.01 mg/kg IM or SC	every 20 minutes × 3	Nonselective α, β-agonist
Magnesium sulfate	25–50 mg/kg IV (max 2 g)		Administer over 15 minutes
Methylprednisolone	1–2 mg/kg IV (max 125 mg)		
Terbutaline (1 mg/ml)	0.01 mg/kg IM or SC	every 20 minutes × 3	More β selective than epinephrine
Terbutaline	2–10 mcg/kg IV load + 0.1–0.4 mcg/kg/minute IV		
Ketamine	0.2 mg/kg bolus followed by 0.5 mg/kg/hour)		

Data from Howton JC, Rose J, Duffy S, Zoltanski T, Levitt MA. Randomized, double-blind, placebo-controlled trial of intravenous ketamine in acute asthma. *Ann Emerg Med*. 1996;27(2):170-175.

Description

Table 27-8 Inhaled Medications Used for Acute Asthma Exacerbations[1,2]

Agent	Dose[1]	Comments
Albuterol nebulizer solution 20 ml vial (0.5%) OR 3 ml vials (0.021%, 0.042%, or 0.083%)	2.5 mg (min) or 5 mg 3 ml NS every 20 minutes for mod-severe initial with Ipratropium then alone continuous or every 1–4 hours	β-agonist (more selective β_2 than isoetharine and metaproterenol)
Albuterol HFA MDI (Ventolin HFA)	90 mcg/puff (200/can) Use spacer + mask (<4 years)	4–8 puffs every 4–6 hours prn
Ipratropium (Atrovent)	Neb 250–500 mcg × 3 or 2–3 puffs of 17 mcg/puff via	Anticholinergic, longer onset than most β-agonists

	MDI	
DuoNeb albuterol + ipratropium	Mixed together for 3 doses given every 20 minutes	Moderate or severe asthma
Continuous albuterol	0.5 mg/kg/hour Max 15 mg/hour	Moderate or severe asthma
Heliox (helium/oxygen)	80:20 or 70:30 (Heliox:O_2 mixture)	↓ Airway resistance, ↑ bronchodilator delivery, ↑ CO_2 elimination
Levalbuterol HFA MDI	45 mcg/puff (200/can) Use spacer + mask (< 4 years)	4–8 puffs every 4–6 hours prn
Levalbuterol/Xopenex (0.31, 0.63, 1.25 mg/3 ml or 1.25 mg/0.5 ml)	0.31–1.25 mg in 3 ml NS	

Description

[1]MDI—metered dose inhaler; HFA—hydrofluoroalkane propellant; can–canister. [2]MDI with spacer/holding chamber (e.g., AeroChamber Plus) improves medicine delivery and is equivalent to a nebulizer for mild/moderate asthma.

Modified from National Asthma Education and Prevention Program: Expert Panel Report III: Guidelines for the diagnosis and management of asthma. NIH publication no. 08-4051. Bethesda, MD: National Heart, Lung, and Blood Institute; 2007. www.nhlbi.nih.gov/guidelines/asthma/asthgdln.htm

Table 27-9 Oral Medications for Acute Asthma Exacerbations

Agent	Preparation	Dose	Comment
Dexamethasone *(Decadron)*	Elixir: 0.5 mg/5 ml Solution: 1 mg/ml	0.6 mg/kg × 1 dose Max 16 mg	Single dose equivalent to 5 days prednisolone
Prednisolone—Pediapred 5/5 Prelone and Orapred 15 mg/5 ml	Solution: 5 and 15 mg/5 ml Tabs: 5 mg	2 mg/kg initial then 1–2 mg/kg/day	Steroid, if treat 3–7 days No taper needed
Prednisone	Solution: 5 mg/5 ml Tabs: 1, 2.5, 5, 10, 20, 50 mg	2 mg/kg initial then 1–2 mg/kg/day	Steroid, if treat 3–7 days No taper needed

Description

BRONCHIOLITIS

Table 27-10 Bronchiolitis Respiratory Distress Assessment Instrument (RDAI)[1]

	0	1	2	3	4
Wheezing					
Expiratory	None	End	½ Lung fields	¾ Lung fields	All fields
Inspiratory	None	Part	Throughout	–	–
Location	None	Segmental	Diffuse	–	–
Retractions					
Supraclavicular	None	Mild	Moderate	Marked	–
Intercostal	None	Mild	Moderate	Marked	–
Subcostal	None	Mild	Moderate	Marked	–

[1]Total points 0–4 = mild, 5–8 = moderate, 9–12 = severe, 13–17 = very severe (cutoffs for decision making have not been created).
Modified from Plint AC, Johnson DW, Patel H, et al. Epinephrine and dexamethasone in children with bronchiolitis. *N Engl J Med*. 2009;360:2079-2089; Lowell DI, Lister G, Von Koss H, McCarthy P. Wheezing in infants: the response to epinephrine. *Pediatrics*. 1987;79(6):939-945.

Description

Bronchiolitis is a lung infection that commonly occurs in infants at or younger than 8 months old with most cases occurring during the winter. Respiratory syncytial virus (RSV) causes 60–90% followed by other viruses, *Mycoplasma* and *Chlamydia*. The median duration of symptoms is 12 days with 18% ill at 21 days and 9% still ill at 28 days.

Table 27-11 American Academy of Pediatrics Management Guidelines for Bronchiolitis

Diagnosis and risk assessment	• Diagnosis and severity assessment is based on history and exam. Routine labs/X-rays are not recommended. • Routine testing for viruses (RSV) is rarely useful clinically. • High risk: <12 weeks, prematurity, heart or lung disease, or immunocompromised.
Respiratory care	• Nasal suctioning. • Oxygen is indicated if O_2 saturation (sat) falls persistently below 90% (to keep ≥ 90%). • Keep well hydrated with oral feeds or IV fluids.

	• Bronchodilators are not routinely recommended. • Nebulized epinephrine is not routinely recommended. • Nebulized hypertonic saline is not routinely recommended in ED. • Steroids are not routinely recommended. • Antibiotics are used only if coexisting bacterial infection. • Chest physiotherapy is not routinely recommended.
	• Heliox is not recommended by AAP. It may improve work of breathing and gas exchange while preventing intubation if respiratory distress.
Isolation	• Respiratory/Contact isolation. Alcohol-based hand cleansing is preferred, although antimicrobials soaps are OK to prevent nosocomial spread of RSV.

Description

Modified from American Academy of Pediatrics Subcommittee on Diagnosis and Management of Bronchiolitis. Diagnosis and management of bronchiolitis. *Pediatrics.* 2006;118(4):1774-93. DOI: 10.1542/peds.2006-2223; Yanney M, Vyas H. The treatment of bronchiolitis. *Arch Dis Child*. 2008;93:793; Plint AC, Johnson DW, Patel H, et al. Epinephrine and dexamethasone in children with bronchiolitis. *N Engl J Med*. 2009;360:2079.

COMMUNITY ACQUIRED PNEUMONIA (CAP)

This refers to an infection of the lung in children who acquired the infection in the community as opposed to hospital-acquired pneumonia.

Table 27-12 Antibiotic Treatment > 3 Months of Age

Setting	Type of pneumonia	Pathogen	Antibiotic
Outpatient Immunized	Uncomplicated pneumonia	*Streptococcus pneumoniae*	Amoxicillin PCN allergic: Clindamycin
Outpatient Unimmunized	Uncomplicated pneumonia	*S. pneumoniae* + *Haemophilus influenzae* type B	Augmentin 30 mg/kg dose bid × 7 days PCN Allergic: Levofloxacin 6 months–5 years: 10 mg/kg bid (max 375 mg/dose) > 5 years: 10 mg/kg every day (max 750 mg)
	Atypical features >5 years old	Mycoplasma *Chlamydophila pneumoniae*	Azithromycin 10 mg/kg day 1, 5 mg/kg days 2–5 Levofloxacin will cover atypical
Inpatient Immunized	Uncomplicated	*S. pneumoniae*	Ampicillin IV PCN allergy: Clindamycin IV
Inpatient Underimmunized	Uncomplicated	*S. pneumoniae* + *H. influenzae* type B	Ceftriaxone PCN/Cef allergy: Levofloxacin
Inpatient	Complicated or severe (large effusion, abscess, empyema or ICU)	Strep and Staph Anaerobes if abscess	Ceftriaxone + Vancomycin PCN/Cef allergy Levofloxacin + Vancomycin

Discharge criteria

- Able to take PO
- Pulse ox > 90% in room air
- Baseline mentation
- Improvement of vital signs
- Social environment able to give PO medications and have close follow-up

Modified from Bradley JS, Byington CL, Shah SS, et al. The management of community-acquired pneumonia in infants and children older than 3 months of age: clinical practice

guidelines by the Pediatric Infectious Diseases Society and the Infectious Diseases Society of America. *Clin Infect Dis*. 2011;53(7):e25.

Description

Table 27-13 Hospital-Acquired Pneumonia

Staphylococcus aureus, Enterobacteriaceae, *Pseudomonas aeruginosa*, and anaerobes	Aminoglycoside (gentamicin OR amikacin) PLUS • Piperacillin-tazobactam 300 mg/kg per day in 4 divided doses (max 16 g/day), OR • Meropenem 60 mg/kg per day in 3 divided doses (max 3 g/day), OR • Ceftazidime 125 to 150 mg/kg per day in 3 divided doses (max 6 g/day), OR • Cefepime 150 mg/kg per day in 3 divided doses (max 4 g/day), OR • Clindamycin 30 to 40 mg/kg per day in 3 or 4 divided doses (max 2.7 g/day)
MRSA	Vancomycin (do not use with Piperacillin-tazobactam)*

Description

*Data from Downes EJ, Cowden C, Laskin BL, et al. Association of acute kidney injury with concomitant vancomycin and piperacillin/tazobactam treatment among hospitalized children. *JAMA Pediatr*. 2017; 171:e173219; American Academy of Pediatrics. Tables of antibacterial drug dosages. In: Kimberlin DW, Brady MT, Jackson MA, Long SS (Eds.), *Red Book: 2018 Report of the Committee on Infectious Diseases*, 31st ed. Itasca, IL: American Academy of Pediatrics; 2018:914.

CYSTIC FIBROSIS

Inherited defect of exocrine gland secretion characterized by (1) chronic pulmonary disease, (2) malabsorption due to pancreatic insufficiency, and (3) ↑ sweat electrolytes with variable expression and severity of disease manifestations. Suspect based on symptoms and confirm via sweat test, ± newborn immunoreactive trypsinogen, DNA sampling.

Table 27-14 Diseases and Complications Associated with Cystic Fibrosis

Organ	Manifestation and management
GI	• *Cholelithiasis*—Up to 5% have stones, 5% have cholestasis, biliary cirrhosis rare. Ursodeoxycholate slows progression of liver lesions. • *Distal intestinal obstruction syndrome (DIOS)*—Later in childhood, distal small bowel obstruction, pain, ↓ stooling, ± diet/med noncompliance. If incomplete, ± Miralax, GoLYTELY, lactulose. • *Meconium ileus*—15% (obstruct distal small bowel with meconium) in first 48 hours of life. Hyperosmolar enemas 50% relief, others need surgery. • *Meconium plug syndrome*—A more benign blockage of the colon. • *Rectal prolapse*—May be presenting symptom (esp. < 3 years). • *Pancreatic insufficiency*—Leading to malabsorption occurs in 90% by age 1 year. Leads to failure to thrive and later diabetes. Enzyme replacement → adequate fat absorption in up to 80%.
Lung	• *Airway obstruction*—Inhaled DNase (Pulmozyme) and intermittent inhaled tobramycin will ↓ viscosity sputum, ↑ lung function. Bronchodilators and oral/inhaled steroids may be useful. • *Hemoptysis*—See management (admit if > 30–60 ml). • *Infection*—Use prior cultures to guide antibiotics, obtain new cultures. *S. aureus* and *Pseudomonas* are common (may require fluoroquinolones). Antibiotics until baseline symptom status (usually ≥ 14 days). Low admit threshold—pO_2 < 60, infiltrate, atelectasis, distress. • *Pneumothorax* develops in 5–8%, chest tube for all > 10% in size.
Metabolic	• Low K, Na, Cl with alkalosis due to respiratory/sweat loss.

Description

Modified from Orenstein DM, Winnie GB, Altman H. Cystic fibrosis: a 2002 update. *J Pediatr*. 2002;140:156-164.

GRUNTING

Table 27-15 Most Common Etiology of Grunting in Children Presenting to a Pediatric ED

Cardiorespiratory	**57%**
Upper or lower respiratory tract infection	28%
Reactive airway disease	20%
Aspiration foreign body/liquid	4%
Myocarditis, congestive heart failure, congenital heart	4%
Sickle cell—acute chest syndrome	2%
Nonrespiratory infection	**25%**
Bacteremia/sepsis	12%
Fever, viral infection	6%
Meningitis/pyelonephritis (4% each)	4%
Surgical abdomen (intussusception, obstruction) ileus	**8%**
Sickle crisis, VP shunt malfunction, corneal abrasion, skull fracture, hemolytic anemia	**2% each**

Description

Modified from Poole SR, Chetham M, Anderson M. Grunting respirations in infants and children. *Pediatr Emerg Care*. 1995;11(3):158-161.

HEMOPTYSIS

Mild < 150 ml/day; large 150–400 ml/day; massive > 400 ml/day (variable definitions).

Table 27-16 Etiology of Hemoptysis for Children Admitted to Hospital[1]

Cystic fibrosis	65%	Neoplasm	3%	Nasopharyngeal	1%
Congenital heart disease	15%	Pulmonary HTN, bleed, embolism	2%	Sepsis	1%
Pneumonia	6%			Vasculitides	1%
		Tuberculosis	1%	Other	5%

[1]Overall 13% died, esp. older, ↑ amount, fever, transfusion.
Data from Coss-Bu JA, Sachdeva RC, Bricker JT, Harrison GM, Jefferson LS. Hemoptysis: a 10-year retrospective study. *Pediatrics.* 1997;100(3):E7. DOI: 10.1542/peds.100.3.e7

Description

Management—Intubate if airway compromise, type and cross blood, administer NS, blood as

needed for massive bleeding. Reverse bleeding disorder (platelets, FFP). Consult pulmonologist or thoracic surgery/interventional radiologist.

Table 27-17 Stridorous Upper Airway Diseases in Children

Feature	Croup	Tracheitis[4]	Epiglottitis[4]	Retropharyngeal abscess[4]
Age (years)	0.3–3.0	5–10	2–8	Median 3.5
Prodrome	days	hours to days	minutes to hours	days (prior URI)
Fever	Low grade	Usual	Usual	Usual
X-ray[1]	Steeple sign[1]	Exudate	Ratios[2]	Soft-tissue swelling[3]
Etiology	Viral	*S. aureus*	*H. influenzae*	Streptococcus/ Staphylococcus/anaerobe
Cough	Yes	Yes	No	Uncommon
Drool	No	No	Yes	Yes
Toxic	Usually no	Yes	Yes	Yes

[1]In epiglottitis, films are normal in up to 60%; in croup they are read as normal in 50%. [2]Three calculations reported as 100% sensitive/highly specific for epiglottitis: AEW/C3W > 0.35, EW/C3W > 0.50, and EW/EH > 0.6. EW—epiglottic width; EH—epiglottic height; C3W—C3 vertebral width; AEW—aryepiglottic fold width. [3]Retropharynx soft tissue > 7 mm ant to C2 or > 14 mm ant to C5/6. (CT = more accurate). See retropharyngeal and neck pain due to torticollis detail, pages 260–261. [4]See pages 149 (epiglottitis), 166 (tracheitis), and 161 (retropharyngeal) for antibiotics.
Modified from Keith KD, Bocka JJ, Kobernick MS, Krome RL, Ross MA. Emergency department revisits. *Ann Emerg Med*. 1990;19:978; Stankiewicz JA, Bowes AK. Croup and epiglottitis: a radiological study. *Laryngoscope*. 1985;95:1159-1160.

Description

Table 27-18 Croup Score (Add the Five Elements Together)[1]

Feature	0	1	2	3
Color	Normal	Dusky	Cyanotic	Cyanotic on O_2
Air movement	Normal	Mild ↓	Moderate ↓	Marked ↓
Retractions	None	Mild	Moderate	Severe
Mentation	Normal	Restless	Lethargic	Obtunded
Stridor	None	Mild	Moderate	Severe/Obstructed
Total score	*Severity*	*Treatment*		
0–4	Mild	Home care		
5–6	Mild/moderate	Consider steroids, admit if < 6 months, unreliable family		
7–8	Moderate	Racemic epinephrine, consider steroids, admit most		
9–14	Severe	Racemic epinephrine, steroids, ICU admission		
15	Life threat	Racemic epinephrine, steroids, intubation		

[1]Any category with score of 3, classify as severe.

Modified from Taussig LM, Castro O, Beaudry PH, Fox WW, Bureau M. Treatment of laryngotracheobronchitis (croup). Use of intermittent positive-pressure breathing and racemic epinephrine. *Am J Dis Child*. 1975;129:790-793.

Description

CROUP MANAGEMENT

- **Oxygen** if respiratory distress (humidity is proven not useful).
- **Dexamethasone** 0.6 mg/kg IM or PO (max 12 mg) or oral prednisolone for 3 days (1–2 mg/kg, max 60 mg)
- **Aerosolized racemic epinephrine** (RE) 0.25–0.50 ml of 2.25% solution diluted 1:8 or standard epinephrine 1 ml of 1:1,000. Observe 2–4 hours after treatment for rebound.
- **Heliox**—When inhaled may be useful at decreasing airway resistance.

Modified from Everard ML. Acute bronchiolitis and croup. *Pediatr Clin North Am*. 2009;56(1):119-133.

VENTILATION—NONINVASIVE

Table 27-19 Contraindications to Noninvasive Mechanical Ventilation

Contraindications	Respiratory arrest, cardiovascular instability, altered mentation, uncooperative, high aspiration risk, viscous or copious secretions, recent face or airway surgery, recent upper GI-esophageal surgery, upper GI tract bleeding, facial trauma, burns, extreme obesity, fixed nasopharyngeal abnormalities limiting use of equipment

Description

Table 27-20 Noninvasive Positive Pressure Ventilation (NPPV) Modes/Parameters[1]

Bilevel positive airway pressure (BiPAP)	1. Start inspiratory positive airway pressure (IPAP) at 8 cm H_2O. Then, increase to 10–16 cm H_2O (available range 2–25 cm H_2O). 2. The expiratory positive airway pressure (EPAP) is usually set at 5–8 cm H_2O (available range 2–20 cm H_2O). This provides positive end expiratory pressure increasing functional residual capacity and maintaining airway patency at the end of expiration. 3. A backup rate may or may not be provided. 4. Nebulized medications can be delivered via BiPAP. 5. Improvement may be heralded by ↓ respiratory rate, ↑ O_2 saturation, ↓ accessory muscle use, reduction of airway occlusion if upper airway obstruction, and improved lung volumes on chest radiography.
Continuous positive airway pressure (CPAP)	CPAP delivers a constant level of pressure support to the airways during inspiration and expiration. A mask with nasal prongs/adapters or a face mask delivers continuous pressure ranging from 4 to 10 cm H_2O. Nebulized treatments are not routinely administered via CPAP.

Description

[1]NIPPV continued on the next page.

Modified from Deis JN, Abramo TJ, Crawley L. Noninvasive respiratory support. *Pediatr Emerg Care*. 2008;24(5):331-338; Hillberg RE, Johnson DC. Noninvasive ventilation. *N Engl J Med*. 1997;337:1746-1752.

Table 27-21 Noninvasive Positive Pressure Ventilation (NPPV) Modes/Parameters

Nasal intermittent positive pressure ventilation (NIPPV)	NIPPV provides periodic increases in positive pressure above a baseline CPAP pressure. NIPPV is delivered via nasal prongs or a tight nasal mask connected to a ventilator or a bilevel nasal CPAP device. If a ventilator is used, the periodic positive pressure can be administered synchronously with an infant's respiratory effort. A low (5 cm H_2O) and a high (8 cm H_2O) CPAP level can be set.
Heated high flow nasal cannula (HFNC)	Heated humidified gas (e.g., ~100% O_2) can be delivered without irritating or drying nasal mucosa. 5 l/minute to 40 l/minute
Weaning parameters for all modes	• Clinically stable for 4–6 hours. • Respiratory rate and heart rate normalize. • Compensated pH > 7.35, $SaO_2 \geq 92\%$ on ≤ 2–3 l O_2.

Description

Modified from Deis JN, Abramo TJ, Crawley L. Noninvasive respiratory support. *Pediatr Emerg Care*. 2008;24(5):331-338, quiz 339; Hillberg RE, Johnson DC. Noninvasive ventilation. *N Engl J Med*. 1997;337(24):1746-1752.

Table 28-1 Pediatric Suicide Risk Tool

Ask Suicide-Screening Questions (ASQ)
(1) In the past few weeks, have you wished you were dead? Yes/No
(2) In the past few weeks, have you felt that you or your family would be better off if you were dead? Yes/No
(3) In the past week, have you been having thoughts about killing yourself? Yes/No
(4) Have you ever tried to kill yourself? Yes/No
If yes, how? _____
When? _____
If the patient answers Yes to any of the above, ask the following acuity question:
(5) Are you having thoughts of killing yourself right now? Yes/No
If yes, please describe: _____
ASQ is designed to assess suicide risk in youths ages 10–21 in the emergency department. Any question 1 through 4 with a “yes” response or left blank is considered as a positive screen. Anyone with a positive screen must have a safety evaluation prior to leaving the ED. The answer to question 5 determines acuity of risk and urgency of further steps.
ASQ has a sensitivity of 96.9%, specificity of 87.6%, negative predictive value of 99.7% for medical/surgical patients, and 96.9% for psychiatric patients.

Description

Modified from Horowitz LM, Bridge JA, Teach SJ, et al. Ask Suicide-Screening Questions (ASQ): a brief instrument for the pediatric emergency department. *Arch Pediatr Adolesc Med.* 2012;166(12):1170-1176. doi:10.1001/archpediatrics.2012.1276.

EVALUATION AND MANAGEMENT OF THE AGITATED PEDIATRIC PATIENT

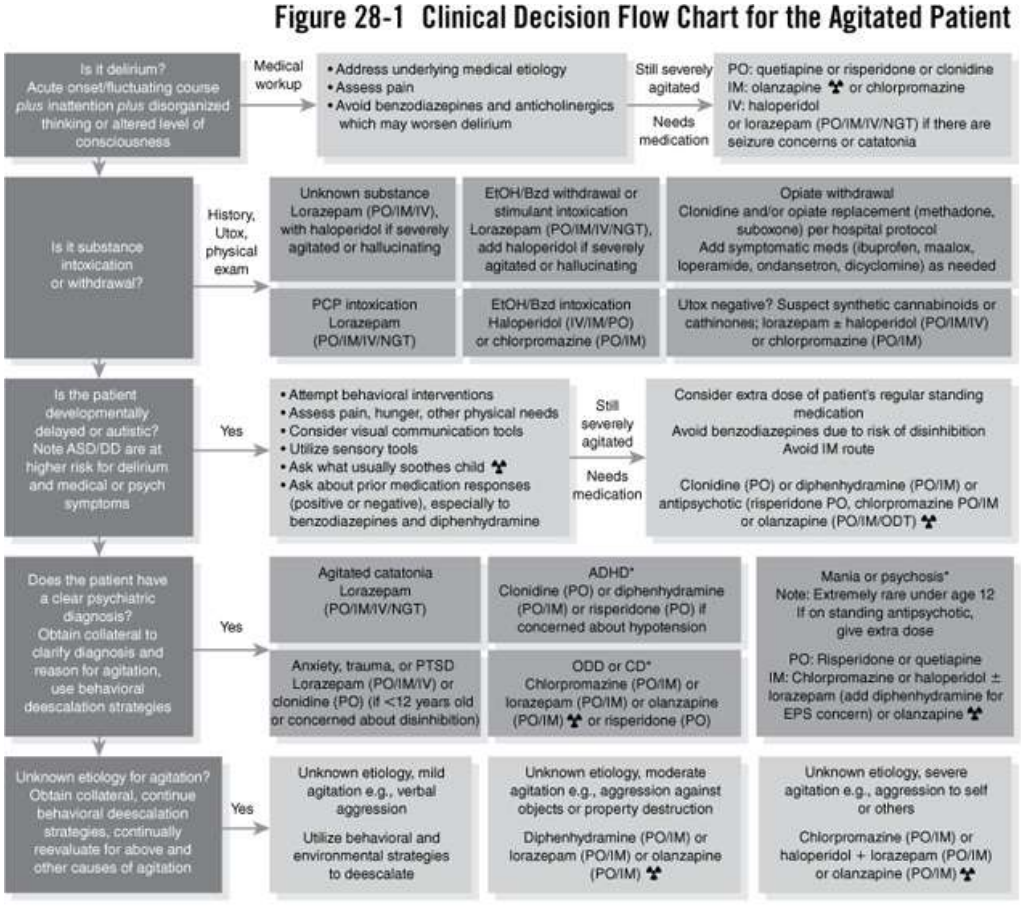


Figure 28-1 Clinical Decision Flow Chart for the Agitated Patient

Reproduced from Gerson R, Malas N, Feuer V, Silver GH, Prasad R, Mroczkowski MM. Best practices for evaluation and treatment of agitated children and adolescents (BETA) in the emergency department: consensus statement of the American Association for Emergency Psychiatry. *West J Emerg Med*. 2019;20(2):409-418.

Description

Expert consensus on the management of agitated pediatric patients in the ED favors an individualized, multidisciplinary approach. The use of medications should be part of a comprehensive strategy, with an emphasis on prevention and de-escalation by treating the root causes of agitation and attempting nonpharmacological interventions first, as well as in conjunction with medication.

The goal of medication management is to provide a calming effect on the patient and should also address the underlying etiology of agitation. Choice of medication is dictated by an assessment of the risk of adverse effects against the potential benefit for an individual patient. Commonly administered medications include diphenhydramine, benzodiazepines, and alpha-2-agonists; neuroleptics should only be used judiciously in cases of severe agitation or delirium. Ketamine, barbiturates, and opioids should be avoided (unless opioids are needed for pain control).

Oral administration is preferred and should be attempted first before using an intramuscular

(or intravenous, if access is available) route. In general, if a first dose of medication is ineffective, a second dose of the same medication should be given, rather than adding a new medication. Attention should be paid to the total daily dose and maximum dose of selected medications. Any patient who receives more than one dose of medication requires continuous monitoring for adverse effects. Continual reassessment of the underlying etiology of agitation should be ongoing, along with concomitant application of nonpharmacological treatments for agitation. Table 28-2 Medication Management for the Agitated Patient is found on the following page.

Table 28-2 Medication Management for the Agitated Patient

Medication	Dose	Max daily dose	Peak effect	Monitoring	Notes
Diphenhydramine (antihistamine)	PO/IM: 12.5-50 mg 1 mg/kg/dose	Child: 50-100 mg Adolescent: 100-200 mg	PO: 2 hours	-Disinhibition or delirium in younger or developmentally delayed patients	Avoid in delirium. May be given with haloperidol or chlorpromazine.
Lorazepam (benzodiazepine)	PO/IM/IV/NGT: 0.5-2 mg 0.05-0.1 mg/kg/dose	Child: 4 mg Adolescent: 6-8 mg Depending on weight/prior medication exposure	IV: 10 minutes PO/IM: 1-2 hours	-Disinhibition or delirium in younger or developmentally delayed patients	May be given with haloperidol, chlorpromazine or risperidone. Do not give within 1 hour of olanzapine.
Clonidine (alpha2 agonist)	PO: 0.05-0.1 mg	27-40.5 kg: 0.2 mg/day 40.5-45 kg: 0.3 mg/day > 45 kg: 0.4 mg/day	PO: 30-60 minutes	-Hypotension -Bradycardia	Avoid giving with benzodiazepines or atypicals due to hypotension risk.
Chlorpromazine (antipsychotic)	PO/IM: 12.5-60 mg (IM should be half PO dose) 0.55 mg/kg/dose	Child < 5 years: 40 mg/day Child > 5 years: 75 mg/day	PO: 30-60 minutes IM: 15 minutes	-Hypotension -QT prolongation	
Haloperidol (antipsychotic)	PO/IM: 0.5–5 mg (IM should be half a dose of PO) 0.55 mg/kg/dose	15-40 kg: 6 mg > 40 kg: 15 mg Depending on prior antipsychotic exposure	PO: 2 hours IM: 20 minutes	-Hypotension -QT prolongation, especially with IV administration.	Note EPS risk with doses of >3 mg/day. IV dosing with very high EPS risk.
Olanzapine (antipsychotic)	PO/ODT or IM: 2.5-10 mg (IM should be half or 1/4 dose of PO)	10-20 mg Depending on antipsychotic exposure	PO: 5 hours (range 1-8 hours) IM: 15-45 minutes		Do not give within 1 hour of any benzodiazepine, given risk for respiratory suppression.
Risperidone (antipsychotic)	PO/ODT: 0.25-1 mg 0.005-0.01 mg/kg/dose	Child: 1-2 mg Adolescent: 2-3 mg Depending on antipsychotic exposure	PO: 1 hour		Can cause akathisia (restlessness/agitation) in higher doses.
Quetiapine (antipsychotic)	PO: 25-50 mg 1-1.5 mg/kg/dose (or divided)	> 10 years: 600 mg Depending on prior antipsychotic exposure	PO: 30 minutes – 2 hours	-Hypotension	More sedating at lower doses.

[1]These doses are effective doses, which are theoretical quantities proposed by the International Commission on Radiation Protection to assess the health risks of low doses of ionizing radiation. [2]DEXA: dual-energy X-ray absorptiometry.

Data from Lin EC. Radiation risk from medical imaging. *Mayo Clin Proc*. 2010;85(12):1142-1146. doi:10.4065/mcp.2010.0260.

Description

RADIATION RISK

Table 28-3 Comparison of Radiation Doses from Medical Imaging Tests and Background Radiation

Imaging		Radiation dose (mSv)[1]	Time to accumulate comparable natural background dose
Computed tomography	Multiphase abdomen and pelvis	31.0	10 years
	Abdomen and pelvis	10.0	3 years
	Chest (pulmonary embolism)	10.0	3 years
	Chest	7.0	2 years
	Head	2.0	8 months
	Sinuses	0.6	2 months
Fluoroscopy	Coronary angiography	5–15	20 months–5 years
	Barium swallow	1.5	6 months
Nuclear medicine	Cardiac perfusion (sestamibi)	12.5	4 years
	Bone scan	4.2	1 year 4 months
	Lung ventilation/ perfusion	2.0	8 months
Radiography	Abdomen	1.2	5 months
	Lumbar spine	0.7	3 months
	Chest	0.1	10 days
	Extremity	0.001	< 1 day
Other	Mammography	0.7	3 months
	Bone densitometry (DEXA[2])	0.001	< 1 day

[1]These doses are effective doses, which are theoretical quantities proposed by the International Commission on Radiation Protection to assess the health risks of low doses of ionizing radiation; millisievert (mSv). [2]DEXA—dual-energy X-ray absorptiometry.

Data from Lin EC. Radiation risk from medical imaging. *Mayo Clin Proc*. 2010;85(12):1142-1146. doi:10.4065/mcp.2010.0260.

Description

Many medical imaging modalities expose patients to ionizing radiation, which can be associated with higher cancer risks. There is no epidemiological evidence of increased cancer risk with exposures of less than 10 mSv and clear evidence of increased risk with exposures of more than 100 mSv. The risk increases in a dose-dependent fashion, but the exact amount of risk at doses between 10 and 100 mSv remains controversial.

A 10 mSv dose of radiation is estimated to cause a 0.1% increased lifetime risk of cancer and a 0.5% excess risk of death from cancer. The effect of any individual image study on cancer mortality is very small. Natural incidence of cancer mortality is 25%.

Average yearly background radiation exposure is 3 mSv, primarily from radon gas in the home. Some radiation also comes from cosmic rays, so living at higher altitudes causes an increase in background radiation as well. It is useful to think about radiation exposure from imaging modalities in comparison to the amount of time it takes to acquire the same amount of radiation just from daily living.

Young children are about three to four times more sensitive to the effects of radiation than adults. They also have a longer lifetime in which to develop cancer; therefore, it is particularly important to minimize unnecessary radiation exposure in this population.

29 ■ SUBMERSIONS (DROWNING)

OVERVIEW

Drowning, or injury due to submersion or immersion in liquid, is the third leading cause of unintentional injury death worldwide and is in the top six causes of injury death in all childhood age groups.[1] Children are at an increased risk, but they also have better outcomes from resuscitation. Most drowning cases are nonfatal drownings and will be seen in the ED. Knowing which patients are at risk for morbidity and mortality is critical to identifying those who require observation and hospital-based care.

TERMINOLOGY

Drowning is defined by WHO as "the process of experiencing respiratory impairment from submersion/immersion in liquid; outcomes are classified as death, morbidity and no morbidity."[2] Historically used diagnoses, such as near-drowning, are discouraged. Terms such as "dry drowning," "wet drowning," "secondary drowning," "passive drowning," "silent drowning," and "delayed drowning" are not accepted medical terms or diagnoses.[3,4] Expert consensus now agrees on three outcomes possible after a submersion/immersion event: fatal drowning, nonfatal drowning with morbidity, and nonfatal drowning without morbidity.[1,5]

Grade	Dead	6	5	4	3	2	1	Rescue
Intervention	None	Start CPR (ABC sequence) After return of spontaneous ventilation, follow intervention for grade 4	Start artificial ventilation Respiratory arrest is usually reversed after a few imposed breaths After return of spontaneous ventilation, follow intervention for grade 4	Administer high-flow oxygen by face mask or orotracheal tube and mechanical ventilation Monitor breathing because respiratory arrest can still occur Start crystalloid infusion and evaluate for use of vasopressors	Administer high-flow oxygen by face mask or orotracheal tube and mechanical ventilation	Low-flow oxygen	Advanced medical attention and oxygen should not be required	None
Further Management	Forensic evaluation	Intensive care unit				Emergency department	If no coexisting conditions, evaluate further or release from the accident site	
Survival	0%	7–12%	56–69%	78–82%	95–96%	99%		

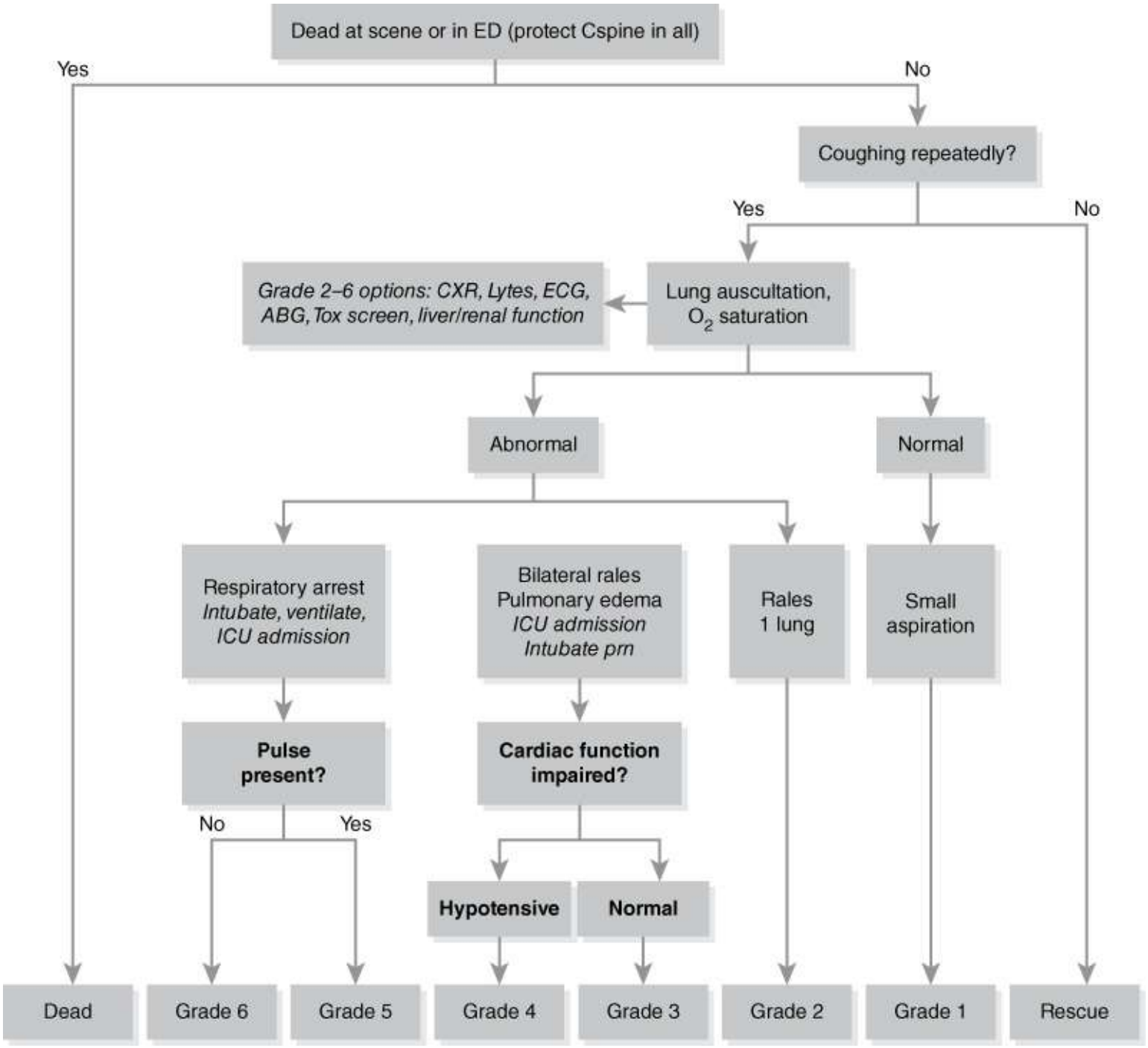


Figure 29-1 Drowning Grading and Mortality Risk

ABC—airway-breathing-circulation; CPR—cardiopulmonary resuscitation.

Szpilman D, Bierens JJ, Handley AJ, Orlowski JP. Drowning. *N Engl J Med.* 2012;366(22):2102-2110.

Description

MANAGEMENT

Patients who present after submersion with no immediate symptoms have a 100% survival rate and can be dismissed from the scene or discharged from the ED without intervention. Patients presenting with cough and without auscultatory findings are also at a very low risk for mortality. These patients need to be observed in the ED and their vital signs, including pulse oximetry, monitored and can be considered for discharge if there is no worsening of symptoms. Those with severe symptoms, abnormal exam, and unstable hemodynamics should undergo resuscitation and stabilization with a focus on aggressive respiratory support, fluid resuscitation, management of hypothermia, and evaluation for traumatic injuries. The role of chest radiographs is unclear in minimally symptomatic patients and is more likely to be useful for the detection of pulmonary edema, aspiration pneumonia, or pneumonitis when used based on clinical indicators.

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30 ■ SURGICAL ABDOMINAL DISORDERS

OVERVIEW

Abdominal pain is a common reason children present to the pediatric emergency department (PED). The ED provider has the difficult task of differentiating the child with a surgical condition that requires acute intervention from the many children presenting with more benign causes. Table 30-1 outlines common etiologies of abdominal pain in children presenting to the PED.

Table 30-1 Common Causes of Abdominal Pain by Age

Age	Emergent	Urgent	Common (and more benign)
<3 months	Trauma NEC Omphalitis Adhesions Testicular torsion		Colic GERD Milk protein allergy
≥3 months to 1 year	Trauma Midgut volvulus Incarcerated hernia Pyloric stenosis Intussusception	Acute gastroenteritis	GERD Constipation
1–5 years	Trauma Appendicitis	Acute gastroenteritis HSP Pneumonia Meckel diverticulum	UTI Constipation
5–12 years	Trauma Appendicitis Testicular or ovarian torsion DKA	Acute gastroenteritis IBD Pneumonia	UTI Constipation FGID GAS
>12 years	Trauma Appendicitis Testicular or ovarian torsion Ectopic pregnancy DKA	Acute gastroenteritis IBD Pneumonia Hepatitis Pancreatitis Nephrolithiasis PID	UTI Constipation FGID GAS Ruptured ovarian cyst

NEC—necrotizing enterocolitis; GERD—gastroesophageal reflux disease; HSP—Henoch-Schönlein purpura; UTI—urinary tract infection; DKA—diabetic ketoacidosis; IBD—inflammatory bowel disease; FGID—functional gastrointestinal disorders; GAS—group A strep; PID—pelvic inflammatory disease.

Data from Smith J, Fox SM. Pediatric abdominal pain. *Emerg Med Clin of North Am*. 2016;34(2):341-361. doi:10.1016/j.emc.2015.12.010.

Description

APPROACH

Initial approach to a child with abdominal pain should include assessment and stabilization as needed depending on vital signs, hydration, and mental status. Children with severe pain should receive analgesia. Following this, the history and physical examination should guide your evaluation.

Key history questions:

- Onset
- Provoking/Palliating factors
- Quality of pain
- Radiation of pain
- Time course
- Trauma
- Associated symptoms:
  - Fever
  - Oral intake (fluids and food)
  - Nausea
  - Vomiting (If yes, bloody? Coffee grounds? Bilious?)
  - Last bowel movement (Frequency? Consistency? Painful? Blood? Tarry?)
  - Urine output and urinary symptoms
  - Weight loss
  - Bloating
  - Testicular pain, swelling, or trauma
- Past medical history
- Past surgical history (specifically any prior abdominal surgeries)
- Physical examination:
- Vital signs: Fever? Tachycardic? Hypotensive?
- Constitutional: Is the child ill appearing? Sitting up playing? Running around the room?
- Abdominal examination: Inspection, palpation, percussion
- In boys: Testicular examination
- Be sure to complete remainder of exam to look for other sources of abdominal pain (pharyngitis, pneumonia)

The history and physical exam should help guide your next steps. The following is an overview of the more common and/or serious abdominal surgical conditions in children.

BILIOUS VOMITING

Bilious vomiting may be a sign of intestinal obstruction and should be evaluated expeditiously. Table 30-2 outlines the etiology by age. In neonates, bilious vomiting represents a surgical disorder in nearly half of all cases.[1] After initial stabilization, including IV placement and fluid resuscitation, neonates with bilious vomiting should be transferred to a facility with pediatric surgeons for further evaluation and definitive care; transfer is time-critical.[2,3] Evaluation will include an upper-gastrointestinal contrast study and consultation with a pediatric surgeon to identify surgical causes of bilious emesis. Older children presenting with bilious emesis should also receive initial stabilization as necessary. Evaluation should be based on history and a physical; considerations include abdominal X-rays (upright and lateral decubitus) to assess for bowel gas pattern, ultrasound to assess for appendicitis or intussusception, and/or laboratory studies to assess for pancreatitis.

Table 30-2 Causes of Bilious Vomiting in Infants and Children[1]

Age	Cause	% of cases
0–4 weeks[2]	**Surgical disorders:** Midgut volvulus, hernia, bowel atresia, meconium ileus/plug, Hirschsprung's **Nonsurgical:** Mostly idiopathic/unknown cause	**20–51** **49–80**
1–12 months	**Surgical disorders:** Intussusception Bowel obstruction or hernia **Nonsurgical disorders:** Gastroenteritis Bronchiolitis Urinary infection	**14** (7) (7) **86** (64) (18) (4)
>12 months	**Surgical disorders:** Appendicitis Small bowel obstruction Pancreatitis (not all surgical) or cholecystitis Intussusception Ventricular shunt failure	**11** (5) (2)

	Nonsurgical disorders: Gastroenteritis or cyclic vomiting Respiratory infection, pharyngitis, otitis, asthma Other (pelvic infection, DKA, HSP, pregnancy)	(2) (1) (1) **89** (74) (11) (4)

Description

[1]In neonates and older children, green emesis more likely to indicate surgical disorder than yellow emesis. [2]Consult surgeon at this age (0–4 weeks) for all bilious emesis.

Modified from Godbole P, Stringer MD. Bilious vomiting in the newborn: How often is it pathologic? *J Pediatr Surg*. 2002;37(6):909-911; Mohinuddin S, Sakhuja P, Bermundo B, et al. Outcomes of full-term infants with bilious vomiting: observational study of a retrieved cohort. *Arch Dis Child*. 2015;100(1):14-17.

APPENDICITIS

In children, appendicitis is most common between 10 and 19 years of age. Appendicitis in children typically presents with the gradual onset of abdominal pain that initially starts in the periumbilical region and then migrates to the right lower quadrant.[4] This pattern is not always presenting in children with appendicitis. Pain may be accompanied by nausea, vomiting, anorexia, and fever. Pain precedes vomiting (though in young children they may not be able to tell you which started first). The risk of perforation increases after 24 hours and is often present in patients with symptoms longer than 48 hours. When perforation occurs, the pain may decrease initially, but then the pain becomes more diffuse.[4] Table 30-3 reviews the presentation of appendicitis and Table 30-4 reviews evaluation of appendicitis.

Table 30-3 Appendicitis

Frequency of historical features at different ages

0–2 years (rare)		2–5 years (<5% all cases)		6–12 years	
Vomiting	85–90%	Abdominal pain	89–100%	Pain	98%
Pain	35–77%			↑ with movement	41–75%
Fever	40–60%	Vomiting	66–100%	Vomiting	68–95%
Diarrhea	18–46%	*(unlike older children and adults, vomiting may precede pain)*		*before pain*	≤ 18%
Irritability	35–40%			Anorexia	47–75%
Cough/Rhinitis	40%			Diarrhea	9–16%
Grunting	8–23%			Constipation	5–28%
Hip pain/ stiffness	3–23%			Dysuria	4–20%
		Fever	80–87%		
		Anorexia	53–60%		

Frequency of physical exam features at different ages

0–2 years (rare)		2–5 years (<5% all cases)		6–12 years	
Temperature > 100°F	87–100%	Temperature > 100°F	82%	Temperature > 100.4°F	4%
Diffuse tender	55–92%	RLQ tender	58–85%	<24 hours pain	64%
RLQ tender	<50%	Diffuse tender	19–28%	>24 hours pain and RLQ tender	>80–95%
Distention	30–52%	Involuntary guarding	85%		
Lethargy	40%				
Mass	30%	Rebound tender	50%	Diffuse tenderness	15%
				Rebound	~50%

Risk of appendicitis[1,2]	Item	M	PAS
MANTRELS (M) score	**M**igration of pain to RLQ	1	1
Total > 6 candidates for surgery	**A**norexia or acetone in urine	1	1
4–6 serial exam or CT/US	**N**ausea with vomiting	1	1
< 4 very low risk of appendicitis	**T**ender right lower quadrant	2	2
	Rebound or equivalent	1	0

Pediatric Appendicitis Score (PAS) In separate studies, a PAS ≥ 3 and ≥ 5 were each 98% sensitive at diagnosing appendicitis	Pain with coughing, hopping, or percussion	0	2
	Elevated temp. (> 38°C/100.4°F)	1	1
	Leukocytosis > 10,000–10,500	2	1
	Shift WBCs > 75% neutrophils	1	1

[1]PAS is more reliable in children, while M score is *unreliable* in children and primarily useful in adolescents and young adults. Calculate total points for M score or PAS by adding points from M or PAS column. [2]2008/(2009) studies recommended surgery for all PAS ≥ 6 (≥ *8*) and recheck, US, or CT if 3–6 (5–7).

Modified from Bhatt M, Joseph L, Ducharme FM, Dougherty G, McGillivray D. Prospective validation of the pediatric appendicitis score in a Canadian pediatric emergency department. *Acad Emerg Med*. 2009;16(7):591-596; Goldman RD, Carter S, Stephens D, Antoon R, Mounstephen W, Langer JC. Prospective validation of the pediatric appendicitis score. *J Pediatr*. 2008;153(2):278-282.

Description

Table 30-4 Appendicitis Diagnosis and Management

Diagnosis	(1) Score—Table 30-3; (2) WBC count and CRP—poor utility (esp. < 24 hours of symptoms); (3) Serial WBC count useless; (4) US is 60–90% sensitive (diameter > 6 mm, target sign, wall > 2 mm)—some perform pre-CT and CT only if normal US; (5) CT is ≥ 95% sensitive (esp. if focused RLQ exam with 3–5 mm cuts/ reconstruction, using IV +/– colonic contrast).
Management	(1) Fluid resuscitation; (2) IV antibiotics if suspect perforation (page 143); (3) Surgical consultation; (4) Limited studies found that select children with symptoms <24 hours OR with >5 days (presumed perforation) treated nonoperatively with IV antibiotics may have superior or equivalent outcome to those treated operatively.

Description

Modified from Henry MC, Gollin G, Islam S, et al. Matched analysis of nonoperative management vs immediate appendectomy for perforated appendicitis. *J Pediatr Surg*. 2007;42(1):19-23, discussion 23-24; Abe M, Petik B, Kazil S. Nonoperative treatment of acute appendicitis in children. *J Pediatr Surg*. 2007;42(8):1439-1442; Rothrock SG, Pagane J. Acute appendicitis in children: emergency department diagnosis and management. *Ann Emerg Med*. 2000;36(1):39-51.

HIRSCHSPRUNG'S DISEASE

Hirschsprung's disease (congenital megacolon) is the congenital absence of parasympathetic ganglion cells in Auerbach's plexus (myenteric) and Meissner's plexus (submucosal) in the intestine, causing uncoordinated intestinal motility. In 80–90%, involvement is limited to the rectum and rectosigmoid colon including the internal anal sphincter. Hirschsprung's is noted in 1/5,000 births and is more common in males and Down syndrome. In newborns, it may present as complete obstruction or delayed passage of meconium with mild constipation. Most affected infants are full term. If left untreated, failure to thrive will be noted, with ill appearance, malnourishment, or chronic constipation. The most serious complication is the development of ulcerative enterocolitis, which may be lethal. In this complication, elevated luminal pressures in the proximal normal colon inhibit total colonic blood flow and shunt blood away from the mucosa. Bowel wall edema, mucosal necrosis, and sepsis occur. Diagnosis is made by barium enema (BE). If BE is nondiagnostic, consider rectal biopsy with acetylcholinesterase histochemistry on mucosa and submucosal biopsy specimens. Children with functional constipation are generally healthy appearing with bowel troubles beginning around the age of 2 years or the time of toilet training, have stool in rectal vault, and fecal soiling. In contrast, Hirschsprung's patients are generally younger, have empty rectal vault, and no fecal soiling.

INCARCERATED HERNIAS

Incarcerated hernias: Manual reduction may be useful regardless of time and may still work if the obstruction is present. Avoid manual reduction if peritonitis, unstable vitals, significant erythema, or other sign of strangulation. Bimanual abdominal/rectal exam may identify a mass between fingers, a finding absent in spermatic cord hydrocele. Palpation of the inguinal region may reveal a dilated external ring or a silk glove sign (smoothness felt as if two pieces of silk are being rubbed together when rolling the spermatic cord in a direction perpendicular to the inguinal canal).

PYLORIC STENOSIS

Pyloric stenosis (PS) is characterized by a hypertrophic pylorus. PS is rare in premature infants and more common in first-born males. Symptoms typically begin at 2 to 3 weeks but may present up to 5 months (though this late presentation is now rare with the increased availability of an ultrasound). Infants present with nonbilious vomit during/after feeding that progresses to projectile vomiting over the ensuing weeks. Patients are hungry with poor weight gain.

Physical examination: Abdomen—peristaltic waves or a palpable “olive” may be seen, but these findings are neither sensitive nor specific. Lab findings show a hypochloremic metabolic alkalosis.

Diagnosis/Management: Ultrasound is the gold standard for diagnosis. Ultrasonography (≥4 mm pyloric muscle thickness or ≥14 mm length) is >95% sensitive for diagnosing pyloric stenosis. Once the diagnosis is made, consult pediatric surgery for laparoscopic management.

INTUSSUSCEPTION

Intussusception is the telescoping of one intestinal segment into another and is the leading cause of obstruction from 3 months to 4 years. Mean age is 8 months, with 80% younger than 2 years. Origin is unknown in 90% unless younger than 1 month or older than 3 years where lead point (e.g., tumor) may be found.[5] This typically presents as a previously well infant who paroxysmally cries out, draws up legs, and may vomit. In some cases, the child may be lethargic, but in other cases the child initially appears well between episodes. An exam may reveal distention and/or a sausage-shaped mass in RUQ but an absence of this does not exclude this diagnosis.

DIAGNOSIS/TREATMENT

US is diagnostic with a classic bull's eye appearance in > 95%. BE, air-contrast enema, or saline enema reduces ~90%. Although an enema is usually therapeutic, it should be avoided in the presence of shock, peritoneal signs, perforation, or high-grade obstruction. After reduction, intussusception may recur in approximately 12% of patients; risk factors for recurrence include age older than 2 years, duration of symptoms > 48 hours, and rectal bleeding.[6,7]

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31 ■ TOXICOLOGY

Table 31-1 Toxins That Affect Vital Signs and Physical Examination

Hypotension			Hypertension
ACE inhibitors α and β antagonists Anticholinergics Arsenic (acutely) Ca^{+2} channel block Clonidine, cyanide	Antidepressants Disulfiram Ethanol, methanol Iron, isopropanol Mercury, GHB Nitrates	Nitroprusside Opioids Organophosphate Phenothiazines Sedatives Theophylline	Amphetamines Anticholinergics Cocaine Lead MAO inhibitors Phencyclidine Sympathomimetics

Tachycardia		Bradycardia
Amphetamines Anticholinergics Arsenic (acutely) Antidepressants Digitalis, disulfiram	Ethylene glycol, iron Organophosphates Sympathomimetics PCP, phenothiazines Theophylline	Antidysrhythmics α agonists, β antagonists Ca^{+2} channel blockers Digitalis, opioids, GHB Organophosphates

Tachypnea		Bradypnea	
Ethylene glycol Methanol Nicotine Organophosphate	Salicylates Sympathomimetics (cocaine) Theophylline	Barbiturates Botulism Clonidine Ethanol	Isopropanol Opioids Organophosphate Sedatives

Hyperthermia		Hypothermia
Amphetamines Anticholinergics Arsenic (acute) Cocaine Antidepressants LSD	Phencyclidine Phenothiazines Salicylates Sedative-hypnotics Theophylline Thyroxine	Carbon monoxide Ethanol Hypoglycemic agents Opioids Phenothiazines Sedative-hypnotics

Mydriasis (pupillary dilation)		Miosis (pupillary constriction)	
Anticholinergics Antihistamines Antidepressants Anoxia—any cause Amphetamines Camphor Cocaine	Cyanide Drug withdrawal Sympathomimetics Select narcotics (meperidine, pentazocine, Lomotil, propoxyphene)	Anticholinesterases Insecticides Bromide Central α_2 agonists Clonidine, guanefacine, Guanabenz, imidazoline Coma—any sedative	Nicotine Opioids Phencyclidine Pilocarpine Physostigmine Yohimbine

Description

Table 31-2 Drugs and Toxins That Cause Seizures[1]

Amphetamines	Carbon monoxide, Cyanide	Lindane, Lithium	Withdrawal (etha-
Anticholinergics	Cocaine, Camphor	Nicotine,	nol, sedative)
Antidepressants	Diphenhydramine	Organophosphates	Theophylline
β blockers	GHB, Isoniazid	PCP, Propoxyphene	Tramadol
Bupropion	Lead, Lidocaine	Quinine, SSRIs	Venlafaxine

Description

Table 31-3 Drugs and Toxins That Cause Hypoglycemia

6-Mercaptopurine (6-MP)	Insecticides (carbamates/organophosphates)
Ackee fruit (unripe fruit Jamaican	Insulin (exogenous)
Ackee tree S. Florida/Caribbean)	Isoniazid
Alcohols (ethanol, methanol, isopropanol, ethylene glycol)	Lithium
	Mamejava plant
Angiotensin-converting enzyme (ACE) inhibitors	Methotrexate
	Monoamine oxidase (MAO) inhibitors
β blockers	Nonsteroidal anti-inflammatory agents
Bishydroxycoumarin (rat poison)	P-aminobenzoic acid
Bitter melon gourds	Pentamidine
Chlorpromazine	Phenylbutazone
Climbing ivory gourd	Phenytoin
Clofibrate	Pomegranate tree
Didanosine	Probenecid
Disodium ethylenediaminetetraacetic acid (EDTA)	Quinine
	Ritodrine
Disopyramide	Salicylates
Fluoxetine	Sertraline
Fenfluramine	Steroids (anabolic: stanozolol)
Fenugreek herb	Sulfonamides
Ginseng plant (American, Asian, Siberian)	Thiazide diuretics
Haloperidol	Thioglycolate
Hypoglycemic agents (sulfonylureas, biguanides, α glucosidase inhibitor, thiazolidinediones, benzoic acid derivatives)	Thyroid hormone
	Tremetol
	Tricyclic antidepressants (TCA)
	Trimethoprim

Description

TOXICOLOGY

Phone numbers to ID hazardous chemical agents/spills and their management:

- CDC/Agency for Toxic Substances Disease Registry (ATSDR): (770) 488-7100
- Chemical Manufacturer's Association (CHEMTREC): (800) 424-9300

Table 31-4 Poisoning (Toxidromes)

Description

See specific toxins within text for treatment.

Syndrome	Toxin	Manifestations
Anticholinergic	*Natural*: Belladonna alkaloids, atropine, homatropine, *Amanita muscuria*. *Synthetics*: Cyclopentolate, dicyclomine, tropicamide, antihistamines, phenothiazines, dextromethorphan, TCA	*Peripheral antimuscarinic*: Dry skin, thirst, blurred vision, mydriasis, ↑ pulse, ↑ BP, red rash, ↑ temperature, abdominal distention, urine retention. *Central symptoms*: Delirium, ataxia, cardiovascular collapse, seizures
Acetylcholinesterase inhibition	Insecticides (organophosphates, carbamates) Nerve gas agents (see page 36)	*Muscarinic effects* (SLUDGE): Salivation, lacrimation, urination, defecation, GI upset, emesis. Also ↓ or ↑ pulse and BP, miosis. *Nicotinic effects*: ↑ pulse, muscle fasciculations, weakness, paralysis, ↓ respirations, sympathetic stimulation. *Central effects*: Anxiety, ataxia, seizure, coma, ↓ respiration, cardiac collapse
Cholinergic	Acetylcholine, betel nut, bethanechol, clitocybe, methacholine, pilocarpine	See *muscarinic* and *nicotinic* effects mentioned previously
Hemoglobinopathy	Carbon monoxide, methemoglobin	Headache, nausea, vomiting, dizziness, coma, seizures, cyanosis, cutaneous bullae, "chocolate" blood with methemoglobinemia
Narcotic	Morphine, dextromethorphan, heroin, fentanyl, meperidine,	CNS depression, miosis (except meperidine), ↓ respirations, ↓ BP,

	propoxyphene, codeine, diphenoxylate, Dilaudid	seizures (with propoxyphene and meperidine)
Sodium channel blockade	β-blockers *(not all),* Benadryl, calcium channel blockers, carbamazepine, citalopram, class I antiarrhythmic, cocaine, cyclic antidepressives, lamotrigine, loxapine, orphenadrine, phenothiazines, thioridazine, tetrodotoxin (TTX)	*SALT syndrome*: *Shock*, *Altered* mental status, *Long* QRS (wide complex), *Terminal* R in aVR. Other ECG features: wide QRS with bradycardia, wide complex tachycardia (ventricular or supraventricular)
Sympathomimetic	Aminophylline, amphetamines, cocaine, ephedrine, caffeine, methylphenidate	CNS excitation, seizures, ↑ pulse, ↑ BP (↓ BP with caffeine), hyperpyrexia, psychosis, sweating
Withdrawal syndrome	Alcohol, barbiturates, benzodiazepines, cocaine, narcotics	Diarrhea, mydriasis, piloerection, ↑ BP, ↑ pulse, insomnia, lacrimation, cramps, yawning, hallucinations

Table 31-5 Poisoning Antidotes and Treatments

Description

See specific toxins within text for more detail.

Toxin	Antidote	Other considerations
Acetaminophen	N-acetyl cysteine see Table 31-13 for dose	Very effective if used within 8 hours, use Rumack-Matthew nomogram to guide management
β blockers	Glucagon 50–150 mcg/kg IV, SC, or IM may repeat	Glucagon may help reverse ↓ pulse and ↓ BP
Ca^{+2} channel blockers	$CaCl_2$ 45–90 mg/kg slow IV, glucagon—see β blocker dose	Glucagon may help reverse ↓ pulse and ↓ BP
Cyanide	Cyanide Kit and Cyanokit	See pages 35–36 for detail
Digoxin	Digoxin Fab fragments	See Table 31-23 for dose
Ethylene glycol	Fomepizole (Antizol) 15 mg/kg IV + 10 mg/kg IV every 12 hours × 4 doses	Ethanol if Antizol not available; ethanol dose Table 31-33, dialysis

Hydrofluoric acid	IV, arterial, or SC or topical calcium gluconate	Acute or delayed deep tissue burn, systemic acidosis, dysrhythmias secondary to hypocalcemia, hypokalemia, and hypomagnesemia
Isoniazid	Pyridoxine—70–75 mg/kg IV up to 5 g	Reverses seizures
Methanol	Antizol, dialysis, ethanol	See pages 307–308 for detail
Methemoglobinemia	Methylene blue (0.2 ml/kg of 1% solution IV over 5 minutes)	Consider exchange transfusion if severe methemoglobinemia
Opiates	Naloxone 0.01–0.10 mg/kg up to 2 mg IV	Codeine, diphenoxylate, fentanyl, propoxyphene may require higher doses
Organophosphates	Atropine 0.05 mg/kg IV may double until effective + pralidoxime (2-PAM)	Exceptionally high atropine doses may be necessary; see Table 31-36
Salicylates	Dialysis Sodium bicarbonate 1 mEq/kg IV	Goal of alkaline diuresis is urine pH 7.50–7.55, see pages 309–311
Sodium channel block	Sodium bicarbonate 1 mEq/kg IV	Goal of narrowing QRS complex and reversing arrhythmias
TCA	Sodium bicarbonate 1 mEq/kg IV	Goal is serum pH 7.50–7.55 to alter protein binding, see pages 313–314

Table 31-6 Radio-Opaque Ingestions

Radio-opaque ingestions *(Mnemonic CHIPES)*
• **C**hloral hydrate and chlorinated hydrocarbons • **H**eavy metals (arsenic, Pb, mercury), health food (bone meal, vitamins) • **I**odides, iron • **P**otassium, psychotropics (e.g., phenothiazines, antidepressants) • **E**nteric-coated tabs (KCl, salicylates)

• **S**olvents (chloroform, CCl_4)

Description

Table 31-7 Drugs Cleared by Hemodialysis and by Hemoperfusion

Drugs cleared by hemodialysis[1]	
• Salicylates • Ethylene glycol • Methanol • Bromide • Ethanol • Theophylline • Depakote	• Isopropyl alcohol • Chloral hydrate • Lithium • Iron • Isoniazid • Barbiturates
Drugs cleared by hemoperfusion[1]	
• Barbiturates (e.g., phenobarbital) • Theophylline • Phenytoin • Possibly digoxin	

Description

[1]Consult local poison center for more detail concerning latest recommendations.

Table 31-8 General Approach to the Poisoned Child

• Treat airway, breathing, and BP. • Insert IV and apply cardiac monitor. • Apply pulse oximeter and administer O_2.	• Dextrose 5–10 ml/kg of $D_{10}W$ in neonate, 2–4 ml/kg $D_{25}W \leq 2$ years, 1–2 ml/kg $D_{50}W > 2$ years • Naloxone 0.01–0.10 mg/kg can be given as a therapeutic trial especially if opioid ingestion is suspected • Benzodiazepines (Ativan 0.05–0.10 mg/kg IV)

Description

Table 31-9 Charcoal

Contraindications	**Drugs cleared by multidose charcoal[1]**
• Caustics (acids, alkalis) • Ileus, bowel obstruction	Carbamazepine, chlorpropamide, dapsone, diazepam, digoxin, nadolol, nonsteroidals,

• Risk of aspiration (if altered mental status) • Drugs bound poorly by charcoal (arsenic, bromide, K^+, toxic alcohols, heavy metals [iron, iodide, lithium], pesticides, solvents)	oleander, phenobarbital, phenytoin, propoxyphene, salicylates, theophylline, and TCA

Description

[1]Administer repeat charcoal doses every 3–4 hours (use cathartic only for first dose). Initial dose is 1 g/kg PO or per NG alone or with cathartic. American Academy of Clinical Toxicology does not recommend for most drugs ≥ 1 hour after ingestion.

Table 31-10 Cathartics

Cathartics theoretically help by ↑ fecal elimination of charcoal-bound toxins, and preventing concretions. Monitor electrolytes closely with their use.	**Cathartic choices[1]**
	• Sorbitol (35%)—1 g/kg PO or NG • Magnesium citrate 4 ml/kg PO or NG • Na^+ or $MgSO_4$—250 mg/kg PO or NG

Description

[1]Only use cathartic one time (with first charcoal dose) or not at all.
Ipecac—Routine use of ipecac in the ED should be abandoned (AACT).

Table 31-11 Whole Bowel Irrigation

Administration	Indications
• Place NG tube • Administer polyethylene glycol (GoLYTELY) at 25–40 ml/kg/hour • Stop when objects recovered or when effluent is clear	• Iron, zinc, Li, sustained release meds • Ingested crack vials or drug packets
	Contraindications
	• CNS or respiratory depression • Ileus, bowel obstruction, perforation

Description

Table 31-12 Acetaminophen Phases

Phase	Time after ingestion	Signs and symptoms
1	30 minutes to 24 hours	Asymptomatic, or minor GI irritant

		effects
2	24–72 hours	Relatively asymptomatic, GI symptoms resolve, possible mild elevation of LFTs or renal failure
3	72–96 hours	Hepatic necrosis with potential jaundice, hepatic encephalopathy, coagulopathy, and renal failure, sepsis
4	4 days–2 weeks	Resolution of symptoms or death

Description

Toxicity Assessment: ≥ 150 mg/kg (200 mg/kg) is potentially toxic. Obtain level ≥ 4 hours after ingestion and plot on nomogram; 4-hour level ≥ 140 mcg/ml indicates need for N-acetyl cysteine. On nomogram, level above thick top line = probable risk. Levels above bottom thinner line = possible risk of toxicity. If unknown times, obtain level at 0 and 4 hours to calculate half-life. If half-life > 4 hours, give antidote.

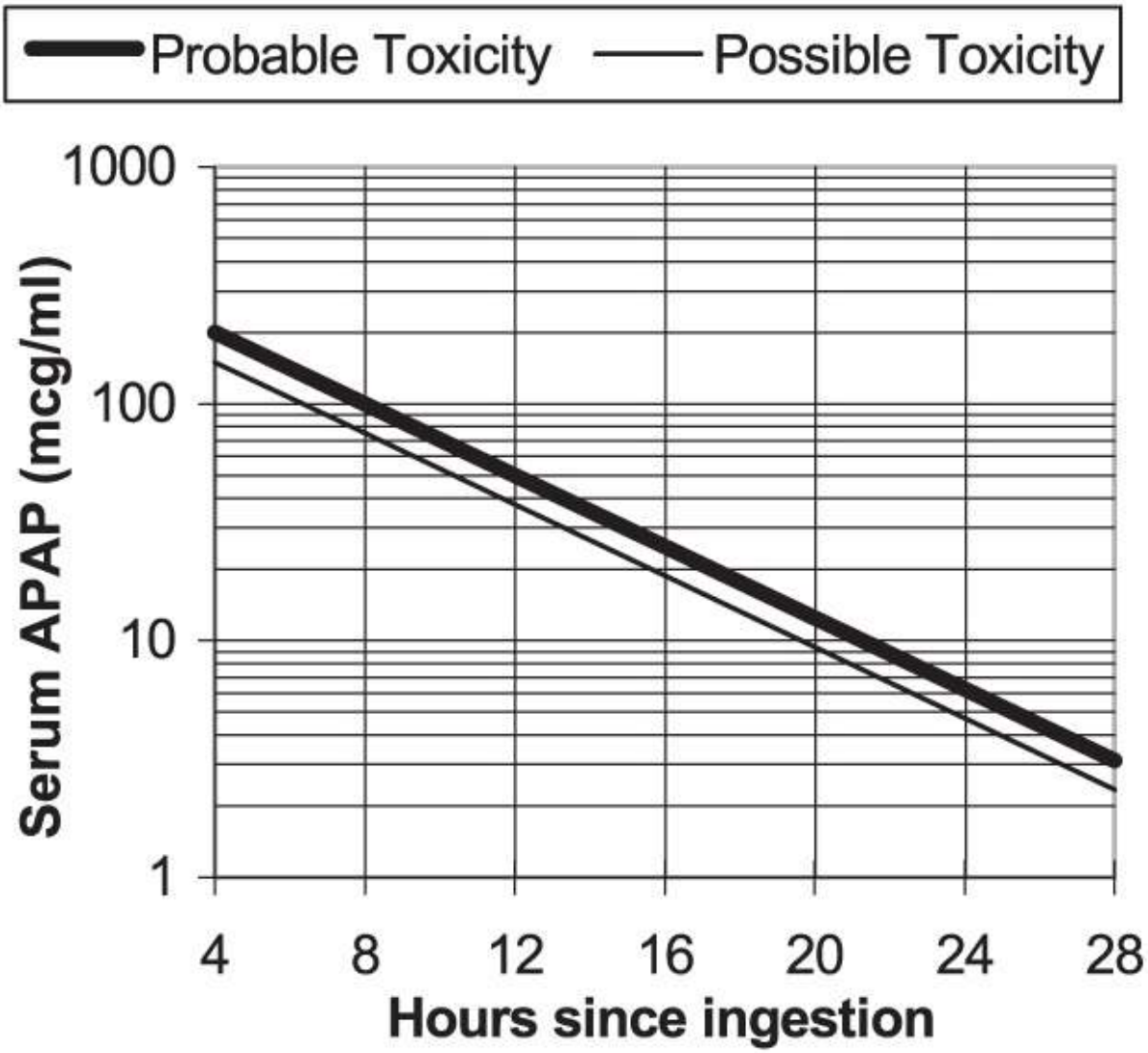
Table 31-13 Management

Decontamination	• Charcoal is indicated only if toxic coingestants are present. • Some ↑ oral Mucomyst dose by 20% if charcoal given.
N-acetyl cysteine (NAC) Mucomyst (Acetadote—IV formulation)	• Assess toxicity based on nomogram. • If drug level will return in < 8 hours post-ingestion, treatment can be delayed until the level is known. NAC prevents 100% of toxicity if administered < 8 hours from ingestion. If level will return > 8 hours and ≥ 150 mg/kg ingested, administer first dose of Mucomyst. NAC is useful ≤ 24 hours after ingestion, possibly up to 72 hours. • *PO dose*: 140 mg/kg PO, then 70 mg/kg every 4 hours × 17 doses. Shorter course (20–36 hours) may be effective if normal liver function tests and undetectable serum acetaminophen level (<10 mcg/ml) at 20–36 hours. Contact poison center for short protocol specifics. Source: Betten DP, Cantrell FL, Thomas SC, Williams SR, Clark RF. A prospective evaluation of shortened course oral N-acetylcysteine for the treatment of acute acetaminophen poisoning. *Ann Emerg Med*. 2007;50(3):272-279. • *IV dose*—150 mg/kg IV (in D_5W) over 15 minutes, then 50 mg/kg (in D_5W) over 4 hours, then 100 mg/kg (in D_5W) over 16 hours. Up to 18% develop anaphylactoid reaction (especially if asthmatic or if they have had a prior NAC

	reaction). If this happens, discontinue and manage symptoms (e.g., antihistamines, epinephrine, inhaled ß agonists, IV fluids). If symptoms stop and were mild, consider restarting NAC. Otherwise, do not restart. • Be aware that NAC can cause anaphylaxis.

Description

Table 31-14 Acetaminophen Nomogram



Winshall JS, Lederman RJ. *Tarascon Internal Medicine & Critical Care Pocketbook*, 4th ed. Jones and Bartlett Publishers, Inc; 2007.

B BLOCKERS

β*1 stimulation*—↑ contraction force + rate, AV node conduction, and renin secretion.

β*2 stimulation*—Blood vessel, bronchi, GI, and GU smooth muscle relaxation. Propranolol is nonselective, blocking β1 and β2 receptors. Other nonselective β blockers: nadolol, timolol, pindolol. Selective β1 blockers: metoprolol, atenolol, esmolol, + acebutolol. Pindolol + acebutolol have some β agonist properties.

Table 31-15 β Blockers

System	Clinical features
CNS	• Lethargy, slurring, confusion, coma, seizures, ↓ respirations
Cardiac	• ↓ HR, ↓ BP, AV block (1st, 2nd, or 3rd), sinus arrest, asystole
GI	• Nausea, vomiting, ileus, obstruction, bowel ischemia/infarction
Metabolic	• Hyperglycemia (esp. verapamil), lactic acidosis
Treatment of β blocker toxicity	
Option	**Recommendations**
Gastrointestinal decontamination	• Avoid ipecac. Aspiration and asystole are reported. Charcoal—Repeat doses (see page 295)
Glucagon	• Indications: ↓ HR or BP. Dose: 50–150 mcg/kg + 50 mcg/kg/hour IV
Glucose and insulin	• Insulin—1 unit/kg bolus, then 0.5 units/kg/hour • Glucose—0.5–1 g/kg bolus, then 0.5 g/hour. Monitor every 30–60 minutes glucose/K^+ until all infusions have been off for ≥ 6 hours.
Atropine	• No HR response is suggestive of β blocker toxicity. Administer 0.02 mg/kg IV prn (maximum of 0.5–1 mg).
Fluid/Vasopressors	• If ↓ BP does not respond to NS, administer α + β agonists (epinephrine/norepinephrine) or pure β agonist (dobutamine).
Other options	Consider $NaHCO_3$ 1–2 mEq/kg IV to reverse sodium channel blockade (SALT syndrome) if wide QRS, low BP, ± acidosis. Use pacemaker if no response to above. Consider dialysis if atenolol, nadolol, or acebutolol overdose. Inamrinone—Consult pharmacist, special dosing/monitoring.

Description

CALCIUM CHANNEL BLOCKERS

Table 31-16 Calcium Channel Blockers

System	Clinical features
CNS	• Lethargy, slurring, confusion, coma, seizures, ↓ respirations
Cardiac	• ↓ HR, ↓ BP, AV block (1st, 2nd, or 3rd), sinus arrest, asystole
GI	• Nausea, vomiting ileus, obstruction, bowel ischemia/infarction
Metabolic	• Hyperglycemia (esp. verapamil), lactic acidosis
Option	**Recommendations**
Gastrointestinal decontamination	• Charcoal. Avoid ipecac. • Whole-bowel irrigation if sustained-release preparation
Calcium	• Usually ineffective at improving cardiac conduction defects • Primary indication is to reverse hypotension. • Administer Ca^{+2} gluconate 60–100 mg/kg IV over 5 minutes, repeat prn. Alternatively, $CaCl_2$ 20 mg/kg IV over ≥ 5 minutes.
Glucagon	• Indications: ↓ HR or BP • Dose: 50–150 mcg/kg IV bolus + 50 mcg/kg/hour IV
Glucose and insulin	• Insulin—1 unit/kg bolus, then 0.5 units/kg/hour • Glucose—0.5–1 g/kg bolus, then 0.5 g/hour. Monitor every 30–60 minutes glucose/K^+ until all infusions have been off for ≥ 6 hours.
Atropine	• Administer 0.02 mg/kg IV if symptomatic ↓ HR (repeat × 3).
Fluids/Pressors	• ↓ BP occurs from peripheral vasodilation. Give NS, then vasoconstrictor: norepinephrine, Neo-Synephrine, ↑ dose dopamine.
Other options	• Consider $NaHCO_3$ 1–2 mEq/kg IV to reverse sodium channel blockade (SALT syndrome) if wide QRS, low BP, ± acidosis • Pacemaker if no response to calcium, glucagon, atropine

Description

CARBON MONOXIDE

Table 31-17 Carbon Monoxide Elimination

Carbon monoxide exposure can occur from fire, catabolism of heme compounds, cigarettes, pollution, ice-surfacing machines, and methylene chloride (dermally absorbed paint remover) degradation. Carbon monoxide displaces O_2 off Hb shifting O_2-Hb dissociation curve to left. Carbon monoxide also binds cytochrome-A cardiac and skeletal muscle myoglobin.	**FIO_2**	**Carbon monoxide half-life**
Description	Room air 100% rebreather 3 ATM hyperbaric O_2	4–6 hours 1–1.5 hours 15–30 minutes

Table 31-18 Clinical Features of Carbon Monoxide Poisoning

Clinical features[1]	
Carboxyhemoglobin level	Typical symptoms at given level of carbon monoxide toxicity
0–10%	Usually none, ± ↓ exercise tolerance, ↑ angina, and ↑ claudication
10–20%	Frontal headache, dyspnea with exertion
20–30%	Throbbing headache, dyspnea with exertion, ↓ concentration
30–40%	Severe headache, vomiting, visual changes
40–50%	Confusion, syncope on exertion, myocardial ischemia
50–60%	Collapse, seizures
> 60–70%	Coma and death
Variable	Cherry red skin, visual field defect, homonymous hemianopsia, papilledema, retinal bleed, hearing changes, pulmonary edema.

	GI upset with vomiting (esp. common < 8 years old)
Assessment of carbon monoxide intoxication	
Carboxyhemoglobinlevels	Levels are unreliable and may be low in significant intoxication.
Anion gap	Cyanide and lactic acidosis may contribute to anion gap.
Saturation gap	Calculated—directly measured arterial O_2 saturation. This gap occurs with cyanide, methemoglobin, and sulfhemoglobin.
ECG	May show changes consistent with myocardial ischemia
Cardiac enzymes	May be elevated from direct myocardial damage
Treatment of carbon monoxide toxicity	
Criteria for admission	**Criteria for hyperbaric oxygen[2]**
• All with carboxyhemoglobin > 15–20% • Pregnancy and carboxyhemoglobin > 10% • Acidosis, ECG changes, myocardial ischemia, abnormal neurologic exam or history of unconsciousness • Symptoms after 100% O_2 × 3 hours	• Cyanide toxicity, coma, unconscious > 20 minutes, abnormal neurological exam, ischemic changes on ECG, dysrhythmias, or neurologic symptoms after 100% O_2 × 3 hours, also consider if pregnant with carboxyhemoglobin level > 15%, or at carboxyhemoglobinlevel > 20%.

Description

[1]May cause flulike symptoms (vomiting and diarrhea) in children (especially with use of combustion heaters in winter). [2]Per the American College of Emergency Physicians 2018 Clinical Policy, emergency physicians should use hyperbaric oxygen (HBO_2) therapy or high-flow normobaric therapy for acute carbon monoxide-poisoned patients. It remains unclear whether HBO_2 therapy is superior to normobaric oxygen therapy for improving long-term neurocognitive outcomes.

CLONIDINE

Clonidine is an α-adrenergic agonist with BP-lowering and sedative properties with the ability to

ameliorate opiate withdrawal symptoms. Serum half-life is 12 hours (6–24 hours).

Table 31-19 Clonidine

Clinical features	
General	• Up to 76% of children manifest symptoms by 1 hour and 100% by 4 hours (unless sustained release pill). Symptoms usually last < 24 hours. • *Caution*: Ingestion of a clonidine patch may cause prolonged symptoms; therefore, admit for observation and consider whole bowel irrigation if this type of ingestion occurs.
CNS	• Lethargy, coma, recurrent apnea, miosis, hypotonia.
Cardiac	• Sinus bradycardia, hypertension (transient), later hypotension.
Other	• Hypothermia and pallor.
Treatment	
Monitor	• Cardiac monitor and pulse oximeter and observe closely for apnea. Apnea often responds to tactile stimulation.
Decontamination	• Charcoal—only consider if < 1 hour from ingestion. Avoid ipecac.
Atropine	• Indication: bradycardia. Dose: 0.02 mg/kg IV.
Treatment	
Antihypertensives	• Hypertension is usually transient. If needed, use short-acting titratable agent (e.g., nitroprusside).
Fluids/Pressors	• Treat hypotension with fluids and dopamine prn.
Naloxone	• 0.02 mg/kg IV may reverse CNS but not cardiac/BP effects. Up to 10 mg may be required. *Caution*: Naloxone may also precipitate hypertension.

Description

COCAINE

Table 31-20 Cocaine Pharmacokinetics

Cocaine is the HCl salt of the alkaloid extract of the *Erythroxylum coca* plant. It can be absorbed across all mucous membranes. It is a local anesthetic (ester-type) that blocks the reuptake of norepinephrine, dopamine, and serotonin.

Route	Peak effect	Duration
Nasal	30 minutes	1–3 hours
GI	90 minutes	3 hours
IV/Inhaled	1–2 minutes	≤ 30 minutes

Data from Cave G, Harvey MG. Should we consider the infusion of lipid emulsion in the resuscitation of poisoned patients? *Crit Care*. 2014;18(5):457; *Ann Emerg Med*. 2008;51:117-134.

Description

Table 31-21 Clinical Features of Cocaine Toxicity

General	• Agitation, hyperthermia, sweat, rhabdomyolysis, GI perf/ischemia.
Cardiac	• A direct myocardial depressant prolongs QT with sympathetic hyperactivity, myocardial ischemia (often with atypical clinical features and ECG findings—acutely or during withdrawal), ↑ BP, ↑ HR, LVH, arrhythmias, ↑ platelet aggregation, accelerated atherosclerosis.
CNS	• Seizures, CNS infarct or bleed, CNS abscess, vasculitis, dystonia.
Lung	• Pneumothorax/Mediastinum, hemorrhage, pneumonitis, ARDS.
Psychiatric	• Paranoia, psychosis.
Management	
General	• Apply cardiac monitor, oxygen, pulse oximeter and observe for arrhythmia, seizures, and hyperthermia. Benzodiazepines are drug of choice for agitation, while haloperidol is also effective (without ↑ cocaine seizure threshold).
Hyperthermia and Rhabdomyolysis	• Benzodiazepines to reduce agitation and muscle activity; cool with mist and fan; continuous rectal probe

	temperature; check serum CK/CO_2; administer IV fluids and bicarbonate to prevent renal failure (page 78).
GI decontaminate	• *Body stuffers*—Charcoal and monitor for perf/ischemia. • *Body packer*—X-ray and whole bowel irrigation; if rupture, consider laparotomy to remove cocaine.
Cardiovascular (arrhythmias and hypertension)	• Administer benzodiazepines for ↑ BP, ↑ HR. Treat according to standard ALS protocols: Use nitroprusside or phentolamine if severe HTN. Use caution with labetalol: β > α block ± ↑ seizures. In the past, experts recommended avoiding β blockade (due to unopposed alpha effects). Limited studies suggest there may be a beneficial, protective effect of β blockade. Currently, clear recommendations cannot be given regarding their use or avoidance. • *Wide-complex tachycardia* due to quinidine like effect. Give $NaHCO_3$ 1 mEq/kg IV and cardiovert.
Cardiovascular (chest pain)	• Administer benzodiazepines, aspirin, and IV NTG if myocardial infarction. Phentolamine IV may reverse coronary vasoconstriction.
Neurologic	• Treat status epilepticus with benzodiazepines. Barbiturates are second line while phenytoin is not useful. Exclude coexisting disease (CT, glucose, electrolytes, R/O infection).

Description

Data from Grant Cave & Martyn G Harvey, Should we consider the infusion of lipid emulsion in the resuscitation of poisoned patients?, *Ann Emerg Med*. 2008;51:117-134. Dattilo PB, Hailpern SM, Fearon K, Sohal D, Nordin C. Beta-blockers are associated with reduced risk of myocardial infarction after cocaine use. *Ann Emerg Med*. 2008; 51(2):117-25. DOI: 10.1016/j.annemergmed.2007.04.015; Hoffman RS. Cocaine and beta-blockers: should the controversy continue?. *Ann Emerg Med.* 2008; 51(2):127-9. DOI: 10.1016/j.annemergmed.2007.08.011; Freeman K, Feldman JA. Cocaine, myocardial infarction, and beta-blockers: time to rethink the equation?. *Ann Emerg Med*. 2008; 51(2):130-4. DOI: 10.1016/j.annemergmed.2007.08.020

DIGOXIN

Natural sources: foxglove, oleander, lily of the valley, and the skin of toads. Therapeutic range —0.5–2.0 ng/ml. Severe poisoning may not demonstrate ↑ levels.

Table 31-22 Digoxin Clinical Features—Acute Toxicity

Clinical features–acute toxicity	
Digoxin level	Usually markedly elevated (obtain > 6 hours after ingestion)
GI and CNS	Nausea, vomiting, diarrhea, headache, confusion, coma
Cardiac	Paroxysmal atrial tachycardia, AV blocks, bradyarrhythmias
Metabolic	Hyperkalemia from inhibition of the Na^+/K^+ ATP pump
Clinical features—chronic toxicity	
Digoxin level	May be normal[1]
History	URI symptoms, on diuretics, renal insufficiency, yellow-green halos
Cardiac	Ventricular arrhythmias (PVCs) are more common than with acute toxicity
Metabolic	Potassium low or normal, magnesium is often low
Treatment of digoxin toxicity	
• Multidose charcoal • Atropine 0.02 mg/kg for ↓ HR • Ventricular arrhythmia: lidocaine 1 mg/kg IV ± $MgSO_4$ 25 mg/kg slow IV	• Treat ↑ K^+: (page 91); avoid calcium. • Avoid cardioversion if possible (predisposes to ventricular fibrillation) • Digoxin Fab fragments (Digibind)
Indications for Digibind	**Total body load digoxin—TBLD estimates**
• Ventricular arrhythmias • Bradyarrhythmias unresponsive to therapy • Ingestion of > 0.1 mg/kg • Digoxin level > 5 ng/ml • Consider if K^+ > 5.5 mEq/l	• First assess total body load of digoxin (TBLD) = [digoxin level (ng/ml) × weight (kg)] ÷ 100 • Acute ingestion—the total mg ingested if digoxin capsules or elixir is ingested • Acute ingestion—the total mg ingested × 0.8 if another form of digoxin is ingested • Or estimate Digibind dose based on serum levels

Description

[1]*Chronic ingestions* may have normal to mildly elevated digoxin levels.

Table 31-23 Dosing Digibind

• Dose (# vials) = [serum digoxin concentration (ng/ml) × weight (kg)]/100. • If ingested quantity unknown, consider empiric administration of 2–10 vials. • One 38 mg Digibind vial can bind 0.5 mg of digoxin if amount ingested known. • Dilute Digibind to 10 mg/ml and administer IV over 30 minutes. Consider using 0.22-micron filter for infusion. Serum digoxin levels are useless after Digibind, as lab assay measures bound + unbound digoxin. These misleading levels may be exceptionally high, as Digibind draws digoxin back into the serum. Once bound, digoxin-Fab complex is renally excreted.

Description

ETHYLENE GLYCOL

Ethylene glycol is found in coolants (e.g., automobile antifreeze), preservatives, lacquers, cosmetics, polishes, and detergents.

Table 31-24 Ethylene Glycol

Timing	**Clinical features**
1–12 hours	• *Early:* Inebriation, ataxia, slurring without ethanol on breath • *Later:* Coma, seizures, and death
12–24 hours	• *Cardiac:* Deterioration occurs during this phase • *Early*: Tachycardia, hypertension, tachypnea • *Later*: Congestive heart failure, ARDS, and cardiovascular collapse • Myositis occasionally occurs during this phase
24–72 hours	• Nephrotoxicity with calcium oxalate crystal precipitation leading to flank pain, renal failure, and hypocalcemia
Diagnosis	**Treatment**
• Anion gap acidosis. • Osmol gap[1] (measured—calculated	• Charcoal ineffective. • $NaHCO_3$ 1 mEq/kg IV—keep pH ~7.40.

osmol) > 10 mOsm/l (page 85). • Hypocalcemia (ECG—↑ QT interval). • Calcium oxalate crystals in urine (urine may fluoresce with UV light—e.g., Wood's lamp). • ↑ BUN and creatinine. • Serum ethylene glycol level > 20 mg/dl is toxic. • Serious toxicity has been reported in the *absence* of an elevated anion gap and crystalluria.	• Ca^{+2} gluconate 10%, 100 mg/kg IV if low calcium. • Pyridoxine and thiamine IV. • Fomepizole[2] (Antizol)—15 mg/kg IV, + 10 mg/kg every 12 hours × 4 doses, then ↑ to 15 mg/kg IV every 12 hours until level < 20 mg/dl. • Ethanol if Antizol unavailable. • Dialysis if (1) oliguria/anuria, (2) severe acidosis, or (3) level > 50 mg/dl *(> 20 mg/dl if fomepizole not used).*

Description

[1]Osmol gap may be normal in significant toxicity. [2]Consult poison center. Administer slow IV over 15 minutes. If unavailable, load IV ethanol (see "Methanol," page 307, Table 31-33).

FLUNITRAZEPAM—ROHYPNOL "ROOFIES"

Rohypnol is a benzodiazepine marketed outside the United States for insomnia, sedation, and pre-anesthesia. It is 10 times as potent as diazepam. It potentiates and prolongs the effects of heroin, methadone, and alcohol and attenuates the withdrawal of cocaine. It produces disinhibition and amnesia and has been used as a "date rape" drug.

Table 31-25 Flunitrazepam—Rohypnol "Roofies"

Onset/Duration	• Maximal absorption is 0.5–1.5 hours with $t_{1/2}$ of nearly 12 hours.
Major clinical effects	• *CNS*—Sedation, incoordination, hallucinations. Paradoxical excitement, especially with alcohol use. ↓ DTRs, mid to small pupils. • *CV-Pulm*—Respiratory depression, hypotension, aspiration.
Management	• NOT routinely detected in urine benzodiazepine screen. • Charcoal if < 1 hour from ingestion. • Protect airway and apply cardiac monitor, pulse oximeter. • Flumazenil (see dose, page 23) may reverse CNS effects. • Admit if lethargic or unstable after 2–4 hours of observation.

Description

GAMMA HYDROXYBUTYRIC ACID (GHB)

Gamma hydroxybutyric acid (GHB) has been promoted as a steroid alternative, a weight

control agent, and as a narcolepsy treatment.

Table 31-26 Gamma Hydroxybutyric Acid

Features	Details
Onset/Duration	• Onset of symptoms is ~15 minutes, with spontaneous resolution from 2 to > 48 hours (depending on dose and coingestant).
Major clinical effects	• *CNS:* Acts with ethanol to produce CNS/respiratory depression. At ↑ levels patients are unresponsive to noxious stimuli and lose pharyngeal reflexes. Seizures, clonic arm/leg/face movements, vomit, amnesia, ↓ DTRs, vertigo, nystagmus, and ataxia occur. • *CV-Pulm:* ↓ HR, irregular or ↓ respirations, ↓ BP.
Management	• Protect airway and apply cardiac monitor, pulse oximeter. • Treat symptomatically (e.g., atropine for persistent ↓ HR). • Exclude coingestant or other diagnosis (e.g., CNS trauma). • Admit if symptoms do not resolve after 6 hours of observation.

Description

IRON

Iron is a chemical element that naturally exists in the body. It plays an active role in various metabolic processes and is found mainly in hemoglobin and myoglobin. These two proteins allow for oxygen transport and storage via the hematopoietic system. There are several formulations of iron that can be taken as dietary supplements and a severe overdose can be lethal.

Table 31-27 Iron

Iron formulations	Elemental iron	Mechanisms of iron toxicity
Ferrous gluconate Ferrous sulfate Ferrous fumarate Ferrous phosphate Ferrous or ferric pyrophosphate Ferrocholinate	12% 20% 33% 37% 12% 12%	• Direct GI mucosal damage with hemorrhagic gastritis, bleeding • Hepatic necrosis • Mitochondrial damage • Venodilation and hypotension • Third-spacing of fluids • Thrombin inhibition-coagulopathy

Description

Table 31-28 Clinical Features—Staging of Iron Poisoning

Stage	Time post ingestion	Findings
I	1–6 hours	Local toxicity: GI bleeding, perforation, diarrhea, and shock due to direct corrosion and vasodilation
II	2–12 hours	Relative stability and resolution: Stage I symptoms resolve
III	12–36 hours	Metabolic disruption: Metabolic acidosis, circulatory collapse, neurologic deterioration, hepatic failure, renal failure, coagulation defects, and third-spacing of fluids
IV	2–4 days	Liver failure: Hepatic necrosis
V	2–6 weeks	Late sequelae: GI tract scarring

Description

Table 31-29 Clinical Features—Suggestive of Iron Toxicity

Vomiting and diarrhea (esp. ≤ 6 hours)	Hypotension	
Mental status changes	Coagulopathy, acidosis	
Estimate of quantity elemental iron ingested and toxicity potential	***Elemental iron (Table 31-27)***	***Toxicity***
	< 20 mg/kg 20–60 mg/kg > 60 mg/kg	None Mild to moderate Severe

Description

Table 31-30 Serum Iron and TIBC levels

Obtain serum iron and total iron-binding capacity (TIBC) at least 4 hours post-ingestion. Absorption may be delayed for slow-release forms, if so obtain second level at 8 hours. Iron levels ≥ 350 mcg/dl (normal 50–150) are serious, as the TIBC (350–500 mcg/dl) is exceeded. High iron falsely lowers TIBC level, rendering test unreliable.	***Serum iron (mcg/dl)***	***Toxicity***
	< 100 100–300 300–500 500–1,000 > 1,000	None Mild Moderate Severe Possibly lethal

Description

Table 31-31 Adjunctive Diagnostic Tests

WBC count	> 15,000 cells/mm^3 is associated with a serum iron > 300 mcg/dl.
Glucose	> 150 g/dl is associated with a serum iron > 300 mcg/dl.
KUB	Radio-opaque tablets on plain films indicate potential for further absorption/toxicity; 50% with iron > 300 mcg/dl = negative X-ray.

Description

Table 31-32 Treatment of Iron Poisoning

Fluid/Blood	• Use NS ± blood prn. Consult surgeon if suspect perforation.
Decontaminate	• Charcoal is ineffective.
Whole bowel irrigation	• Administer polyethylene glycol (GoLYTELY; Table 31-11). This option is especially useful if X-ray shows tablets beyond pylorus.
Deferoxamine	• Do not rely on deferoxamine challenge to make decisions. • 15 mg/kg/hour IV infusion. Do not wait for iron levels to return if the patient is symptomatic. Deferoxamine given IV or IM causes ↓ BP, which is usually the limiting factor in infusion rate. Seizures can occur following deferoxamine. If improving, discontinue deferoxamine when urine clears and iron level < 100 mcg/dl.
Dialysis	• If renal failure prevents excretion of ferrioxamine.
Indications for chelation with deferoxamine	• Multisystem toxicity (e.g., vomiting, diarrhea, GI bleeding, ↓ BP, acidosis, altered mental status, coagulopathy). • Tablets seen on plain abdominal radiograph. • Serum iron > 350 mcg/dl or serum iron > TIBC (TIBC can be unreliable when serum iron levels are high).

Description

METHANOL

Methyl alcohol sources are wood alcohol, solvents, paint removers, shellacs, windshield

washing fluids, and antifreeze. Toxicity is from formaldehyde/formic acid. Death has been reported after ingestion of 15 ml of 40% solution.

Table 31-33 Methanol Toxicity

<table>
<tr><th colspan="2">Clinical features</th><th>Treatment</th></tr>
<tr><td>0–12 hours</td><td>• Inebriation, drowsiness
• Asymptomatic period</td><td rowspan="4">• Charcoal
• $NaHCO_3$ 1 mEq/kg IV—keep pH > 7.35
• Folate
• Consult poison center
• Fomepizole (Antizol)—(see ethylene glycol dosing, Table 31-24).
• Ethanol (10%) in D_5W (if no Antizol)—(1) IV loading dose 10 ml/kg over 1–2 hours, (2) then 1.6 ml/kg/hour (3) Ethanol goal: = 100–150 mg/dl.
• Dialyze if (1) visual symptoms, (2) CNS depression, (3) level > 50 mg/dl, (4) severe metabolic acidosis, or (5) history of ingestion of > 30 ml.
• Stop dialysis and ethanol when methanol levels fall to < 20 mg/dl.</td></tr>
<tr><td rowspan="3">12–36 hours</td><td>• Vomiting, hyperventilation
• Abdominal pain, pancreatitis
• Visual blurring, blindness with mydriasis and papilledema
• CNS depression</td></tr>
<tr><td>Diagnostic studies</td></tr>
<tr><td>• Osmol gap[1] may occur before anion gap acidosis (see page 85).
• Anion gap and lactic acidosis.</td></tr>
<tr><td colspan="2">Diagnostic studies</td><td></td></tr>
<tr><td colspan="2">• Hemoconcentration, hyperglycemia.
• Methanol levels > 20 mg/dl are toxic.
1. CNS symptoms occur > 20 mg/dl
2. Visual symptoms occur > 50 mg/dl</td><td></td></tr>
</table>

Description

[1]Osmol gap may be normal in significant toxicity.

ORGANOPHOSPHATES AND CARBAMATES

Organophosphates irreversibly bind and inhibit cholinesterases at CNS receptors, postganglionic parasympathetic nerves (muscarinic effects), and autonomic ganglia and skeletal myoneural junctions (nicotinic effects). Carbamates irreversibly bind cholinesterases and are less toxic.

Table 31-34 Clinical Features of Insecticide Toxicity

Onset of symptoms	• Usually begin < 24 hours after exposure. Lipid-soluble organophosphates (e.g., fenthion) may take days to produce symptoms with persistence for weeks to months and periodic relapses.
CNS	• Cholinergic excess: delirium, confusion, seizures, respiratory depression. Carbamates have less central effects.
Muscarinic	• SLUDGE: Salivation, lacrimation, urination, defecation, GI upset, emesis; miosis, bronchoconstriction, bradycardia.
Nicotinic	• Fasciculations, muscle weakness, sympathetic ganglia stimulation (hypertension, tachycardia, pallor, rarely mydriasis).

Description

Table 31-35 Diagnostic Studies in Insecticide Poisoning

Labs	• ↑ Glucose, ↑ K^+, ↑ WBC, ↑ amylase, glycosuria, proteinuria
ECG	• Early—↑ in sympathetic tone (tachycardia) • Later—Extreme parasympathetic tone (sinus bradycardia, AV block, and ↑ QT)
Serum *(pseudo)* RBC *(plasma)* Cholinesterase	• Serum levels are more sensitive but less specific than RBC • Plasma levels return to normal before RBC levels • Mild cases: Levels are < 50% of normal • Severe cases: Levels are < 10% of normal

Description

Table 31-36 Treatment for Insecticide Poisoning

General	• First take off all clothing that may contain the toxin. • Wash toxin off patient if dermal exposure. • Support airway, breathing, and blood pressure. Respiratory depression is the most common cause of death. • Medical personnel should gown and glove if dermal exposure. • Administer charcoal if oral ingestion.
Atropine *Extremely large*	• Competitively blocks acetylcholine (ACh) at muscarinic (not

doses often needed	nicotinic) receptors. Atropine may reverse CNS effects. • *Dose:* ≥ 0.05 mg/kg every 5 minutes. Mix 50 mg in 500 ml NS and titrate. • *Goal:* Titrate to mild anticholinergic signs (dry mouth, secretions) and not to pupil size or heart rate. • Treatment failure most often due to not using enough atropine.
Pralidoxime (2-PAM)	• PAM has endogenous anticholinergic effects, while reversing nicotinic and central effects. It does not reverse carbamate toxicity. • *Dose:* 20–50 mg/kg IV over 15 minutes. May repeat in 1–2 hours, then may repeat every 10–12 hours. Onset of effect is 10–40 minutes after administration.
Atrovent	• Ipratropium bromide 0.5 mg neb. every 4–6 hours may dry secretions.

Description

SALICYLATES

Methyl salicylate (oil of wintergreen) is the most toxic form. Absorption generally is within 1 hour of ingestion (delays ≥ 6 hours occur with enteric-coated and viscous preparations). At toxic levels, salicylates are renally metabolized. Alkaline urine promotes excretion. At different acidosis/alkalosis states, measurable salicylate levels change, therefore, measure arterial pH at the same time as the drug level.

Table 31-37 Salicylate Toxicity—Levels

Ingestion	Severity	Signs and symptoms
< 150 mg/kg	Mild	Vomiting, tinnitus, and hyperpnea
150–300 mg/kg	Moderate	Vomiting, hyperpnea, diaphoresis, and tinnitus
>300 mg/kg	Severe	Acidosis, altered mental status, seizures, and shock

Description

Table 31-38 Clinical Features of Salicylate Toxicity

Direct	• Irritation of GI tract with reports of perforation

Metabolic	• *Early:* Respiratory alkalosis from respiratory center stimulation • *Later:* Anion gap acidosis—uncoupled oxidative phosphorylation • Hypokalemia, ↑ or ↓ glucose, ketonuria, and either ↑ or ↓ Na+
CNS	• *Early:* Tinnitus, deafness, agitation, hyperactivity • *Later:* Confusion, coma, seizure, CNS edema (esp. < 4 years old)
GI	• Vomiting, gastritis, pylorospasm, ↑ liver enzymes, perforation
Pulmonary	• Noncardiac pulmonary edema (esp. with chronic toxicity)

Description

Table 31-39 Indicators of Salicylate Toxicity

Clinical	• See Table 31-38 for features associated with toxicity.
Ingestion	• Ingestion of ≥ 150 mg/kg is associated with toxicity.
Ferric chloride	• Mix 2 drops $FeCl_3$ + 1 ml urine. Purple = salicylate ingestion.
Phenistix	• Dipstick test for urine. Brown indicates salicylate or phenothiazine ingestion (not toxicity). Adding 1 drop 20N H_2SO_4 bleaches out color for phenothiazines but not salicylates.
Salicylate levels	• A level > 30 mg/dl drawn ≥ 6 hours after ingestion is toxic. Clinical picture more important than levels (esp. if chronic component to overdose). Do not wait for 6 hours to treat ill patients. • Follow serial levels (every 2–3 hours) until downward trend established. • In patients with a low pH, CNS penetration increases and toxicity can occur at lower levels. • *Done nomogram* is unreliable indicator of toxicity.
Nontoxic ingestion	• If each of the following are present, acute toxicity is unlikely (1) < 150 mg/kg ingested, (2) absent clinical features, (3) level < 30 mg/dl obtained ≥ 6 hours after ingestion (unless enteric-coated preparation, viscous preparation, or chronic

	ingestion).

Description

Table 31-40 Treatment of Salicylate Poisoning

General	• Treat dehydration, electrolyte abnormalities. CSF hypoglycemia occurs with normal serum glucose—add D_5W or $D_{10}W$ to all fluids.
Decontaminate	• Multidose charcoal. Whole bowel irrigation (if enteric coated).
Alkalinization	• Add 100 mEq $NaHCO_3$ to 1 l D_5W 1/2NS (± 20–40 mEq/l K^+ if no renal failure). *Goal*—urine pH > 7.5.
Hemodialysis	• *Indications:* Renal failure, noncardiogenic pulmonary edema, congestive heart failure, persistent CNS disturbances, deterioration of vital signs, unable to correct acid–base or electrolyte imbalance, salicylate level > 100 mg/dl (acutely).

Description

Table 31-41 Chronic Salicylate Toxicity

Presentation	• Patients are older, on chronic salicylates. Neuro changes and noncardiogenic pulmonary edema are more common. Many are treated for infectious/neuro disease prior to correct dx.
Toxicity	• Salicylate levels are often normal to therapeutic.
Treatment	• Supportive measures and urinary alkalinization are recommended. Dialyze if acidosis, confusion, or pulmonary edema.

Description

SELECTIVE SEROTONIN REUPTAKE INHIBITORS AND NON-TRICYCLIC ANTIDEPRESSANTS

Table 31-42 Selective Serotonin Reuptake Inhibitors and Non-tricyclic Antidepressants

Selective serotonin reuptake inhibitors (SSRIs) Overdose is	**SSRIs**

relatively benign. Most common symptoms: ↑ HR, tremor, vomiting, and drowsy. ECG: ↑ HR, nonspecific ST-T changes. Seizures, cardiotoxicity (wide QRS/QTc) can occur at high levels (esp. fluoxetine). ↓ HR is seen with fluvoxamine at high or low doses. *Treatment*: (1) exclude coingestants, (2) observe for 6 hours, (3) Charcoal 1 g/kg (< 1 hour post-ingest.), (4) $NaHCO_3$ IV if wide QRS tachycardia, (5) observe for potentially lethal *serotonin syndrome*.	Citalopram (Celexa) Escitalopram (Lexapro) Fluoxetine (Prozac) Fluvoxamine (Luvox) Paroxetine (Paxil) Sertraline (Zoloft)

Monoamine oxidase inhibitors (isocarboxazid/Marplan, phenelzine/Nardil, selegiline/Eldepryl, tranylcypromine/Parnate). overdose may have onset up to 12 hours later. Excess α+β adrenergic symptoms: Headache, tremor, ↑ BP, ↑ DTR rigidity, chest pain, ↑ temp. Later ↓ BP, ↓ HR, seizures. *Treatment*: (1) Nipride or phentolamine for ↑ BP (No β blockers), (2) NS + Norepi. for ↓ BP, (3) charcoal, (4) benzodiazepines, (5) treat hyperthermia (see malignant hyperthermia/rhabdomyolysis page 78).

Serotonin, norepinephrine reuptake inhibitors—Venlafaxine (Effexor), duloxetine (Cymbalta)—overdose causes ↑ HR and ↓ level of consciousness, brief and limited seizures, mild hypotension. Treat with supportive care.

Norepinephrine and dopamine reuptake inhibitor—Bupropion (Wellbutrin). Overdose causes lethargy (41%), tremors (24%), and seizures (21%). Mean seizure onset is 3.7 hours. Treat with benzodiazepines, phenytoin. One case prolonged QRS/QTc.

Noradrenergic and serotoninergic antidepressants—Mirtazapine (Remeron) inhibits presynaptic α_2 receptors increasing serotonin and norepinephrine transmission. Serotonin-2 and -3 receptors are blocked diminishing anxiety and GI side effects. Overdose is rare—with sedation and drowsiness requiring rare intubation. No cardiac conduction effects or seizures have been noted to date.

Serotonin-2 receptor antagonists—Nefazodone (Serzone), trazodone (Desyrel) (esp. trazodone) cause sedation, lightheadedness, GI upset, headaches. Trazodone has been associated with nonsustained ventricular tachycardia and other dysrhythmias. Treatment for overdose of either agent is supportive.

Description

Table 31-43 Serotonin Syndrome

	Mild	Moderate	Severe
CNS	Confused, restless	Agitated, sleepy	Coma, seizures
Autonomic	Temp. (T) < 38°C, mydriasis, diarrhea, ↑ HR	T < 39.5°C, BP low or high, mydriasis	T > 39.5°C, dyspnea, diaphoresis, ↑ HR
Neuromuscular	Clonus, ataxia, akathisia, ↑ DTRs	Myoclonus, clonus, ataxia	Muscle rigidity (rhabdomyolysis)
Causes: Coingestion SSRIs, TCA, MAOI, meperidine, codeine, dextromethorphan *Treatment*: Stop drug, manage complications (hyperthermia/rhabdomyolysis), administer benzodiazepines. Some experts recommend cyproheptadine.			

Data from O'Malley GF. Emergency department management of the salicylate-poisoned patient. *Emerg Med Clin North Am*. 2007;25(2):333-346; Reilly TH, Kirk MA. Atypical antipsychotics and newer antidepressants. *Emerg Med Clin North Am*. 2007;25:477.

Description

SULFONYLUREAS

Examples: Chlorpropamide, tolbutamide, glipizide, gliclazide, glimepiride, glyburide.
Clinical: 50% of children develop symptoms of hypoglycemia in 2 hours, while 96% develop symptoms by 8 hours unless long-acting pill ingested (XL preps). Neurologic (lethargy, seizure, headache, focal deficits) and autonomic symptoms (sweat, hypertension, tachycardia, pallor) occur.

Table 31-44 Sulfonylureas Treatment/Disposition

Treatment: If hypoglycemia, IV glucose (age < 1 month: 10 ml/kg $D_{10}W$, 1–24 months: 4 ml/kg $D_{25}W$; > 2 years: 2 ml/kg of $D_{50}W$). Drip: $D_{10–20}W$/ $D_{10–20}NS$. If no IV, glucagon 0.02–0.03 mg/kg SC (if < 20 kg) or 1 mg if > 20 kg. If recurrent: octreotide (2 mcg/kg IV/SC every 6–12 hours) OR if unavailable, diazoxide (1–3 mg/kg) IV over 30 minutes every 4 hours. Charcoal does not absorb all sulfonylureas and may be aspirated. Consider risks/benefits of whole bowel irrigation if XL prep.
Disposition: Admit for 24 hours if first-generation overdose, symptomatic, or XL ingestions since delayed onset 16–24 hours after ingestion can occur. If second or third generation (gliclazide, glimepiride, glipizide, glyburide), asymptomatic, normal glucose and unintentional overdose, some experts observe ≥ 8–12 hours post-ingestion, then discharge.

SYMPATHOMIMETICS

Table 31-45 Sympathomimetics (Amphetamines and Derivatives)

Effects of amphetamines are (1) *sympathomimetic*—α and β adrenergic—mydriasis, ↑ HR, ↑ BP, ↑ temp., arrhythmias, MI, rhabdomyolysis, psychosis, CNS bleed, ↑ sweat, seizures; (2) *dopaminergic*—restlessness, anorexia, hyperactive, movement disorders, paranoia; (3) *serotonergic*—mood, impulse control, serotonin syndrome.

Ice/Crank (crystal methamphetamine) is one of most commonly synthesized illicit drugs. Onset is minutes, lasts 2–24 hours. **MDMA (Ecstasy)**—popular at "raves" and consumed orally. Low dose—euphoria, mild sympathomimetic symptoms last ~4–6 hours. Potent serotonin releaser (no impulse control). High dose—effects (1–3) above.

Treatment: (1) supportive care, cardiopulmonary and neuro monitoring; (2) benzodiazepines for agitation; (3) labetalol or Nipride or phentolamine for ↑ BP; (4) if ↓ BP, dopamine or norepinephrine; (5) consider charcoal; (6) treat complications.

Description

TRICYCLIC ANTIDEPRESSANTS

Table 31-46 Tricyclic Antidepressants (TCA)

Clinical features are due to α adrenergic block (↓ BP), anticholinergic effects (altered mentation, seizures, ↑ HR, mydriasis, inhabitation of norepinephrine uptake (↑ catecholamines), Na^+ channel block (quinidine-like cardiac depression).

ECG findings in TCA overdose	
Sinus tachycardia • ↑ QRS > 100 ms[1], ↑ PR interval, ↑ QT interval, BBB[2] (esp. right BBB) • Right axis deviation of the terminal 40 ms of the QRS > 120° (prominent terminal R in AVR—see figure) • AV conduction blocks (all degrees) • Ventricular fibrillation or tachycardia	
Treatment of TCA toxicity	
General	• Apply cardiac monitor, obtain ECG.

	• QRS width, QT interval
Decontaminate	• Administer charcoal 1 g/kg PO or NG every 2–4 hours. • Ensure patent airway and gag reflex prior to decontamination. • Avoid ipecac, as patients may have rapid mental status decline or develop seizures.
$NaHCO_3$	• *Indications*: (1) acidosis, (2) QRS width > 100 ms, (3) ventricular arrhythmias, or (4) hypotension. • Alkalinization enhances TCA protein binding and reverses Na^+ channel blockade and toxic cardiac manifestations. • *Dose:* 1–2 mEq/kg IV. May repeat or initiate drip. • *Goal*: Arterial pH of 7.50–7.55 or normal QRS. • $NaHCO_3$ is ineffective for CNS manifestations (e.g., seizures).
Fluids/Pressors	• Administer 10–20 ml/kg NS for hypotension. Repeat 1–2×. • If fluids are ineffective administer phenylephrine or norepinephrine (not dopamine) due to prominent α effects.
Antiseizure medications	• Use lorazepam followed by phenobarbital. • Phenytoin may be ineffective in TCA-induced seizures.
$MgSO_4$	• 25 mg/kg administered slow IV (over 15 minutes) may be useful for ↓ BP, and arrhythmias.
Disposition	*May transfer to psychiatric facility if all of following are present:* • No major evidence of toxicity during 6 hours ED observation. • Active bowel sounds. • ≥ 2 charcoal doses are given (not all experts recommend this). • There is no evidence of toxic coingestant.

Description

32 ■ TRAUMA

- Leading cause of death/disability for people under the age of 19 in the United States.
- Major causes of death are airway compromise and inadequate fluid resuscitation.
- Blunt trauma > penetrating trauma.
- Fatal injuries involve those to the head, chest, and abdomen.
- Injury characteristics vary by age.
- Earliest sign of shock = tachycardia.
- Firearms cause the highest percentage of fatality/incidence, though overall incidence is low.

Sources: Tisherman SA, Forsythe, RM, Kellum, JA. *Trauma Intensive Care*. New York, NY: Oxford University Press; 2013:251-271; Schneeweiss S, Leilani A. *The Hospital for Sick Children Handbook of Pediatric Emergency Medicine*. Sudbury, MA: Jones and Bartlett; 2008:37-42.

Table 32-1 Guidelines for Field Triage of Injured Patients[1]

Step 1: Are any of following present?: GCS < 14, SBP < 90 mm Hg [*while 70 + age × 2 numerically estimates hypotension in children, the expert panel used higher cutoff (< 90 mm Hg) to ensure appropriate overtriage of children*], or RR < 10 or > 29 breath/minute (< 20 if < 1 year old)

NO → Go to **Step 2**

↓ YES

Take to Highest-Level Trauma Center

Step 2: Are any of following present?: Penetration to head, neck, torso, extremity proximal to elbow, or knee, amputation proximal to wrist/ankle, flail chest, 2 or more proximal long bone fractures, mangled/crushed or degloved extremity, pelvic fracture, open or depressed skull fracture or paralysis

NO → Go to **Step 3**

↓ YES

Take to Highest-Level Trauma Center

Step 3: Are any of following present?: Fall > 10 feet or > 2–3 × child's height, high-risk auto crash (intrusion > 12 inches occupant side, or > 18 inches any side), ejection, death in same passenger compartment, high-risk car telemetry data, auto vs. pedestrian/bicyclist with one of following: thrown, run over, > 20 mph impact; or motorcycle crash > 20 mph, or EMS provider judgment

NO → Go to **Step 4**

↓ YES

Take to Closest Appropriate Trauma Center, Which Need Not Be the Highest-Level Trauma Center

Step 4: Children (esp. those < 5 years old) are triaged preferentially to closest pediatric-capable trauma center. Patients with bleeding disorder (e.g., blood thinner) with burns, time-sensitive injury (fracture that is open or neurovascular compromise), on dialysis, or pregnancy > 20 weeks

NO → Go to **Step 5**

↓ YES

Step 5: Contact medical control and consider transport to a trauma center or specific resource hospital (e.g., isolated burns without trauma to burn center), if significant trauma, still transport to resource hospital.

NO → Follow local transport protocols

[1]GCS—Glasgow coma scale (see Pediatric GCS); SBP—systolic blood pressure; RR—respiratory rate.

Modified from Sasser SM, Hunt RC, Sullivent EE, et al. Guidelines for field triage of injured patients. Recommendations of the National Expert Panel on Field Triage. *MMWR Recomm Rep*. 2009;58(RR-1):1-35.

Description

TRAUMA SCORING AND ASSESSMENT

Table 32-2 Pediatric Trauma Score[1]

		Patient Features					
		Weight (kg)	Airway	Systolic BP (mm Hg)	Mental status	Open wounds	Extremity fractures
Score	−1	<10	Nonmaintainable	<50	Comatose	Major	Open or multiple
	+1	10–20	Maintainable	50–90	Obtunded	Minor	Closed
	+2	>20	Normal	>90	Awake	None	None

[1]A total score of ≤8 suggests possible serious injury, <1 predicts mortality rate of >98%, 4 = 50% mortality, > 8 predicts < 1% mortality.
Data from Ramenofsky, M. L., Ramenofsky, M. B., Jurkovich, G. J., Threadgill, D., Dierking, B. H., & Powell, R. W. The Predictive Validity of the Pediatric Trauma Score. The Journal of Trauma: Injury, Infection, and Critical Care; 1998:28(7),1038-1042. doi:10.1097/00005373-198807000-00021

Description

Table 32-3 Pediatric Glasgow Coma Scale[1]

Eye opening	Best motor	Best verbal
0–1 year 4 Spontaneous 3 To shout 2 To pain 1 No response	0–1 year 6 Spontaneous movement 5 Localizes pain 4 Flexion withdrawal 3 Flexion/Decorticate 2 Extension/Decerebrate 1 No response	0–2 years 5 Normal cry, smile, coo 4 Cries 3 Inappropriate cry, scream 2 Grunts 1 No response
> 1 year 4 Spontaneous 3 To verbal 2 To pain 1 No response	> 1 year 6 Obeys 5 Localizes pain 4 Flexion withdrawal 3 Flexion/Decorticate 2 Extension/Decerebrate 1 No response	2–5 years 5 Appropriate words 4 Inappropriate words 3 Cries or screams 2 Grunts 1 No response
		> 5 years

	5 Oriented 4 Disoriented but converses 3 Inappropriate words 2 Incomprehensible 1 No response

Description

[1]Total score indicates that injury is mild (13–15), moderate (9–12), or severe (≤8).

Table 32-4 Revised Trauma Score (RTS)[1]

RTS—add each category	GCS	Systolic BP (mm Hg)	Respiratory rate
4	13–15	> 89	10–29
3	9–12	76–89	> 29
2	6–8	50–75	6–9
1	4–5	1–49	1–5
0	3	0	0

[1]RTSC—modified for children. RR > 29 is normal (4) if aged 0–3 years, RTS < 12 indicates possibility of significant trauma, RTS < 7 = 79% probability of emergent surgery.

Description

Table 32-5 Initial Approach to Pediatric Trauma

<table>
<tr><th colspan="4">Primary survey (0–5 minutes)</th></tr>
<tr><th>Assessment</th><th colspan="3">Action</th></tr>
<tr><td><u>A</u>irway—Assess air movement, while immobilizing cervical spine.</td><td colspan="3">Endotracheal intubate if (1) unable to ventilate, (2) altered mentation/aspiration risk, (3) need for hyperventilation in head injury, (4) flail chest, (5) severe shock. See pages 15–17 for ET tube size and rapid sequence technique.</td></tr>
<tr><td><u>B</u>reathing—Assess ventilation effectiveness and oxygenation.</td><td colspan="3">Apply pulse oximeter (± end-tidal CO_2 monitor), O_2, perform needle thoracostomy for tension pneumothorax, occlusive dressing for sucking chest wound, and ET tube if needed.</td></tr>
<tr><td><u>C</u>irculation—Assess strength, rate, quality of peripheral pulses, while stopping external bleed.</td><td colspan="3">Attach cardiac monitor, apply pressure to external bleed. Insert two large peripheral venous lines, and draw blood for type and cross-match, and basic labs.</td></tr>
<tr><td rowspan="2">See pages 5–6 for a complete list of normal vitals by length, weight, and age. See pages 10–11, 14 for central venous catheter sizes, and IO technique.</td><td>Age</td><td>IV catheter size</td><td>Intraosseous size</td></tr>
<tr><td>0–1 year
> 1–6 years
8–12 years
> 15 years</td><td>20–22 gauge
18–20 gauge
16–20 gauge
14–18 gauge</td><td>17F
15F
—
—</td></tr>
<tr><td><u>D</u>isability—Assess pupils and alertness (AVPU).</td><td colspan="3">Assess pupils + Pediatric GCS (page 317), Alert, responds to Voice, Pain, Unresponsive (AVPU)</td></tr>
<tr><td><u>E</u>xposure</td><td colspan="3">Completely undress patient (begin radiant warming)</td></tr>
<tr><td colspan="4">Resuscitation (simultaneously performed during primary survey)</td></tr>
<tr><td>Airway/Breathing</td><td colspan="3">Reassess, see airway and breathing boxes above in this table</td></tr>
<tr><td>Circulation</td><td colspan="3">Note: Do not spend > 2–3 minutes attempting peripheral IV.
If hypotensive, obtain IO or central venous access.
Administer NS 20 ml/kg IV for hypotension/shock. Reassess, and repeat NS 20 ml/kg IV if needed. Administer O negative whole blood or packed RBCs 10–20 ml/kg.</td></tr>
</table>

Primary survey (0–5 minutes)	
Assessment	**Action**
	Insert NG tube, Foley catheter (see page 5 for size). A base deficit (BD) ≤ -8 mEq/L predicts a 15 $\times$ increased risk of transfusion requirement compared to a normal BD.
Secondary survey and definitive care	
Reassess ABCDE	Address any deterioration or new abnormalities. Insert chest tube prn (e.g., if prior needle thoracostomy).
Head-to-toe examination	Complete vital signs (do not forget back and rectal exams).
Address extremity injuries	Reduce dislocations compromising circulation.
Initial X-rays	Cervical spine, chest, pelvis, extremities, and CT scans as indicated by the physical exam.
Pain control, infection risk	Administer analgesics, antibiotics, tetanus.
Begin disposition	Call surgeon and consultants as need is identified. Initiate transfer, admission, or prepare for operating room. Splint fractures and dress wounds.
Documentation	Document all abnormalities (including X-ray, lab abnormalities), consults, and times. Talk with family.

Description

Table 32-6 Abdomen CT Criteria if Significant Pediatric Blunt Torso Trauma

Predictor panel[1]	Predictive values of predictor panel (95% confidence interval)	
• Low systolic BP • Abdomen tender • Femur fracture • ALT > 125 U/L • AST > 200 U/L • Hematocrit < 30% • UA with > 5 RBC/hpf • Seat belt sign	Sensitivity	95% (90–98%)[2]
	Specificity	49% (34–40%)
	Negative predictive value	98% (96–99%)
	Positive predictive value	20% (17–23%)

Description

[1]Listed panel + GCS < 14 = author's prior cited indicators for abdominal CT. [2]Sensitivity for surgical intervention was 100% (1 nontherapeutic laparotomy performed).
Data from Holmes JF, Mao A, Awasthi S, McGahan JP, Wisner DH, Kuppermann N. Validation of a prediction rule for the identification of children with intra-abdominal injuries after blunt torso trauma. *Ann Emerg Med*. 2009;54(4):528-533; Borgialli DA, Ellison AM, Ehrlich P, et al. Association between the seat belt sign and intraabdominal injuries in children with blunt torso trauma in motor vehicle collisions. *Acad Emerg Med*. 2014;21(11):1240-1248.

Table 32-7 Predictors of Abdominal, GU Injury, and Death Based on Pelvic Fracture Class

Torode class[1]	Mortality	GU injury	Other fracture[2]	Neuro. injury	Abd. surgery
II	0%	6%	39%	61%	11%
III	3%	26%	49%	57%	13%
IV	13%	38%	56%	56%	40%

[1]See Table 26-10 for Torode and Zieg Class. [2]Others found that multiple pelvic fracture sites (80% associated injury) + RTS < 11 (see Table 32-4) predicted abdominal/GU injuries. If only single fracture site and RTS of 11 or 12, only 0.5% had intra-abdominal injury.
Data from Torode I, Zieg D, Pelvic fractures in children. *J Pediatr Orthop*. 1985;5:76; Silber JS, Flynn JM. Changing patterns of pediatric pelvic fractures with skeletal maturation: implications for classification and management. *J Pediatr Orthop*. 2002;22:22; Bond SJ, Gotschall CS, Eichelberger MR. Predictors of abdominal injury in children with pelvic fracture. *J Trauma*. 1991;31(8):1169-73.

Description

Table 32-8 Management of Blunt Abdominal and Flank Trauma

- 10% of trauma-related deaths
- Spleen > liver
- Main complications: bleeding; solid organ or vascular injury; peritonitis—hollow viscus perforation
- Validity of single pediatric FAST exam controversial—negative FAST cannot rule out intra-abdominal injury
- + FAST = immediate abdominal CT if stable
- Hemodynamically unstable patient needs OR

Description

Modified from Tisherman SA, Forsythe, RM, Kellum, JA. *Trauma Intensive Care*. New York, NY: Oxford University Press; 2013:251-271; Schacherer N, Miller J, Petronis K. Pediatric blunt abdominal trauma in the emergency department: evidence-based management techniques. *Pediatr Emerg Med Pract*. 2014;11(10):1-23. Eric Brader, and Christina Halldorson. “Updates in Pediatric Trauma, Part I.” *Pediatric Emergency Medicine Reports*, vol. 20, no. 4, AHC Media LLC, 3/24/2015. “Blunt Pelvic Trauma.” *Trauma Reports*, vol. 15, no. 6, AHC Media, LLC, 11/1/2014.

Table 32-9 High Yield Criteria for Cranial Computed Tomography in Children < 2 Years Old After Trauma[1]

Predictors	*Predictive values*[4,5]	
• Altered mental status[2] • Scalp hematoma[2] • Loss of consciousness ≥ 5 seconds • Severe mechanism[3] • Palpable fracture • Not acting normal per parents	Sensitivity	100% (86–100%)
	Specificity	54% (52–56%)
	Negative predictive value	100% (99.7–100%)
	Positive predictive value	2% (1–2%)

Description

[1]*Study inclusion criteria*—Head trauma within prior 24 hours with GCS 14–15 (page 317). *Exclusion criteria*—Penetrating trauma, known brain tumor, preexisting neurological disorder, prior CT pretransfer, ventricular shunt, bleeding disorder, or GCS < 14. [2]*Altered mental status*—GCS < 15, agitation, sleepy, slow response, repetitive questioning. *Scalp hematoma*—Frontal hematoma allowed. [3]*Severe mechanism*—Ejection from vehicle, death of another passenger, rollover, pedestrian or bicyclist without helmet struck by motor vehicle, fall > 3 feet, head struck by high-impact object. [4]*Predictive value* in detecting clinically important traumatic brain injury (ciTBI) if any one of predictors present with (95% confidence intervals). [5]*ciTBI detected by criteria*—Death from TBI, intubation > 24 hours for TBI, hospital admit ≥ 2 nights for abnormal CT.

Data from Kuppermann N, Holmes JF, Dayan PS, et al. Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study. *Lancet*. 2009;374(9696):1160-1170.

Table 32-10 PECARN Head Injury Criteria for Imaging (with Risk of ciTBI)[1]

	CT recommended	Dependent on clinical factors	CT not recommended
Age < 2 years old	GCS = 14 or other signs of altered mental status, or palpable skull fracture (4.4%)	Occipital/parietal/temporal scalp hematoma, history of loss of consciousness more than 5 seconds, severe mechanism of injury, or not acting normally per parent Observation vs. CT dependent on: Physician experience Multiple or isolated findings Worsening symptoms or signs after ED observation Age < 3 months old Parental preference (0.9%)	Previously mentioned features not present (<0.02%)
Age < 2 years old	GCS = 14 or other signs of altered mental status, or signs of basilar skull fracture (4.3%)	History of loss of consciousness, history of vomiting, severe mechanism of injury, or severe headache Observation vs. CT dependent on: Physician experience Multiple or isolated findings Worsening symptoms or signs after ED observation Parental preference (0.8%)	Previously mentioned features not present (<0.05%)

[1]For use in patients with GCS (Glasgow Coma Scale) scores of 14–15 following head trauma; ciTBI—clinically important traumatic brain injury.

Data from Kuppermann N, Holmes JF, Dayan PS, Hoyle JD Jr, Atabaki SM, Holubkov R, Nadel FM, Monroe D, Stanley RM, Borgialli DA, Badawy MK, Schunk JE, Quayle KS, Mahajan P, Lichenstein R, Lillis KA, Tunik MG, Jacobs ES, Callahan JM, Gorelick MH, Glass TF, Lee LK, Bachman MC, Cooper A, Powell EC, Gerardi MJ, Melville KA, Muizelaar JP, Wisner DH, Zuspan SJ, Dean JM, Wootton-Gorges SL; Pediatric Emergency Care Applied Research Network (PECARN). Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study. *Lancet*. 2009;374(9696):1160-70. doi: 10.1016/S0140-6736(09)61558-0.

Recognize signs and symptoms of Increased ICP:.
-Vital sign changes: bradycardia, hypertension, abnormal respirations.
-Pupillary dilation.
-Extensor posturing.
-Temporary treatment.
-Hyperventilation titrated to reversal of pupillary dilation;.
-Mannitol (0.5–1 g/kg) over 10 minutes, or hypertonic saline 3%; 1–3 mL/kg, up to a maximum dose of 250 mL.
-Avoid hypoxia.
-Ensure hemodynamic stability.
source: Kochanek PM et al. Management of Pediatric Severe Traumatic Brain Injury: 2019 Consensus and Guidelines-Based Algorithm for First and Second Tier Therapies. Pediatr Crit Care Med. 2019;20(3):269.

Description

Table 32-11 Consensus Statement on Concussion in Sports—Fifth International Conference, Berlin 2016

Suspected diagnosis of sports-related concussion (SRC) can include one or more of the following clinical domains: 1. Symptoms: somatic (e.g., headache), cognitive (e.g., feeling like in a fog), and/or emotional symptoms (e.g., lability) 2. Physical signs (e.g., loss of consciousness, amnesia, neurological deficit) 3. Balance impairment (e.g., gait unsteadiness) 4. Behavioral changes (e.g., irritability) 5. Cognitive impairment (e.g., slowed reaction times) 6. Sleep/Wake disturbance (e.g., somnolence, drowsiness)	
Step 1	**Immediately** remove from play.
Step 2	**Neuroimaging** only if concerned regarding bleed or increased ICP Concussion is clinical diagnosis Consider possibility of C-spine injury. *Advanced neuroimaging, fluid biomarkers, and genetic testing are important research tools, but require further validation to determine their ultimate clinical utility in evaluation of SRC.*
Step 3	**Neurocognitive testing**—Prior *grading* systems have been abandoned in favor of individualized evaluation of each athlete. Standardized Sports Concussion Assessment Tool (SCAT5) or other sideline assessment tool. This evaluation tool includes a symptom score, physical sign score, GCS, balance assessment, coordination exam, and a cognitive assessment that are followed over time.

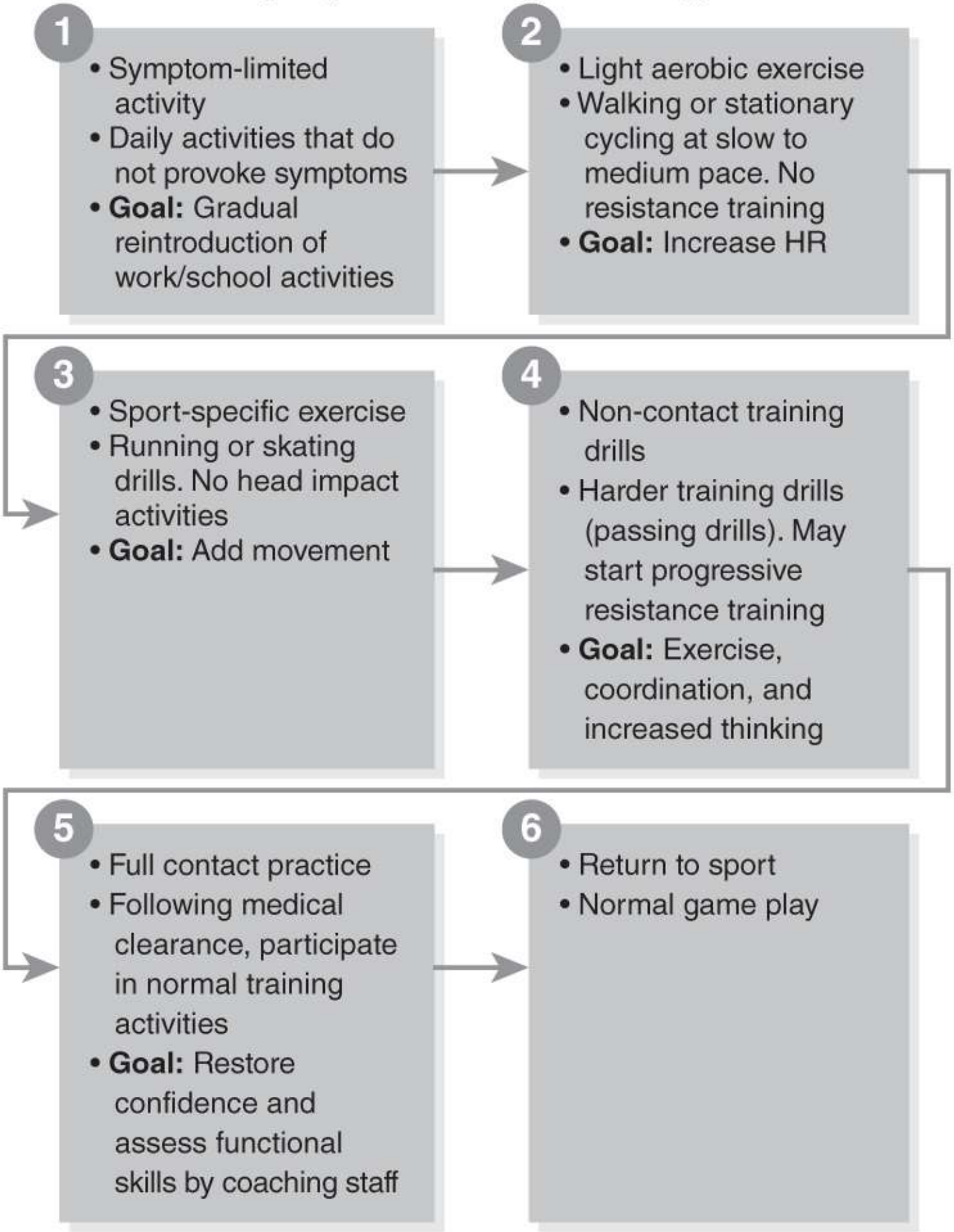
Step 4	**Observation**—The player should not be left alone after the injury, and serial monitoring for deterioration is essential over the initial few hours after injury. The patient should go to the hospital immediately if he or she experiences a new headache, drowsiness, the inability to recognize people or places, repeated vomiting, abnormal behavior (e.g., irritability), seizures, weakness, or sensory changes in arms or legs, unsteady gait, or speech changes. If concern regarding brain bleed, avoid NSAIDs and aspirin.
Step 5	**Return to play (RTP)**—See Table 32-13. Recommended that all athletes should have a clinical neurological assessment (including an evaluation of mental status/cognition, oculomotor function, gross sensorimotor, coordination, gait, vestibular function, and balance) as part of their overall management. Patients should spend at least 24 hours without any concussive symptoms or neurocognitive abnormalities at each RTP stage before progressing to the next step.

Description

Modified from McCrory P, Meeuwisse W, Dvorˇ ák J, et al. Consensus statement on concussion in sport—the 5th international conference on concussion in sport held in Berlin, October 2016. *Br J Sports Med*. 2017;51(11):838-847.

Concussion is defined as a disturbance in brain function from trauma with or without loss of consciousness (LOC). Suspect if any: symptoms (headache, feel like in fog, emotion labile), LOC, amnesia, behavior change, impaired cognition, or sleep problem.

Table 32-12 Return to Play (RTP) Guidelines for Sports Concussions[1]



[1]An initial period of 24–48 hours of both relative physical rest and cognitive rest is recommended before beginning the RTS progression.

There should be at least 24 hours for each step of the progression. If any symptoms worsen

during exercise, the athlete should go back to the previous step. Resistance training should be added only in the later stages (stage 3 or 4 at the earliest). If symptoms are more than 10–14 days in adults or more than 1 month in children, the athlete should be referred to a healthcare professional who is an expert in the management of concussion.

McCrory P, Meeuwisse W, Dvořák J3, Aubry M, Bailes J, Broglio S, Cantu RC, Cassidy D, Echemendia RJ, Castellani RJ, Davis GA, Ellenbogen R, Emery C, Engebretsen L, Feddermann-Demont N, Giza CC, Guskiewicz KM, Herring S, Iverson GL, Johnston KM, Kissick J, Kutcher J, Leddy JJ, Maddocks D, Makdissi M, Manley GT, McCrea M, Meehan WP, Nagahiro S, Patricios J, Putukian M, Schneider KJ, Sills A, Tator CH, Turner M, Vos PE. Consensus statement on concussion in sport-the 5th international conference on concussion in sport held in Berlin, October 2016. *Br J Sports Med*. 2017;51(11):838-847. doi: 10.1136/bjsports-2017-097699.

Description

Table 32-13 NEXUS Criteria for Cervical Spine Imaging in Pediatric Blunt Trauma[1]

NEXUS criteria	**Operator characteristics *(95% confidence interval)***	
Midline tenderness Impaired consciousness, poor history Neurologic deficit Distracting/Painful injury Intoxication	Sensitivity[1]	100% (89–100%)
	Specificity	20% (19–21%)
	Negative predictive value	100% (99–100%)
	Positive predictive value	1% (1–2%)

Description

[1]CT preferred if high risk, NEXUS C-spine (prospective) study included 3,065 children <18 years old (88 ≤2 years, 817 = 2–8 years, and 2,160 = 8–17 years). Other retrospective studies found that NEXUS criteria were only 43–94% sensitive in detecting significant pediatric C-spine injury with 100% sensitivity if >8 years old. NEXUS may not apply if ≤2–8 years old, or if underlying congenital/acquired spine instability.
Data from Viccellio P, Simon H, Pressman BD. A prospective multicenter study of cervical spine injury in children. *Pediatrics*. 2001;108:e20; Garton HJ, Hammer MR. Detection of pediatric cervical spine injury. *Neurosurgery*. 2008;62:700-708; Ehrlich PF, Wee C, Drongowski R, Rana AR. Canadian C-spine rule and the national emergency X-radiography utilization low-risk criteria for C-spine radiography in young trauma patients. *J Pediatr Surg*. 2009;44:987.

A—Atlantal dens interval—(*Predental space*) <5mm if <8 years, >8 years <3 mm.

B—Posterior cervical line, spino-laminar line of C2 should be within 2 mm anterior or posterior to line.

C—Prevertebral space ≤7 mm in front of C2 or < 1/3 width of C2 vert. body.

D—Limit of overriding of vertebral bodies is 2.5 mm.

E—Retrotracheal space should be <14 mm in front of C6 or < 5/4 of width of C5 in front of C5 (# are inexact)

F—Prevertebral fat stripe—should not bulge out.

X ÷ Y = Power's ratio

Normal value is 0.7–1.0

Value < 0.7 suggests anterior subluxation atlantooccipital (AA) joint.

Also, a line from the anterior margin of the foramen magnum to the tip of the odontoid should be <10–12 mm. If greater, atlanto-occipital dislocation may be present.

Wackenheim line—a line drawn along posterior clivus usually intersects tip of odontoid tangentially. If displaced, suspect atlantooccipital joint laxity. May be unreliable in young children.

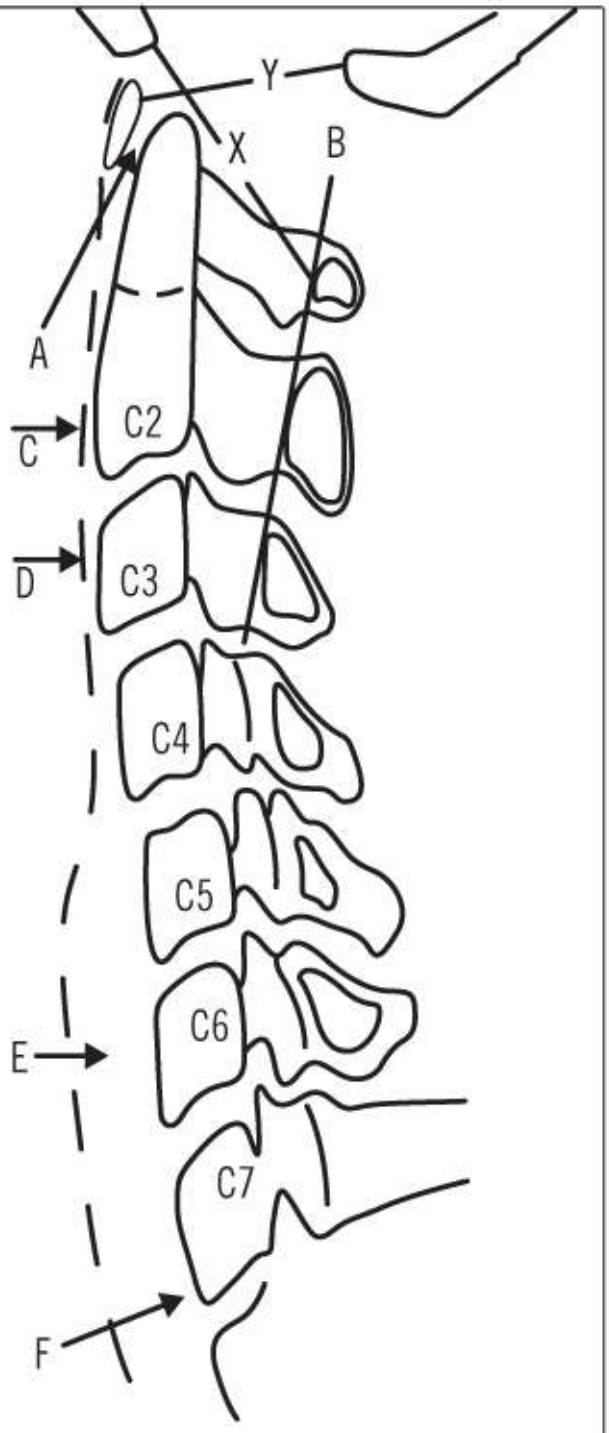


Figure 32-1 Normal Cervical Spine Spaces

Description

Table 32-14 Cervical Spine Anatomy in Children < 8 Years Old

Normal lordosis to cervical spine is absent in 14% of children.
Normal posterior angulation of odontoid seen in up to 4% of children.
Majority of injuries occur at C1–C2 ≤ 8 years old and lower cervical spine > 8 years.
Os odontoideum—Congenital anomaly where odontoid does not fuse with C2.[1]
Ossiculum terminale—A secondary center of ossification for odontoid tip, appears by age 3 (in 26% of children) and fuses with odontoid by 12 (may never fuse).

Prevertebral space at C3 is ≤ 1/3–2/3 of C3 vertebral body width or ≤ 5–7 mm.[2]Prevertebral space at C5 is ≤ 5/4 of (C5 or C6) vertebral body width or ≤ 14 mm.[2]Predental space up to 5 mm ≤ 8 years (up to 3 mm > 8 years).
Pseudo-Jeffersonian fracture-C1 lateral masses grow faster than C2 so C1 overlaps C2 (usually <6 mm). Present in 90% age 1–2, 18% aged 7 years.
Pseudosubluxation of C2/C3 or C3/C4 in 40% (normal variant where anterior aspect of C2 spinolaminar line is ≤ 2 mm anterior or posterior to posterior cervical line; see page 324).

Description

[1]Spine injury with minor trauma occurs. [2]These norms can be unreliable in children.

Table 32-15 Development of Cervical Spine

Age	Feature
<6 months	C1 ring invisible and all synchondroses are open, vertebrate are normally wedged anteriorly, and there is often no lordosis to the uninjured spine.
1 year	Body of C1 becomes visible radiographically.
3 years	Posteriorly located spinous process synchondroses fuse. Dens becomes ossified (visible radiographically).
3–6 years	Neurocentral (body) and C2-odontoid synchondroses fuse. Summit ossification center appears at the apex (top) of the odontoid. Anterior wedging of the vertebral bodies resolve (now is not normal if seen).
8 years	Pseudosubluxation and predental widening resolve, lordosis is normal now.
12–14 years	Secondary ossification centers appear at spinous process tips (mistaken for fractures), summit ossification center of odontoid fuses (if it does not, *os odontoideum* occurs), superior/inferior epiphyseal rings appear on the body.
25 years	Secondary ossification centers at tips of spinous processes fuse, superior/inferior epiphyseal rings fuse to the vertebral body.

Description

SPINAL CORD INJURY WITHOUT RADIOLOGIC ABNORMALITY

(SCIWORA)

SCIWORA accounts for 1/5 of all pediatric spinal cord injuries. Immediate plain films, CT are always normal, immediate MRI is normal in up to 50% with atrophy of spinal cord evident on MRI performed 1–3 months after the accident. Those with initial normal MRI almost always have 100% recovery. Delayed onset of neurologic deficit occurs in 54% (mean 1.2 days), with half of the delayed subset complaining of paresthesias at the time of the accident; 83% of cases involve the cervical cord, and 2/3 are 8 years old or younger; 44% have isolated sensory, 31% isolated motor, and 25% motor plus sensory deficits. For children with delayed paralysis, progression of weakness is rapid and usually causes complete cord lesion.

Sources: Kriss VM, Kriss TC. SCIWORA (spinal cord injury without radiographic abnormality) in infants and children. Clin Pediatr (Phila). 1996;35:119; Baker C, Kadish H, Schunk JE. Evaluation of pediatric cervical spine injuries. Am J Emerg Med. 1999;17:230; Grabb PA, Pang D. Magnetic resonance imaging in the evaluation of spinal cord injury without radiographic abnormality in children. Neurosurgery. 1994;35:406.

Table 32-16 Spinal Cord Injury Syndromes[1]

Anterior cord syndrome	Central cord syndrome
• Flexion or vertical compression injury to anterior cord or spinal artery • Complete motor paralysis • Hyperalgesia with preserved touch and proprioception (position sense) • Loss of pain and temperature sense • Most likely cord injury to require surgery	• Hyperextension injury • Motor weakness in hands > arms • Legs are unaffected or less affected • Variable bladder/sensory deficit • Prognosis is generally good and most do not require surgery
Complete cord injury	**Brown-Séquard syndrome**
• Flaccid below injury level • Absent deep tendon reflexes • Decreased sympathetics • Warm skin, low BP, and slow HR • Sensation may be preserved • Priapism may be present • If lasts > 24 hours, will be complete	• Hemisection of cord • Ipsilateral weakness • Ipsilateral loss of proprioception • Contralateral loss of pain and temperature sensation
	Posterior cord syndrome
	• Pain, tingling of neck and hands • 1/3 have upper extremity weakness • Mild form of central cord syndrome

Description

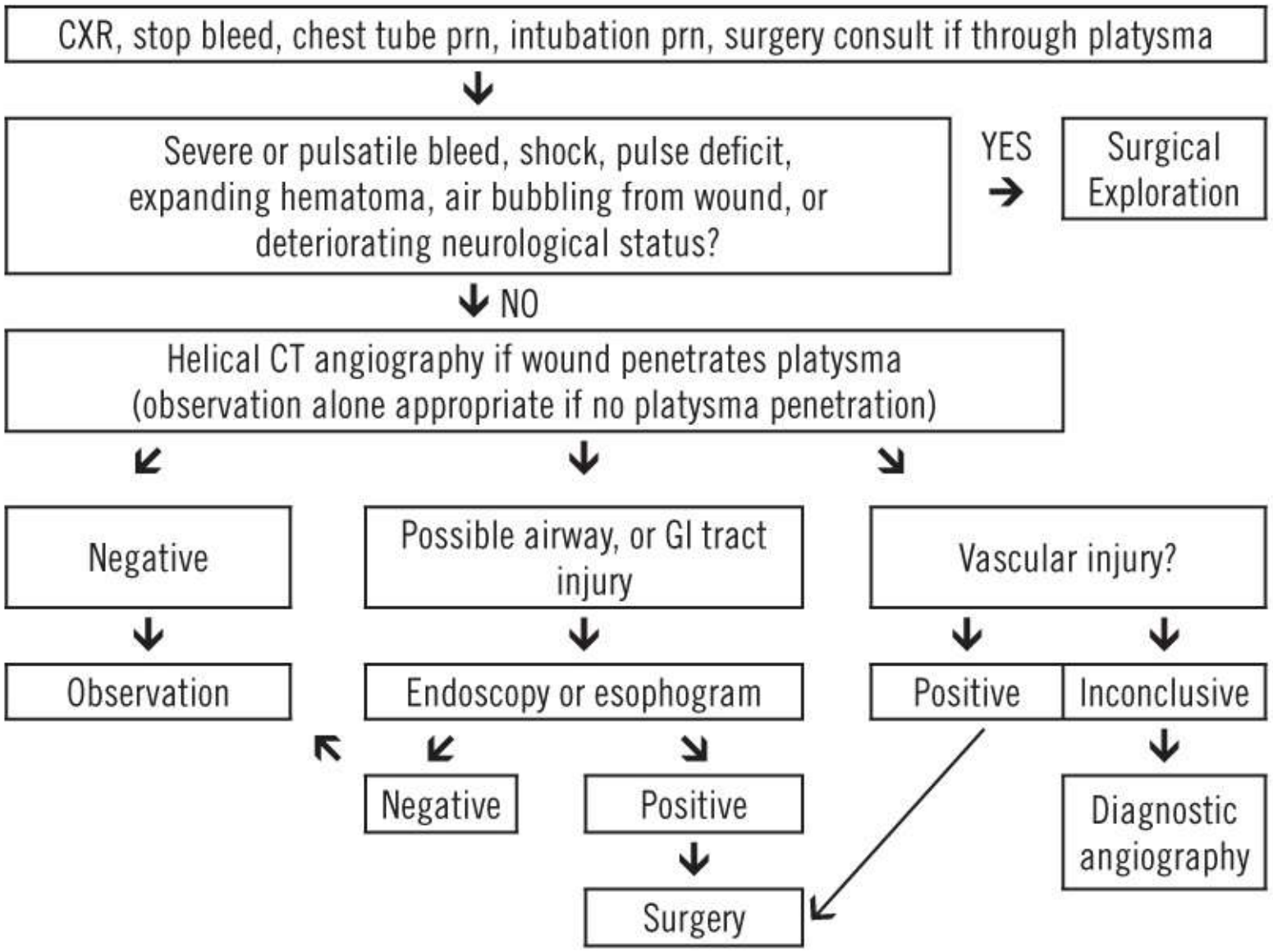
[1] Diffuse flexion withdrawal can occur in children with paralyzed limbs if stimulated.

STEROID PROTOCOL FOR TREATMENT OF ACUTE SPINAL CORD INJURY

According to the American Association of Neurological Surgeons and Congress of Neurological Surgeons and American Academy of Emergency Medicine, the use of steroids in acute spinal cord injury is not recommended.

Source: Hurlbert RJ, Hadley MN, Walters BC, et al. Pharmacological therapy for acute spinal cord injury. Neurosurgery. 2013;72 (Suppl 2):93-105.

Table 32-17 Management of the Penetrating Neck Injury



Modified from Múnera F, Cohn S, Rivas LA. Penetrating Injuries of the neck: use of helical computed tomographic angiography. *J Trauma*. 2005;58(2):413-418; Hogan AR, Lineen EB, Perez EA, Neville HL, Thompson WR, Sola JE. Value of computed tomographic angiography in neck and extremity pediatric vascular trauma. *J Pediatr Surg*. 2009;44(6):1236-1241.

Description

Table 32-18 Evaluation of Suspected Urethral Trauma

Retrograde urethrogram indications	Retrograde urethrogram technique
• Penile, perineal, vaginal, or scrotal trauma • Blood at urethral meatus or cannot void • Extravasation of blood/urine to scrotum, perineum, abdominal wall, or penile shaft • Abnormal prostate examination • Significant pelvic fracture • Inability to easily pass Foley catheter	• Obtain preinjection KUB film • Place Cooke adapter or Christmas tree adapter on end of 30–60 ml syringe (may substitute Foley) • Inject 0.2 ml/kg of contrast dye over 60 seconds • Take X-ray during last 10 seconds

Description

Table 32-19 Evaluation of Suspected Bladder Trauma

Cystogram indications	Cystogram technique
• Penetrating injury to low abdomen or pelvis • Blunt lower abdominal-perineal trauma with significant microscopic hematuria (> 20 RBC/hpf), gross blood, blood at meatus • Significant pelvic fracture • Unable to void or minimal urine after Foley	• After urethrogram, empty bladder • Instill contrast into bladder until 5 ml/kg or discomfort or bladder is full (see formula below for normal bladder volumes[1]) • Obtain oblique, and AP films of bladder, empty bladder then repeat films

Description

[1]*Bladder volume* if [< 1 year = weight (kg) × 10 ml]; if [≥ 1 year = (age in years + 2) × 30 ml].

Table 32-20 Estimated Urethral Catheter Size (French/Fr) Based on Age

Age (years)	1 day	3 months	1	3	6	8	10	12	Teen
Size (Fr)	5	8	8–10	10	10	10–12	12	12–14	16+

Description

Table 32-21 Independent Predictors of Intrathoracic Injury if Significant Pediatric Blunt Torso Trauma

Predictors	Predictive values[1] *(95% confidence interval)*	

• ↓ BP or ↑ resp rate • Chest wall tender • Abraded/Contused • Specificity • ↓ Breath sounds, or rales or rhonchi • Femur fracture • GCS < 15	Sensitivity	98% (91–100%)[2]
	Specificity	37% (34–40%)
	Negative predictive value	99% (98–100%)
	Positive predictive value	12% (10–15%)

Description

[1]Predictive value if any one of the identified predictors is present. [2]100% sensitive in predicting abnormality requiring therapy in this single study.
Data from Holmes JF, Sokolove PE, Brant WE, Kuppermann N. A clinical decision rule for identifying children with thoracic injuries after blunt torso trauma. *Ann Emerg Med*. 2002;39(5):492-499.

Table 32-22 Rib Fracture Etiology in Infants < 1 Year

Abuse	82%	Fragile bones[1]	8%
Nonintentional	8%	Birth trauma	3%

[1]Includes osteogenesis imperfecta, rickets, prematurity.

Description

Table 32-23 Chest Tube Sizes (French/Fr) for Hemothorax/Pneumothorax Based on Age

Age (years)	1 month	0.5	1	3	5–6	8	12	16
Size (Fr)	12–18	14–20	14–24	16–28	20–32	24–32	28–36	28–40

Modified from Schafermeyer R. Pediatric trauma. *Emerg Med Clin North Am*. 1993;11:187-205.

Description

33 ■ UROLOGY

Table 33-1 Clinical Features of Common Conditions Associated with Scrotal Pain in Children and Adolescents[1]

	Acute epididymitis	Testicular torsion	Torsion of appendage
History			
Duration of pain	> 24 hours	< 12 hours	> 12 hours
Dysuria/Pyuria	Common	Rare	
Nausea/Vomiting	Uncommon	Common	Uncommon
onset of pain	Gradual	Acute/Sudden	
Peak incidence	< 2 years old and postpubertal	Perinatal and puberty	Prepubertal
Previous episode	Unusual	Typical	Unusual
Trauma	Unusual	Occasional	Unusual
Imaging			
Blood flow on color Doppler ultrasound	Normal or increased	Decreased	Normal or increased
Physical examination			
Cremasteric reflex	Usually present	Usual absent	Usually present
Scrotal edema/ erythema	Common > 12 hours		
Suggestive findings	None	High-riding testicle in horizontal plane	Palpable nodule "blue-dot"
Tenderness	Epididymis, then diffuse	Testis, then diffuse	Appendage, then testis

[1]Adapted from Brenner J, Ojo A. Causes of scrotal pain in children and adolescents. UpToDate. https://www.uptodate.com/contents/causes-of-scrotal-pain-in-children-and-adolescents. Accessed June 2018.

Description

1. Testicular torsion
    - Testicular torsion results from inadequate fixation of the testis to the tunica vaginalis through the gubernaculum testis, leading to “bell clapper” deformity (testis resting in horizontal plane).
    - Testicular torsion is a clinical diagnosis and immediate urology consultation is imperative when suspected for surgical detorsion and fixation. Do not wait for the ultrasound to confirm the diagnosis.
    - Color Doppler ultrasound of the scrotum is the first-line imaging modality given its timely accessibility compared to the nuclear scan. It is generally indicated for cases with equivocal clinical findings. The reported sensitivity and specificity range from 69 to 100% and 77–100%, respectively.[1–7]
    - Consider manual detorsion prior to surgery if emergency operative care is not available in a timely manner. Use the “open book maneuver”—the external rotation of the testicle 360 degrees one to two times under appropriate sedation and analgesia.
2. Torsion of appendage
    - Torsion of appendix testis or appendix epididymis. The physical examination typically reveals a nontender testicle and a tender localized mass at the superior or inferior pole. A “blue dot” represents a gangrenous appendage seen through the scrotum.
    - Torsion of appendage is a clinical diagnosis. Color Doppler ultrasound is indicated for cases where testicular torsion cannot be excluded.
    - Supportive management with analgesics and scrotal support.
3. Acute epididymitis
    - Commonly occurs in sexually active late adolescents but also seen in prepubertal boys with anatomical/functional abnormalities in the urinary tract.
    - Perform urinalysis and urine culture. Consider further testing for sexually transmitted infections such as nucleic acid amplification for *Chlamydia trachomatis* and *Neisseria gonorrhea*.
    - Antibiotic treatment options vary depending on the etiology, if indicated. Refer to “epididymitis antibiotic recommendations” on page 148.
4. Other common conditions associated with scrotal pain in children and adolescents include:
    - Trauma
    - Incarcerated inguinal hernia
    - Orchitis (mumps, coxsackie, and parvovirus)
    - IgA vasculitis (Henoch-Schönlein purpura)

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APPENDIX

Table A-1 Commonly Used Oral Medications

			Age	2 months	4 months	6 months	9 months	12 months	15 months	2 years	3 years	5 years
			Weight (kg)	5	6.5	8	9	10	11	13	15	19
Medication	Strength (mg/5 ml)	mg/kg/dose	Frequency	ml per dose								
acetaminophen	160 mg/5 ml	15	every 6 hours	2.3	3	3.8	4.2	4.7	5.2	6.1	7	8.9
ibuprofen	100 mg/5 ml	10	every 6 hours	–	–	4	4.5	5	5.5	6.5	7.5	9.5
amoxicillin	125 mg/5 ml	25	bid	5	6.5	8	9	10	11	13	15	19
amoxicillin	250 mg/5 ml	25	bid	2.5	3.3	4	4.5	5	5.5	6.5	7.5	9.5
amoxicillin	400 mg/5 ml	45[1]	bid	2.8	3.7	4.5	5.1	5.6	6.2	7.3	8.4	10.7
amoxicillin/ clavulanic acid	200 mg/28.5 mg/5 ml	20 (amox)	bid	2.5	3.3	4	4.5	5	5.5	6.5	7.5	9.5
azithromycin[3,4]	100 mg/5 ml	5	daily	1.3[2]	1.6[2]	2	2.3	2.5	2.8	3.3	3.8	4.8
azithromycin[3,4]	200 mg/5 ml	5	daily	0.6[2]	0.8[2]	1	1.1	1.3	1.4	1.6	1.9	2.4
cefaclor[3]	125 mg/5 ml	20	bid	4	5.2	6.4	7.2	8	8.8	10.4	12	15.2
cefaclor[3]	250 mg/5 ml	20	bid	2	2.6	3.2	3.6	4	4.4	5.2	6	7.6
cefadroxil		15	bid	3	3.9	4.8	5.4	6	6.6	7.8	9	11.4
cefadroxil	250 mg/5 ml	15	bid	1.5	2	2.4	2.7	3	3.3	3.9	4.5	5.7
cefdinir	125 mg/5 ml	14	daily	2.8[2]	3.6[2]	4.5	5	5.6	6.2	7.3	8.4	10.6
cefixime[4]	100 mg/5 ml	8	daily	2	2.6	3.2	3.6	4	4.4	5.2	6	7.6
cefprozil	125 mg/5 ml	15	bid	3[2]	3.9[2]	4.8	5.4	6	6.6	7.8	9	11.4
cefprozil	250 mg/5 ml	15	bid	1.5[2]	2[2]	2.4	2.7	3	3.3	3.9	4.5	5.7
cephalexin	125 mg/5 ml	12.5	four times per day	2.5	3.3	4	4.5	5	5.5	6.5	7.5	9.5
cephalexin	250 mg/5 ml	12.5	four times per day	1.3	1.6	2	2.3	2.5	2.8	3.3	3.8	4.8
clindamycin	75 mg/5 ml	10	three times per day	3.3	4.3	5.3	6	6.7	7.3	8.7	10	12.7
penicillin V[5]	250 mg/5 ml	250 mg/dose	bid/three times per day	–	5	5	5	5	5	5	5	5
SMX/TMP(Bactrim)	200 mg SMX: 40 mg TMP/5 ml	5 (TMP)	bid	3.1	4.1	5	5.6	6.3	6.9	8.1	9.4	11.9
diphenhydramine	12.5 mg/5 ml	1.25	every 6 hours	2.5	3.3	4	4.5	5	5.5	6.5	7.5	9.5
cetirizine	5 mg/5 ml	2.5 mg/dose	daily	–	–	2.5	2.5	2.5	2.5	2.5	2.5	2.5
prednisolone	15 mg/5 ml	1	daily	1.7	2.2	2.7	3	3.3	3.7	4.3	5	6.3
prednisone	5 mg/5 ml	1	daily	5	6.5	8	9	10	11	13	15	19

[1]AAP recommends 80–90 mg/kg/day for otitis media in children. Augmentin used as ES only. [2]Dosing at this age/weight is NOT recommended by the manufacturer. [3]Dose shown is for otitis media only; see dose in text for alternative indications. [4]Give a double dose of drug

(azithromycin) for the first day. [5]AHA dosing for streptococcal pharyngitis. Treat for 10 days.

Description

Table A-2 Critical Drugs and IV Infusions[1]

adenosine	• 0.1 mg/kg IV *rapid* push (max dose 6 mg), second dose 0.2 mg/kg IV *rapid* push (max dose 12 mg).
amiodarone	• 5 mg/kg IV bolus if pulseless VT/VF (max dose 300 mg). Administer over 20–60 minutes if perfusing rhythm. May repeat to daily max of 15 mg/kg.
atropine	• 0.02 mg/kg IV (max dose 0.5 mg)[2].
diazepam	• 0.1–0.3 mg/kg IV (max dose 10 mg). 0.5 mg/kg PR (2–5 years old); 0.3 mg/kg PR (6–11 years old); 0.2 mg/kg (≥ 12 years old). Max PR dose 20 mg.
dobutamine	• 0.5–20 mcg/kg/minute IV infusion. Titrate to desired effect.
dopamine	• 2–20 mcg/kg/minute IV infusion. Titrate to desired effect.
enalaprilat	• 0.005–0.01 mg/kg IV (max dose 1.25 mg).
epinephrine	• Pulseless arrest: 0.01 mg/kg IV every 3–5 minutes (max single dose 1 mg). • Infusion: 0.1–1 mcg/kg/minute. • Anaphylaxis: 0.01 mg/kg IM every 15 minutes prn (max single dose 0.3 mg).
esmolol	• 100–500 mcg/kg IV bolus (optional), followed by infusion of 25–100 mcg/kg/minutes. Titrate infusion by 25–50 mcg/kg/minute every 5–10 minutes up to 500 mcg/kg/minute.
fosphenytoin[3]	• 15–20 mg PE/kg IV (preferred) or IM. Max infusion rate for loading dose: 150 mg PE/minute.
isoproterenol	• 0.05–1 mcg/kg/minute IV infusion. Titrate to desired effect.
labetalol	• 0.2–1 mg/kg IV bolus (max 40 mg). Infusion: 0.25–3 mg/kg/hour (initiate infusion at low end of dosing range & titrate slowly).
levetiracetam	• 20–60 mg/kg IV bolus (max 3,000–4,500 mg/dose).

lidocaine	• 1 mg/kg IV; infusion: 20–50 mcg/kg/minute.
lorazepam	• 0.05–0.1 mg/kg IV (max single dose 4 mg).
midazolam	• 0.05–0.2 mg/kg IV/IM (max 10 mg); 0.2 mg/kg intranasal (max 10 mg). Infusion: 0.03–0.12 mg/kg/hour. Titrate to desired effect.
milrinone	• 50 mcg/kg IV over 10–60 minutes (optional), followed by infusion of 0.25–0.75 mcg/kg/minute IV infusion.
nicardipine	• 0.5–5 mcg/kg/minute IV infusion.
nitroprusside	• 0.3–10 mcg/kg/minute IV infusion.
norepinephrine	• 0.05–2 mcg/kg/minute IV infusion.
pentobarbital	• 1–2 mg/kg IV bolus, followed by infusion of 0.5–1 mg/kg/hour[4]. Titrate slowly to desired effect.
phenobarbital	• 15–20 mg/kg IV (max dose 1,000 mg). Max infusion rate for loading dose: 1 mg/kg/minute, not to exceed 30 mg/minute.
phenylephrine	• 5–20 mcg/kg IV q 10–15 minutes. Infusion: 0.1–2 mcg/kg/minute.
procainamide	• 10–15 mg/kg (max 1,500 mg) IV over 30–60 minutes. Infusion: 20–80 mcg/kg/minute. Stop for hypotension or QRS widens by 50% of original width.
prostaglandin E_1 (alprostadil)	• 0.05–0.1 mcg/kg/minute IV infusion initially. Once therapeutic response is achieved, decrease rate to lowest effective dose. Usual dosing range: 0.01–0.4 mcg/kg/minute.

Description

[1]Details regarding indications, dosing, side effects, and contraindications are listed for resuscitation (Table 2-11), cardiovascular (pages 48–49), HTN (Table 16-2), seizures (Table 22-5). [2]Minimum dose of 0.1 mg is controversial and not recommended in patients < 5 kg due to reports of toxicity.[3] PE—phenytoin equivalents.[4] Higher loading dose (10–15 mg/kg) may be used to induce pentobarbital coma.

INDEX

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

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A table lists appearances of bruises over time.
The table shows the following information. First, bruises of any color, that is, red, blue, purple, yellow, green, and gray can occur at any time. Second, evidence for accurately dating bruises is lacking. Third, abuse should be suspected if injuries occur over non-bony prominences such as ears, neck, face, hands, back, buttocks, forearm, foot, and abdomen, especially in children less than 4 years, or if the mechanism does not fit the injury pattern.

Back to Table

A table lists bony injuries associated with child abuse.
There are two columns. Row 1: Fractures associated with a high or moderate specificity for abuse. Rib fractures especially posteromedial have highest probability of abuse, scapular fractures, sternal fractures; Metaphyseal-epiphyseal fractures for example, corner fractures or bucket-handle fractures, and metaphyseal lucency; Spinous process, vertebral body fractures and subluxations; Fractures in different stages of healing or delayed presentation; Fractures inconsistent with history or developmental age; Skull fractures, that is, if multiple, bilateral, or cross suture lines; Pelvic fractures, that is, rare or spine fractures without significant force; Femur fractures in nonambulatory patients; Midshaft humeral fractures less than or equal to 1 to 2 years old. Row 2: Fractures associated with a low specificity for abuse. Clavicle fractures due to birth, that is, infants less than 22 days, or infants less than 30 days with a healing fracture; Distal tibia spiral fractures or toddler’s fracture, unless nonambulatory; Supracondylar fractures, fractures of the hands or feet except digital fractures in nonambulatory infants or multiple fractures; Torus fractures of long bones.

Back to Table

A table lists appearances of fracture over time.
There are two columns: Age of fracture and fracture appearance. Row 1: 4 to 10 days; Resolution of soft tissue swelling. Row 2: 10 to 14 days; New periosteal bone. Row 3: 14 to 21 days; Fracture line definition lost and soft callus present. Row 4: 21 to 42 days; Hard callous present. Row 5: 2 to 24 months; Remodeling of fracture.

Back to Table

A table lists head injury associated with abuse.
The table shows the following information. First, subdural hematoma; Second, extra-axial hemorrhages especially interhemispheric, multiple bleeds, or in posterior fossa; Third, parenchymal brain injury, for example, contusion, axonal injury, or laceration; Fourth, retinal hemorrhage, that is, usually bilateral.

Back to Table

A table lists age-based estimates for vital signs and weight.
There are six columns: Age, Weight in kg, Heart rate superscript 1 BPM superscript asterisk, Respiratory rate per minute, Systolic BP superscript 2 millimeters of mercury, and Diastolic BP superscript 2 millimeters of mercury. Row entries are as follows. Row 1: Premature; 1; 145; approximately equal to 40; 42 plus minus 10; 21 plus minus 8. Row 2: Premature; 1 to 2; 145; approximately equal to 40; 40 plus minus 10; 28 plus minus 8. Row 3: New born; 2 to 3; 125; approximately equal to 40; 60 plus minus 10; 37 plus minus 8. Row 4: 1 month; 4; 120; 24 to 35; 80 plus minus 10; 46 plus minus 16. Row 5: 6 months; 7; 130; 24 to 35; 89 plus minus 29; 60 plus minus 10. Row 6: 1 year; 10; 120; 20 to 30; 96 plus minus 30; 66 plus minus 25. Row 7: 2 to 3 years; 12 to 14; 115; 20 to 30; 99 plus minus 25; 64 plus minus 25. Row 8: 4 to 5 years; 16 to 18; 100; 20 to 30; 99 plus minus 20; 65 plus minus 20. Row 9: 6

to 8 years; 20 to 26; 100; 12 to 25; 100 plus minus 15; 60 plus minus 10. Row 10: 10 to 12 years; 32 to 42; 75; 12 to 25; 110 plus minus 17; 60 plus minus 10. Row 11: greater than 14 years; greater than 50; 70; 12 to 18; 118 plus minus 20; 60 plus minus 10.

Back to Table

A table lists resuscitation equipment: first drug dose based on length, weight, or age superscript 1.
There are eight columns: Age, 3 months, 6 months, 1 year, 2 years, 3 years, 5 years, and 10 years. Row entries are as follows. Row 1: Length in centimeters; 50 to 58; 58 to 70; 70 to 85; 85 to 95; 95 to 107; 107 to 124; 138. Row 2: Weight in kilograms; 5 to 6; 7 to 8; 9 to 11; 12 to 14; 15 to 17; 18 to 24; 32. Row 3: Bag mask; Infant; Infant; Child; Child; Child; Child; Adult. Row 4: Oral airway; Infant; Infant; Child; Child; Child; Child; Sm superscript 2 adult. Row 5: LMA; 1; 1; 2; 2; 2; 2.5; 3. Row 6: O2 mask; New born; New born; Peds; Peds; Peds; Adult; Adult. Row 7: ET tube superscript 3; 3 to 3.5; 3.5 to 4; 3.5 to 4; 4 to 4.5; 4.5; 5; 6 to 6.5. Row 8: Laryngoscope; 1 Miller; 1 Miller; 1 Miller; 2 Miller; 2 superscript 4; 2 superscript 4; 2 to 3 superscript 4. Row 9: Suction catheter; 8F; 8F; 8 to 10F; 10F; 10F; 10F; 10F. Row 10: NG tube; 5 to 8F; 5 to 8F; 8 to 10F; 10F; 10 to 12F; 12 to 14F; 16 to 18F. Row 11: Urine catheter; 5 to 8F; 5 to 8F; 8 to 10F; 10F; 10 to 12F; 10 to 12F; 12 to 14F.

Back to Table

A table lists CPR maneuvers and techniques in new-borns, infants, and children.
There are four columns: Maneuver, newly born or neonate, infant that is, less than 1 year, and child, that is, 1 to 8 years. Row entries

are as follows. Row 1: Open Airway; Head tilt, chin lift or jaw lift without head tilt if trauma in all ages. Row 2: Breathing, that is, initial; May require 30 to 40 centimeters H2O pressure; Two breaths to make chest rise; Two breaths to make chest rise. Row 3: Subsequent, that is, if no CPR; 30 to 60 breaths per minute; 12 to 20 breaths per minute; 12 to 20 breaths per minute. Row 4: Subsequent, that is, during CPR; 30 to 60 breaths per minute; 8 to 10 breaths per minute; 8 to 10 breaths per minute. Row 5: Circulation superscript 1, that is, Check pulse; Umbilical or brachial; Brachial or femoral; Carotid. Row 6: Compress at; Lower one-third sternum; Lower one-third sternum; Lower one-third sternum. Row 7: Compress with; Two thumbs encircle chest with hands; Two thumbs encircle chest with hands; Heel of one hand. Row 8: Depth; One-third depth of chest for all listed ages. Row 9: Rate superscript 2; 120 per minute; 100 to 120 per minute; 100 to 120 per minute. Row 10: Ratio superscript 3, 4; 3 in ratio to 1, that is, interpose breaths; 15 in ratio to 2; 15 in ratio to 2. Row 11: Foreign Body Airway Obstruction superscript 5; Back blows, and chest thrusts; Back blows, and chest thrusts; Chest thrust, back blows, or abdominal thrusts.

Back to Table

A flowchart depicting newly born resuscitation.
After birth, we need to see the term gestation or delivery, superscript 1, breathing or crying, and is muscle tone good? If yes to all, then provide warmth or maintain normal temperature, routine care, dry patient, clear airway, and ongoing evaluation. If the answer is no, provide warmth, position or clear airway and dry, stimulate, reposition and provide O2 as needed, superscript 2. Now, evaluate respirations, HR, and color. If breathing, pink and HR is greater than 100, then provide support care. If breathing, HR is greater than 100, but cyanotic, then consider oxygen which would lead to

pink and hence further provide support care. If there is persistent cyanosis, and labored breathing or if there is apnea and HR greater than 100, then there should be positive pressure ventilation, superscript 3, consider CPAP, and SpO2 and ECG monitoring. If HR is greater than 100, ventilating, and pink, then provide ongoing care. If HR is less than 60, provide positive pressure ventilation, superscript 3, and chest compressions. If HR is still less than 60, administer epinephrine via umbilical vein, peripheral venous line, trachea, or IO. Recommended dose is 0.01 to 0.03 milligram per kilograms, that is, 0.1 to 0.3 milliliters per kilograms of 1 in ratio to 10,000; higher for endotracheal 0.05 to 0.1 milligrams per kilograms q 3 to 5 minute. Lastly, discontinuation of resuscitation may be justified if there are no signs of life after 10 minutes of continuous and adequate resuscitation. But if after administering epinephrine via umbilical vein, peripheral venous line, trachea, or IO, the HR becomes greater than 60, then positive pressure ventilation and chest compressions need to be given. If further HR is above 60, then provide positive pressure ventilation superscript 3, consider CPAP, and SpO2 and ECG monitoring. Lastly, when HR is greater than 100, ventilating, and pink, provide ongoing care.

Back to Table

A table lists newly born resuscitation—withholding or discontinuing superscript 1.
The table shows the following information. Row entries are as follows. Row 1: Withhold resuscitation, that is, do not begin; Death is certain based on weight, that is, less than 400 grams, age less than 22 weeks, or congenital anomaly incompatible with life, for example, anencephaly, trisomy 13 or 18. If condition with uncertain prognosis, that is, 22 to 24 weeks, survival borderline, high morbidity, and anticipated burden to child is high, then follow parent’s wishes. Resuscitation is nearly always indicated if high

survival and acceptable morbidity, for example, greater than or equal to 24 weeks and most congenital malformations. Row 2: Discontinue or stop resuscitation; If no signs of life, that is, no heart rate or respirations after 10 minutes of continuous and adequate resuscitation.

Back to Table

A table lists size of endotracheal tube or laryngoscope blade for newly born.
There are four columns: Gestational age, Birth weight in grams, Size of ET tube superscript 1 and 2, and blade size superscript 3. Row entries are as follows. Row 1: less than 28 weeks; less than 1,000; 2.5; Number 0 straight. Row 2: 28 to 34 weeks; 1,000 to 2,000; 2.5 to 3.0; Number 0 straight. Row 3: 34 to 38 weeks; 2,000 to 3,000; 3.0 to 3.5; Number 0 straight. Row 4: greater than 38 weeks; Term, that is, greater than 3,000; 3.5; Number 0 to 1 straight.

Back to Table

A table lists normal blood pressure for different birth weights.
There are five columns: Weight, less than 1 kilogram, 1 to 2 kilograms, 2 to 3 kilograms, and greater than 3 kilograms. Row entries are as follows. Row 1: Systolic BP; 40 to 60; 50 to 60; 50 to 70; 50 to 80. Row 2: Diastolic BP; 15 to 35; 20 to 40; 25 to 45; 30 to 50.

Back to Table

A table lists Apgar Scoring superscript 1.
There are four columns: Sign, 0, 1, and 2. Row entries are as follows. Row 1: Heart rate; Absent; less than 100; greater than 100.

Row 2: Respiratory effort; Absent; Slow or irregular; Good, cry. Row 3: Muscle tone; Flaccid; Some extremity flexion; Active motion. Row 4: Reflex irritability; No response; Grimace; Vigorous cry. Row 5: Color; Pale; Cyanotic, Completely pink.

Back to Table

A table lists normal arterial blood or hematocrit or Hct values in full-term newly born superscript 1.
There are six columns: Age, PaO2, PaCO2, pH, Base excess, and Hct in volume percentage. Row entries are as follows. Row 1: 1 hour; 63 millimeters of mercury; 36 millimeters of mercury; 7.33; minus 6.0 milliequivalent per liter; 53. Row 2: 24 hours; 73 millimeters of mercury; 33 millimeters of mercury; 7.37; minus 5.0 milliequivalent per liter; 55.

Back to Table

A table lists management of the critically ill neonate, that is, less than or equal to 28 days old.
The table lists the following information under perform initial resuscitation. Check O2 saturation, administer 100 percent O2, ventilate or intubate if needed. Apply cardiac monitor; assess heart rate, rhythm, perfusion, blood pressure; and examine. Obtain IV or IO access and administer NS, that is, 10 milliliters per kilograms in new born, 20 milliliters per kilograms if older, if hypoperfusion, for example, low blood pressure, altered mentation, poor skin signs unless congestive heart failure present, that is, see Congestive Heart Failure, which follows. Check glucose, administer D10, that is, 5 to 10 milliliters per kilograms, if less than 30 to 40 milligrams per deciliter new born, less than 50 milligrams per deciliter in infant. Labs, that is, cultures, CBC, electrolytes, UA, ECG, CXR, and other tests, for example, ultrasound, CT as indicated.

Back to Table

A table lists central venous catheter diameter based on age and site, that is, int. diameter-French.
There are five columns: Age in years, Weight in kilograms, Internal jugular vein, Subclavian vein, and Femoral vein. Row entries are as follows. Row 1: 0 to 0.5; 3 to 7; 3F; 3F; 3F. Row 2: 0.5 to 2; 7 to 15; 3F; 3F; 3 to 4F. Row 3: 3 to 6; 15 to 25; 4F; 4F; 4 to 5F. Row 4: 7 to 12; 25 to 60; 4 to 5F; 4 to 5F; 5 to 8F.

Back to Table

A table lists right internal jugular and right subclavian or SC central venous catheter depth in centimeters superscript 1, 2.
The table shows the following information. Initial catheter insertion based on patient height or length; if height is less than 100 centimeters, then initial catheter depth is equal to height in centimeters upon 10 minus 1 centimeter. If height is greater than or equal to 100 centimeters, initial catheter depth is equal to height in centimeters upon 10 minus 2 centimeters. Initial catheter insertion based on patient weight, that is, note: chart and formula are based on patient’s weight when known, and age is only approximated based on patient’s weight. There are three columns: Approximate age, Weight in kilograms, and Length or Depth in centimeters. Row entries are as follows. Row 1: 0 to 2 months; 3.0 to 4.9; 5. Row 2: greater than 2 to 5 months; 5.0 to 6.9 6. Row 3: 6 to 11 months; 7.0 to 9.9; 7. Row 4: 1 to 2 years; 10.0 to 12.9; 8. Row 5: greater than 2 to 6 years; 13.0 to 19.9; 9. Row 6: greater than 6 to 9 years; 20.0 to 29.9; 10. Row 7: greater than 9 to 12 years; 30.0 to 39.9; 11. Row 8: 12 to 14 years; 40 to 50; 12.

Back to Table

A table lists femoral vein catheter mean length or insertion depth. There are four columns: Age, Weight in kilograms, Height in centimeters, and Length in centimeters. Row entries are as follows. Row 1: 1 month; 4.2; 55; 15.7. Row 2: 3 months; 5.8; 61; 17.3. Row 3: 6 months; 7.8; 68; 19.1. Row 4: 9 months; 9.2; 72; 20.1. Row 5: 1 year; 10.2; 76; 21.1. Row 6: 1.5 years; 11.5; 83; 22.9. Row 7: 2 years; 12.8; 88; 24.2. Row 8: 4 years; 16.5; 103; 28.1. Row 9: 6 years; 20.5; 116; 31.4. Row 10: 8 years; 26; 127; 34.2. Row 11: 10 years; 31; 137; 36.8. Row 12: 12 years; 39; 149; 39.9. The steps involved are as follows. Symptomatic with seizure, ataxia coma, etc.; No, ICU if less than 125; If euvolemic or overload, restrict 1 over 3 to 2 over 3 maintenance. Only use 0.9 NS; If dehydrated; 130 to 135: IV or oral; less than 130: 0.9 NS at maintenance; If yes; Rx with 3 percentage sodium chloride, 3 to 5 milliliter per kilogram over 15 to 30 minutes. Administer until seizure stops or sodium greater than 120 1 milliliter per kilogram of 3 percentage by 1 milliequivalent per liter.

Back to Table

A table lists the Endotracheal Tube Size and Depth, and Laryngoscope Size based on age and weight in kilograms. There are five columns: Age, Laryngoscope superscript 1, Weight in kilograms, ET size, and ET depth superscript 2. Row entries are as follows. Row 1: Premature; Straight 0; 1.5; 2.5 to 3.0; 8. Row 2: Term; Straight 0 to 1; 3.0; 3.0 to 3.5; 9. Row 3: 3 months; Straight 1; 5 to 6; 3.5; 9 to 10. Row 4: 6 months; Straight 1; 7 to 8; 3.5 to 4.0; 10. Row 5: 1 year; Straight 1; 10; 4.0 to 4.5; 11. Row 6: 2 years; Straight 1; 12; 4.0 to 4.5; 12 to 13. Row 7: 3 years; Miller or Macintosh 2; 14; 5.0; 15. Row 8: 4 years; Miller or Macintosh 2; 16; 5.5; 16.5. Row 9: 5 years; Miller or Macintosh 2; 18; 5.5; 16.5. Row 10: 6 to 7 years; Miller or Macintosh 2; 20 to 22; 6.0; 18. Row 11: 8 to 10 years; Miller or Macintosh 2; 25 to 30; 6.0 to 6.5; 18 to 18.5.

Row 12: 10 to 12 years; Miller or Macintosh 2; 30 to 35; 6.5; 18.5.
Row 13: 12 to 14 years; Miller or Macintosh 3; 35 to 40; 7.0; 21.

Back to Table

A table lists the GlideScope video laryngoscope, GVL, sizes, www.verathon.com.
There are three columns: Age, approximate, Weight, GVL size superscript 1, 2. Row entries are as follows. Row 1: Premature to neonate; less than 3.6 kilograms; GVL 1. Row 2: New born to 1 year; 1.8 to 10 kilograms; GVL 2. Row 3: 1–18 years 10 kilograms to adult GVL 3. Row 4: 12 years to adult; 40 kilograms to obese; GVL 4. Row 5: 12 years to adult; 40 kilograms to obese; GVL 5.

Back to Table

A table lists the Steps for Rapid Sequence Intubation, RSI. Equipment: Ready two-wall suction devices with Yankauer tips; check laryngoscope lights. Appropriate-size ET tube and backup 0.5 to 1 size smaller; consider stylet. Check integrity of cuff, if present, use no cuff or low-pressure cuff for those younger than 8 years. Patient Preparation and Medications: Raise bed, for example, patient’s nose at intubator’s xiphoid, prepare alternate airway: jet ventilation, cricothyrotomy, for older than 8 years, estimate weight, for example, Broselow-Luten tape. Confirm working pulse oximeter, cardiac monitor, and end-tidal CO2 detector. Specify person for (1) cricoid pressure, uncertain benefit, may obstruct airway, (2) neck immobilization, (3) handling ET tube, (4) watching O2 saturation and cardiac monitors, and (5) medications. Position head appropriately, sniffing position if no trauma. Draw up all drugs in syringes and ensure secure IV access is available. Preoxygenate with 100 percent oxygen for at least 3 to 4 minutes, if time permits. Consider lidocaine 1 to 1.5 milligrams

per kilogram, max 100 milligrams IV if head injury, however, no clear evidence that in acute traumatic injury pretreatment with lidocaine before RSI reduces ICP. Atropine 0.01 milligrams per kilogram IV, no minimum dose but max dose is 0.5 milligrams, use if neonate, preexisting bradycardia, or in those who receive a second dose of succinylcholine, current PALS recommendations do not include routine use and do not require a minimum dose. Most experts do not routinely use atropine as a defasciculating agent. Administer sedating and then paralyzing agent IV; apply Sellick maneuver.

Back to Table

A table lists the Drugs for Rapid Sequence Intubation.
There are three columns: Age, approximate, Weight, GVL size superscript 1, 2. Row entries are as follows. Row 1: Defasciculating drug—for use if using succinylcholine as paralytic; no data; no data; Not recommended in children by most experts, especially younger than 5 years. Row 2: Rocuronium; 0.06 to 0.1; 2 to 3; no data. Row 3: Vecuronium; 0.01; 3; Minimal tachycardia. Sedating drug: Row 4: Etomidate; 0.3 to 0.4; less than 1; Minimal blood pressure effect. Row 5: Fentanyl; 2 to 6 mcg per kilogram; 1 to 2; upwards facing arrow ICP, chest wall rigidity. Row 6: Ketamine; 1 to 2; less than 1; upwards facing arrow BP, upwards facing arrow ICP, upwards facing arrow GI, and eye pressure. Row 7: Midazolam; 0.1 to 0.2; 1 to 3; Hypotension. Row 8: Thiopental; 3 to 5; less than 1; Hypotension, bronchospasm. Paralyzing drug: Row 9: Rocuronium superscript 1,2; 0.6 to 1.2; 0.5 to 1.5; Esmeron, rapid onset, lasts 25 to 60 minute. Succinylcholine superscript 3; 1 to 2; less than 1; Fasciculation upwards facing arrow BP, ICP, GI, eye pressures, malignant hyperthermia, hyperkalemia. Row 10: Vecuronium superscript 2; 0.1 to 0.2, 1 to 4; Prolonged action. Reversal drug, if nondepolarizing agent used. Row 11: Sugammadex super script

asterisk, Bridion; 16 milligrams per kilogram for neuromuscular blockade due to a single dose of rocuronium 2 to 4 milligram per kilogram, routine reversal dose; 3 minute; Only for use in older than 2 years; can cause anaphylaxis, bradycardia.

Back to Table

A table lists the Checklist After Performing Intubation.
Check tube placement, CO2 detector or capnography preferred. Inflate cuff, if present then release cricoid pressure. Measure and record tube depth, see below. Reassess clinical status, downward facing arrow HR equals esophageal intubation. Obtain CXR to verify correct placement depth. Consider longer-acting sedative and paralytics.

Back to Table

A table lists the Formulae for Estimating Depth of ET Tube After Intubation.
Distance in centimeter from mid-trachea to incisors or gum line equals 3 times ET tube ID. Distance in centimeter from mid-trachea to incisors or gum line equals 12 plus age in years divided by 2. Distance in centimeter from mid-trachea to incisors or gum line equals height in centimeter divided by 10 plus 5. Distance in centimeter from mid-trachea to nares, for nasotracheal equals 12 plus age in years divided by 2.

Back to Table

A table lists the Laryngeal Mask Airway, LMA Sizes.
There are four columns: Mask size, Patient weight in kilograms, Maximum cuff volume in milliliters; Maximum ET tube size in millimeter uncuffed. Row entries are as follows. Row 1: 1; less than

5; less than or equal to 4; 3.5. Row 2: 1.5; 5 to 10; less than or equal to 7; 4. Row 3: 2; 10 to 20; less than or equal to 10; 4.5. Row 4: 2.5 20 to 30; less than or equal to 14; 5. Row 5: 3; 30 to 50; less than or equal to 20; 6. Row 6: 4; 50 to 70; less than or equal to 30; 6. Row 7: 5; 70 to 100; less than or equal to 40; 7. Row 8: 6; more than 100; less than or equal to 50; 7.

Back to Table

A table lists the Tracheostomy Tube Replacement Sizes for different age groups.
There are four columns: Age, Size, Inner diameter in millimeter, Outer diameter in millimeter, Suction catheter size, French. The row entries are as follows. Row 1: Premature; 00; 3.1; 4.5; 6. Row 2: New born to 3 months; 0; 3.4; 5.0; 6, 8. Row 3: 3 to 10 months; 1; 3.7; 5.5; 6, 8. Row 4: 10 to 12 months; 2; 4.1; 6.0; 6, 8. Row 5: 13 to 24 months; 3; 4.8; 7.0; 8, 10. Row 6: 2 to 9 years; 4; 5.0; 8.5; 8, 10. Row 7: 10 to 11 years; 6; 7.0; 10.0; 12, 14. Row 8: More than or equal to 12 years; 6; 7.0; 10.0; 12, 14. Row 9: More than or equal to 12 years; 8; 8.5; 12.0; 14, 16. Row 10: More than or equal to 12 years; 10; 9.0; 13.0; 16, 18.

Back to Table

A table lists the Parameters for Transtracheal Jet Ventilation.
There are three columns: Age in years, Initial PSI, and Tidal volume in milliliter. The row entries are as follows, Row 1: less than 5; 5; 100. Row 2: 5 to 8; 5 to 10; 240–340. Row 3: 8 to 12; 10 to 25; 340 to 625. Row 4: More than 12; 30 to 50; 700 to 1,000.

Back to Table

A table lists the Initial Ventilator Settings for Volume Limited

Ventilators.
There are five columns: Age in years, Tidal volume in milliliters per kilogram, Rate superscript 1, Inspiratory time superscript 2, and PEEP superscript 3. The row entries are as follows, Row 1: 0 to 1; 8 to 10; 20; 0.8; 3 to 5. Row 2: 1 to 3; 10; 16; 0.9; 3 to 5. Row 3: 4 to 10; 8; 12; 1; 3 to 5. Row 4: more than or equal to 11 to 12; 6 to 8; 10; 1; 3 to 5.

Back to Table

A table lists the Guidelines for Mechanical Ventilation.
There are three columns: Item, Neonates and young infants, younger than 1 year superscript 1, and Older children. The row entries are as follows, Row 1: Ventilator; Pressure-limited if weight less than 10 kilograms; Volume limited. Row 2: Resp rate; 30 to 40 per minute; Normal for age 12 to 20. Row 3: I is to E ratio superscript 2; 1 is to 2; 1 is to 2. Row 4: PEEP superscript 3; Start at 3 to 5 centimeter H2O; Start at 3 to 5 centimeter H2O. Row 5: PSV Initial pressure support ventilation, PSV 10 centimeter H2O, may upward facing arrow to 35 centimeter. Row 6: FiO subscript 2; 5 to 10 percent above preintubation FiO2, adjust to oxygen saturation. Row 7: Setting; Begin peak inspiratory pressure at 16 mm Hg, upward facing arrow 2 mm Hg until adequate excursion; Tidal volume 5 to 8.

Back to Table

A table lists the Maximum Dose of Local Anesthetics Without and With Epinephrine.
The row entries are as follows, Row 1: Bupivacaine, Marcaine, Sensorcaine superscript 1; 2.5 milligram per kilogram, 3 milligram per kilogram. Row 2: Lidocaine, Xylocaine superscript 2; 5 milligram per kilogram, 7 milligram per kilogram. Row 3:

Mepivacaine, Carbocaine, 4 milligram per kilogram, 7 milligram per kilogram. Row 4: Prilocaine, never use for younger than 6 months old; 5.5 milligram per kilogram, 8.5 milligram per kilogram.

Back to Table

A table lists the Oral Analgesic Agents, Liquid Preparations. The column entries are as follows: Agent, Dose milligram per kilogram, Frequency, and Concentration and comments. The row entries are as follows, Row 1: Acetaminophen; 15; q 4 hours; 80 milligrams per 0.8 milliliter, dropper or 160 milligrams per 5 milliliter. Row 2: Acetaminophen with codeine; 0.5 to 1; q 4 to 6 hours; Acetaminophen 120 mg plus codeine 12 milligrams per 5 milliliter, dose in milligram per kilogram based on codeine. Row 3: Aspirin; 10 to 15; q 4 hours; No elixir available. Row 4: Hydrocodone; 0.1 to 0.2; q 4 to 6 hours; Hycet elixir, 2.5 milligram hydrocodone per 108 milligrams Tylenol per 5 milliliter also contains 7 percent alcohol. Lortab elixir, 2.5 milligram hydrocodone per 167 milligram Tylenol per 5 milliliter also contains 7 percent alcohol. Row 5: Ibuprofen, suspension; 5 to 10; q 6 to 8 hours; Children’s Motrin or Advil: 100 milligrams per 5 milliliter. Row 6: Oxycodone; 0.05 to 0.2; q 4 to 6 hours; 5 milligram per 5 ml solution and 20 milligram per milliliter concentrate—exercise caution because the presence of two preparations and a high concentration increases dosing error risk. Max dose 10 milligrams. Row 7: Naproxen suspension; 5–7; q 8 to 12 hours; 125 milligrams per 5 milliliters.

Back to Table

A table lists the Uses, Agents, and Onset of Topical Analgesia. The column entries are: Use, Agent, and Onset in minutes. The row entries are as follows, Row 1: Un-intact skin; LET- lidocaine 4 percent, epinephrine 0.1 percent, tetracaine 0.5 percent—apply

with cotton ball, not gauze. Use 1 to 3 milliliter, 1 milliliter per centimeter to maximum 3 milliliter. 90 to 95 percent effective on face or scalp, 50 percent on limbs or torso; 20 to 30. Row 2: Un-intact skin; EMLA- 2.5 percent prilocaine, 2.5 percent lidocaine) may be used on un-intact skin if LET unavailable, less effective on un-intact skin. Use less than or equal to 1 gram per 10 centimeter square; 45 to 60. Row 2: Intact skin; EMLA, See un-intact skin above; 45 to 60. Intact skin; LMX4 or 5, 4 to 5 percent liposomal lidocaine formerly ELA-Max–use less than or equal to 1 gram per 10 centimeter square; 30. Intact skin; Synera–lido or tetracaine, apply patch to vascular access site or needle stick, only if older than 3 years; 20 to 30. Intact skin; Topicaine 4 to 5 percent lidocaine gel– apply, 0.3 to 0.4 g per 10 centimeter square; 30 to 60. Row 3: Needle-free injection, pre-IV; J-tip: Buffered lidocaine, 0.25 milliliter of 1 percent buffered lidocaine or alternate dosing, via compressed CO2; 3. Needle-free injection, pre-IV; Zingo: 0.5 milligram lidocaine delivered via helium-powered device; 3. Row 4: Iontophoresis; 1 milliliter of lidocaine 2 percent with 1 is to 100,000 epinephrine added to drug electrode. Apply 1 milliampere, mA to site and slowly increase until tingling sensation gone to a total dose of 30 mA. Place ground electrode onto major muscle of child or parent; 10 to 15.

Back to Table

A table lists the Analgesia and Sedation details.
The column entries are as follows: Agent Trade name, Dose, Route, and Onset in minute, Duration in hours, and Comments and select properties. The row entries are as follows, Row 1: Diazepam Valium; Sedative: Younger than 6 months: not recommended; no data; less than 1; 1 to 2; downward facing arrow respirations. Diazepam Valium; 6 months to 6 years: less than 0.5 milligram per kilogram; PO; no data; no data; no data. Diazepam Valium; Older

than 12 years: 0.12 to 0.8 milligram per kilogram; IV or IM; no data; no data; no data. Or 0.04 to 0.20 milligram per kilogram; PR; no data; no data; no data. Diazepam Valium; Status epilepticus: 0.2 to 0.5 milligram per kilogram OR 6 months to 5 years: 0.2 to 0.5 milligram per kilogram; Older than 5 years: 1 milligram; IV; no data; no data; no data. Row 2: Etomidate Amidate; 0.1 to 0.4 milligram per kilogram; IV; less than 1; less than 0.25; Administer over 1 minute, causes myoclonus, vomiting. Row 3: Fentanyl Sublimaze; 1 to 3 mcg per kilogram 1 to 1.5 mcg per kilogram; IV Intranasal, use with atomizer; 2 to 3; 0.5; downward facing arrow, Respirations, downward facing arrow, BP, bradycardia, rare chest wall rigidity, due to rapid administration. Row 4: Flumazenil Romazicon; 0.01 milligram per kilogram, maximum dose of 0.05 milligram per kilogram up to max of 1 milligram; IV; less than 1; 1; Reverses benzodiazepines, for example, lorazepam, midazolam, diazepam. Row 5: Ketamine Ketalar; 1 to 2 milligram per kilogram; IV; less than 1; 0.25; Elevated BP, upward facing arrow intracranial or ocular pressure, rare laryngospasm. Ketamine Ketalar; 4 milligram per kilogram; IM; 5; 0.5 to 1; Elevated BP, upward facing arrow intracranial or ocular pressure, rare laryngospasm. Ketamine Ketalar; 5 to 10 milligram per kilogram; PO; 30; 1 to 2; Elevated BP, upward facing arrow intracranial or ocular pressure, rare laryngospasm. Row 5: Methohexital; 20 mg; PR; 15; 0.5; downward facing arrow Respirations, downward facing arrow BP. Row 6: Midazolam Versed; 0.10 milligram per kilogram; IV; 2; 0.5; downward facing arrow Respirations. Midazolam Versed; 0.10 to 0.15 milligram per kilogram; IM; 10 to 15; 0.75; downward facing arrow BP. Midazolam Versed; 0.2 to 0.3 milligram per kilogram; Intranasal; 10 to 15; 1; Start IV dose at 0.05 to 0.10 milligram per kilogram with slow titration to max of 0.4 to 0.5 milligram per kilogram. Midazolam Versed; 0.5 milligram per kilogram; PO or PR; 15 to 30; 1 to 1.5; Start IV dose at 0.05 to 0.10 milligram per

kilogram with slow titration to max of 0.4 to 0.5 milligram per kilogram. Row 6: Morphine; 0.1 milligram per kilogram; IV; less than 5; 3 to 4; downward facing arrow Respirations, downward facing arrow BP. Row 7: Naloxone Narcan; 0.01 to 0.1 downward facing arrow; IV, IM, SC; less than 1; less than 1; Reverses narcotics, erratic absorption SC, use low dose first. Row 8: Nitrous oxide; 30 percent; Inhaled; 1 to 2; less than 0.1; Patient holds mask to self-titrate. Row 9: Propofol Diprivan; 1 to 2 downward facing arrow, Max first dose 40 milligram; IV; less than 1; less than 0.25; Pain on IV site, respiratory depression, apnea, hypotension; don’t use if allergy to egg yolk, lecithin, soybean oil, glycerol, EDTA, infuse 0.1 to 0.3 downward facing arrow per minute; not recommended for younger than 3 years old. Row 10: Thiopental Pentothal; 3 to 5 milligram per kilogram; IV; less than 1; 0.1 to 0.5; Slow IV at 1 milligram per kilogram q 1 to 2 minute; causes histamine release, downward facing arrow respiration, downward facing arrow BP. Thiopental Pentothal; 25; PR; 5; 0.5 to 1.0; Slow IV at 1 milligram per kilogram q 1 to 2 minute; causes histamine release, downward facing arrow respiration, downward facing arrow BP. Row 11: Dexmedetomidine Precedex; Loading 0.5 to 1.0 mcg per kilogram Maintenance 0.3 to 2.0 mcg per kilogram per hours; IV; less than 5; 2 to 3; Hypotension, bradycardia, and cardiac arrest.

Back to Table

A table lists the Management of Anaphylaxis.
The row entries are as follows. Row 1: Airway; Assess and support the airway. Administer 100 percent oxygen. Consider early intubation if airway edema is suspected. Row 2: Cardiac; Apply cardiac monitor and pulse oximeter; assess vitals frequently. Initiate chest compressions if cardiovascular arrest occurs. Row 3: Skin Remove the inciting allergen, if possible. Apply ice to bite, sting

sites. The four column headings are: Drugs, Dose, Route, and Indications and Detail. The row entries are as follows, row 1: Epinephrine; 0.01 milligrams per kilogram, max of 0.5 milligrams, Concentration: 1 is to 1000, Immediately and then q 5 to 15 minute as necessary; IM; First line of treatment. Inject IM into anterolateral thigh, NOT subcutaneously. Epinephrine; 0.1 to mcg per kilogram per minute, to a maximum of 10 mcg per minute; IV; IV epinephrine infusion if persistent shock exists despite IM epinephrine and fluid resuscitation See IV drip, page xxx. Row 2: Other vasopressors; Consider norepinephrine or vasopressin if IV fluids and epinephrine drip fail to resolve hypotension. Row 3: Normal saline; 20 milliliter per kilogram Give as quickly as possible; IV Intraosseous access if IV access is not readily available; Hypotension, repeat as needed. Row 4: Methylprednisolone, Solu-Medrol; 1 to 2 milligrams per kilogram, max 120 milligrams; IV; Second-line agent. Or Dexamethasone; 0.6 milligrams per kilogram, max 10 milligrams; IV or PO; no data. Row 5: Diphenhydramine, Benadryl; 1 milligrams per kilogram, max 50 milligrams; PO or IV or IM; second-line agent, relieve the cutaneous symptoms. Or Cetirizine; 2.5 to 10 milligrams; PO; Onset of action is faster for cetirizine than Benadryl. Row 6: Famotidine; 0.5 milligrams per kilogram, max 20 milligram; IV; H2 blocker second-line agent or Ranitidine; 1 milligrams per kilogram, max 50 milligram; IV; Combined effect of H1 and H2 antagonist is superior to H1 alone in treating cutaneous manifestations. Row 7: Glucagon; 20 to 30 mcg per kilogram bolus, maximum 1 milligram, followed by continuous infusion at 5 to 15 mcg per minute; IV Administer bolus slowly over 5 minutes as rapid administration can induce vomiting; Consider for patients on β blockers when anaphylaxis is refractory to IV epinephrine and fluid. Row 8: Albuterol; 2.5 to 5 mg q 15 minute; Nebulized or Metered-dose inhaler, two to six inhalations; Bronchospasm refractory to epinephrine. Racemic epinephrine;

Currently not recommended. Anecdotal evidence that it may decrease oropharyngeal edema and make airway management less difficult in anaphylaxis. Patient positioning; Place adults and adolescents in recumbent position; place young children in position of comfort; place pregnant patient on left side. Observation Per expert opinion observe all for 4 to 8 hours. Consider longer observation or admission if severe or refractory symptoms or with a history of asthma or risk factors for severe anaphylaxis. Follow-up; Prescribe epinephrine auto-injector, for example, Twinject 0.15 milligram, if 15 to less than 30 kilograms, or Twinject, 0.3 milligram if greater than or equal to 30 kilograms, each device has two doses OR EpiPen, 0.3 milligram, if greater than or equal to 30 kilograms or EpiPen Jr, 0.15 milligrams if 15 to less than 30 kilograms, each as single dose or 2-Pak to all with serious symptoms. Educate patient, patient provider, and family on the use of auto-injector Provide anaphylaxis action plan Outpatient allergy-immunology referral. Monitor closely, as life-threatening complications, for example, ischemia, arrhythmias can occur. Efficacy of the second-line agents has not been proven Sources: Modified from Lieberman P et al. Ann Allergy Asthma Immunol. 2015; 115. Campbell RL et al. Ann Allergy Asthma Immunol. 2014; 113:599-608. Lieberman P, Nicklas RA, Randolph C, et al. Anaphylaxis-practice parameter update 2015. Ann Allergy Asthma Immunol. 2015; 115 5:341–384.

Back to Table

A table lists the Hereditary Angioedema.
A rare genetic condition with autosomal dominant inheritance. Affected individuals have either a reduced level, type I or functional deficiency, type II of C1 esterase inhibitor, C1-INH or excessive bradykinin due to an increased factor XII activity type III. It causes recurrent painful episodes of swelling, typically in the face, hands, feet, or genitals. May also occur in the airways and intestinal tract.

Manifestations include abdominal pain, nausea, vomiting, diarrhea, and possible life-threatening airway obstruction. Trauma, stress, infections, surgery, and drugs, for example, estrogens are typical precipitants. Acute management: (1) If, there is, isolated extremity, or truncal edema, a wait and see approach is appropriate. Alternatively, increase Danazol by 2.5 to 5 milligrams per kilogram per day in those already taking this agent to abort an attack. Tranexamic acid, not FDA-approved, is another prophylactic agent. (2) First-line agent for severe attacks is C1-INH concentrate, Cinryze, 10 to 20 units per kilogram IV, if less than 50 kilogram, 1,000 units, if 50 to 100 kilograms, or 1,500 units IV, if greater than 100 kilograms. This agent is not FDA-approved in children. Recombinant C1 inhibitor, Ruconest and bradykinin B2-receptor antagonist, Icatibant are other available options. Ecallantide, Kalbitor—30 milligrams, three doses of 10 milligrams each—given at three separate sites subcutaneously is approved in children more than 12 years. Discuss appropriate use and dosing of these drugs in children with pediatric allergist or hematologist. If previously mentioned medicines are unavailable or contraindicated, consider fresh frozen plasma, FFP, may worsen attacks. Consider intubation if progressive laryngeal edema; epinephrine, dosing mentioned previously, administered IM, or IV if life-threatening, may or may not be effective. However, steroids and antihistamines are ineffective for hereditary angioedema.

Back to Table

Table is titled, Fluid Resuscitation in Burn Victims.
Column reads: Intravenous fluid resuscitation required if greater than or equal to 10 percent BSA burns. Partial- or full-thickness, not erythema, are used to calculate the total BSA. Pediatric burn fluid resuscitation formula follows. Parkland formula: LR 4 milliliter per kg per percent. BSA burn in first 24 hours from time of burn,

maintenance fluid, with half over first 8 hours, and half over subsequent 16 hours. Cincinnati, young children: 4 milliliter per kilogram per percent. TBSA: burn 1500 milliliter per meter square total BSA of LR. Half over first 8 hours and half over next 16 hours. First 8 hours add 50 mEQ per liter of sodium bicarbonate. Second 8 hours only LR. Third 8 hours of first 24 hours only, add 12.5 gram of 25 albumin per liter of crystalloid. D5W as needed. Cincinnati, older children: 4 liter per kg per percent TBSA burn plus 1500 milliliter per meter square total BSA of LR. Half over first 8 hours and half over next 16 hours; no albumin D5W as needed. Galveston (see page xxx for maintenance rate): 5000 milliliter per meter square BSA burn plus 2000 milliliter per meter square total BSA of LR. 12.5 gram of 25 percent albumin per liter of crystalloid. D5W as needed. Half over first 8 hours and half over next 16 hours. Text below reads: Use 5 percent dextrose in maintenance fluids in children less than 30 kilogram. Adult, teenager, burn fluid resuscitation formula follow: Parkland formula: 4 milliliter per kilogram per percent TBSA burn of LR half over first 8 hours and half over next 16 hours. No colloid or glucose. Modified Brooke: 3 milliliter per kilogram per percent TBSA burn of LR. Half over first 8 hours and half over next 16 hours. No colloid or glucose.

Back to Table

Table is titled, Estimation of burns in children as a percentage of body surface area, BSA.
The table has five data columns for the parameter, Age in years. The column heads are: less than 1, 1, 5, 10, and 15. Data follow: for row 1, Head percentage: 19, 17, 13, 11, and 9. Next row, Neck percent: 2, 2, 2, 2, and 2, Trunk, anterior or posterior percentage: 13, 13, 13, 13, and 13. One buttock percentage: 2.5, 2.5, 2.5, 2.5, and 2.5. Genitalia and perineum percentage: 1, 1, 1, 1, and 1. One forearm 3 and upper arm 4 percentage: 3 to 4 throughout. One

hand 2.5 or foot 3.5 percentage: 2.5 to 3.5 throughout. One thigh percentage: 5.5, 6.5, 8, 8.5, and 9. One leg, below knee percentage: 5, 5, 5.5, 6, and 6.5. Diagram below shows the percentage figures with respect to various parts of the body: Front and back, 13 percent each; Hands, 7 percent each; Buttocks: 2.5 percent each; Palms of hands: 2.5 percent each; Genitalia: 1 percentage; Feet: 3.5 percent each. Table at right reads as follows. Burns admission criteria: 5 to 10 percent TBSA partial thickness burns; 2 to 5 percent full thickness burn; Circumferential burn; Inhalation burn; High-voltage injury; Associated medical conditions or suspected abuse. Burn Center Referral Criteria: Partial-thickness burns greater than or equal to 10 percent BSA; Greater than or equal to 2 percent full-thickness burns in any age group; Burns to face, hands, feet, genitalia, perineum, or major joints; Chemical burns; High-voltage burn; Inhalational injury; Concomitant major trauma; Pre-existing medical disorders that would complicate management, prolong recovery, or affect mortality; Inadequate support or suspected abuse.

Back to Table

Table is titled, Cardiac Conditions Requiring Infective Endocarditis. Prior infectious endocarditis or any prosthetic cardiac valve. Congenital heart disease (CHD)-only CHD categories below require prophylaxis: Unrepaired CHD including those who have had shunts for palliation; Repaired CHD with residual defects at or adjacent to prosthetic patch or device; First 6 month post-op: Completely repaired CHD defects with prosthetic graft or device. Postcardiac transplantation with valve regurgitation.

Back to Table

Table is titled, Normal ECG Values.

The age column is followed by four columns: P-R interval, QRS interval, QRS axis, mean; and QTc superscript 2. Values follow. For row 1: 0 to 7 days; 0.08 to 0.12; 0.04 to 0.08; 80 to 160, 125; 0.34 to 0.54. Row 2 follows. 1 to 4 weeks; 0.08 to 0.12; 0.04 to 0.07; 60 to 160, 110; 0.30 to 0.50. Next row. 1 to 3 months; 0.08 to 0.12; 0.04 to 0.08; 40 to 120, 80; 0.32 to 0.47. Next row. 3 to 6 months; 0.08 to 0.12; 0.04 to 0.08; 20 to 80, 65; 0.35 to 0.46. Next row. 6 to 12 months; 0.09 to 0.13; 0.04 to 0.08; 20 to 100,65; 0.31 to 0.49. Next row. 1 to 3 years; 0.10 to 0.14; 0.04 to 0.08. 20 to 100, 55; 0.34 to 0.49. Next row. 3 to 8 years; 0.11 to 0.16; 0.05 to 0.09; 40 to 80, 60; 0.45. Next row. 8 to 16 years; 0.12 to 0.17; 0.05 to 0.09; 20 to 80, 65; 0.45.

Back to Table

Table is titled, 8-3 ECG Diagnosis of Chamber Enlargement, Hypertrophy.
R in V1 greater than 20 mm; greater than 25 mm but less than 1 month. S in V6 greater than 6 mm; greater than 12 mm but less than 1 month. Upright T in V3R, R in V1 after 5 days. QR pattern in V3R, V1. Biventricular hypertrophy has the following details: RVH and (S in V1 or R in V6) exceeding mean for age. LVH and (R in V1 or S in V6) exceeding mean for age. Left ventricular hypertrophy, LVH, has the following details. R in V6 greater than 25 mm, but greater than 21 mm and less than 1 year. S in V1 greater than 30 mm but greater than 20 mm and less than 1 year. R in V6 plus S in V1 greater than 60 mm; use V5 if R in V5 greater than R in V6. Abnormal R over S ratio. S in V1 greater than 2 times R in V5. Right atrial enlargement has the following details. Peak P value greater than 3 mm but less than 6 months, greater than 2.5 mm, and greater than or equal to 6 months. Left atrial enlargement has the following details. P in II greater than 0.09 seconds. P in V1 with late negative deflection greater than 0.04 seconds and greater than

1 mm deep.

Back to Table

Table is titled, ECG features of disorders associated with or mistaken for disease states.
Table has two columns: Disorder and ECG abnormality. Data follow. Row 1. Arrhythmogenic right ventricular cardiomyopathy - right bundle branch block RBBB or in absence of RBBB. QRS greater than 110 ms in leads V1 to V3 with T wave inversion in V2 and V3, LBBB ectopic beats, epsilon wave. The ECG abnormality on the right has three graphs. The first shows Epsilon wave with a sharp dip and rise; the second shows V2 with a less steep dip and rise and another crest and trough. The third shows V3 with a similar diagram. Next row: Benign early repolarization. Criteria include 1. Widespread ST elevation 90 percent less than 2 mm in precordial leads, and less than 0.5 mm in limb leads with precordial greater than limn leads. 2. J point elevation. 3. Concave initial upsloping of ST segment. 4. Notching or irregular contour of J point. 5. Prominent concordant T waves. 6. Stability of ECG over time. The right side shows two rows of three waves from V1 through V6. V1 through V3 have a sharp descent and subsequent ascent and the sharpness keeps decreasing progressively. V4 through V6 has a sharp ascent and a descent and are similar. Table titled, ECG features of disorders associated with or mistaken for disease states, continues… ECG Evaluation is provided in two columns: Disorder and ECG abnormality. Data follow. Conduction defects: Sinoatrial block, AV blocks, bradyarrhythias. Drugs and toxins: See specific drug or toxin in the Toxicology section. Hyperkalemia - Early narrow or peaked T waves, short QT interval, later widened QRS with decreased P wave height, then loss of P waves, AV block, sine wave pattern, asystole. The ECG abnormality on the right has three graphs. The first has a sharp peak and a trough followed by another

one shortly. The first has K superscript plus greater than 6 mEq per liter tall T wave. The second is also similar. It has K superscript plus greater than 7.5 mEq increased PR, Increase in QRS. The third has two short peaks with a deep trough in between. It has: K superscript, greater than 9 mEq per liter, no P, sinusoidal. Next row: Hypocalcemia - prolonged QT; see prolonged QT pages, xx, xx. Prolongs QT by lengthening ST segment, also decrease T wave voltage, flat T waves, terminal T wave inversion, or deeply inverted T waves, if severe, rare ST elevation. Hypokalemia - ST depression, flat T waves, and prominent U wave arrow, prolonged QT. The ECG has a steady line followed by a sharp ascent and descent and a series of very short ups and downs at the right. Next row: Hypertrophic cardiomyopathy: idiopathic subaortic stenosis. Nonspecific ST-T wave abnormalities; left ventricular hypertrophy, QRS complexes largest in midprecordial leads; Q waves in inferior II, III, aVF or precordial V2 or V6 leads, or both. Twelve ECG abnormalities are given below from I through III, aVR, aVL, aVF, and V1 through V6. I has a steady line with a peak in between. II and III have a sharp descent and an ascent with a loopy peak at right. aVR has a steady descent, a spike, and a loopy trough at right. aVL has a sharp peak and descent followed by a steady line at right. aVF has a sharp descent and a rise and a loopy rise at right. V1 through V6 have a very sharp descent and a rise following that. The right side slowly progresses in each graph from a steady line to an increase loose peak at right. Next row: Intracranial hemorrhage - may cause deep wide T waves, bradycardia, prolonged QT interval, minor ST elevation less than 3 mm, U waves. The three graphs at right, V1 through V3 show a steep descent followed by an ascent, and a loose dip at right. Next row: Ischemia, including arteritis, Kawasaki aneurysm occlusion or anomalous coronary artery. With anomalous coronary arteries, resting ECG is often normal. Focal ST segment elevation or

depression, Q waves, T wave inversion. Reciprocal changes. Data are provided in two columns: Disorder and ECG abnormality. Data follow. Kawasaki disease - most with Kawasaki's have ECG evidence of carditis. Abnormality: The most common ECG findings are elevated ST-T segments, elevated Q over R ratio, 55 percent each, followed by a prolonged QT interval of 35 percent, elevated P waves, diminished R waves, V1, prolonged PR intervals and flat T waves. After coronary artery formation, classic myocardial ischemic findings can occur. ECG findings are not part of current criteria in the diagnosis of Kawasaki disease. Echocardiogram is recommended when Kawasaki disease is considered. Next row. Lyme disease - Carditis occurs in 16 percent. Most are older than 10 years, have arthralgia or cardiopulmonary symptoms, pain, dyspnea, and syncope. The most common ECG findings in order of frequency are first-degree AV block, then second- or third-degree AV block, usually transient, prolonged QT, and then ST-T wave changes. Next row: Myocarditis - Patients may have ECG evidence of both myocarditis and pericarditis. In one study, 100 percent of patients with myocarditis had abnormal ECG. 73 percent had elevated CK, and 54 percent had elevated troponin. 90 percent had cardiomegaly, 15 percent pulmonary edema, and 5 percent an infiltrate. Shortness of breath occurred in 69 percent, vomiting in 48 percent, poor feeding in 40 percent, plus URI 39 percent. Abnormality data follows. Sinus tachycardia is most common with frequent nonspecific ST-T wave changes, occasional ischemic changes, pathologic Q waves, and variable AV blocks. Most common ECG findings in myocarditis with frequency in percentage are provided. Sinus tachycardia, 46. Ventricular tachycardia, 41. ST wave abnormality, 32. T wave abnormality, 31. Bundle branch, 10. Arrhythmia, 7. AV block, 5. Prolonged QT interval, 5. Data are provided in two columns: Disorder and ECG abnormality. Data follow. Pericarditis - 1. Diffuse ST elevation. 2. ST depression in

aVR plus or minus II and V1. ST segment is typically concave upward plus less than or equal to 5 mm height. Q waves are rare. PR segment depression is common inferior plus lateral. 3. Sequence. a. initial ST, b. ST returns to baseline, c. T waves flip decrease and T wave amplitude is usually less than or equal to 5 mm, d. T waves normalize. 4. Height of ST segment or T wave is greater than 0.25 in V5, V6, or I. The right side has six abnormality graphs. The top three have a sharp ascent and a descent after that with a loose rise at the right top. The bottom three have a sharp descent with a sharp rise afterwards and a loose rise at the right. This progressively increases from left to right. Next row. Prolonged QT syndrome - QTc interval greater than 0.46 to 0.50 milliseconds, may need stress testing to uncover prolongation of QT. The graph at right has QT at the base. The graph has a sharp increase and decrease with a steady line flowing right and another sharp increase and decrease with another steady line further. R - R dash are measured above. Next row. Sudden unexpected death syndrome, SUDS or Brugada syndrome - RBBB with ST segment elevation in V1 to V3 or incomplete RBBB with ST segment elevation in V1 and V2. Three graphs at right, V1 through V3, show a steady line flowing from left to right with a steep descent in the middle followed by a sharp ascent. V1 has a steady line with a moderate rise at right. V2 has a moderate rise and a fall. V3 has a very steep descent and ascent and a moderate rise at right. Next row. Wolff-Parkinson-White syndrome - Delta wave, wide QRS, short PR interval, wide complex AFib/SVT. The graph at right shows a sharp spike and descent with a line flowing at right afterward.

Back to Table

Table shows a flowchart and is titled, Symptomatic Bradycardia. The first box is titled, Identify and Treat Underlying Cause. Sub-points follow: Maintain patent airway; Provide oxygen; Cardiac

monitor, BP, pulse oximetry; IV/IO access; 12-lead EKG if available. The next box is Cardiopulmonary compromise? AMS, hypotension, signs of shock. A Yes response below leads to: Chest compressions if pulse is less than 60 per minute, with poor perfusion despite oxygenation and ventilation. This further leads to a question, Bradycardia persistent? A No response from this leads to: Support ABCs, Give Oxygen, Observe, and Consider consultation. A No response from above Cardiopulmonary compromise also leads to this. A Yes response from Bradycardia leads below to: Epinephrine 0.01 mg per kg with 0.1 mL per kg of 0.1 mg per ml. Atropine 0.2 mg per kg and minimum of 0.1 mg, max 0.5 mg, for increased vagal tone per primary AV block and consider pacing.

Back to Table

Table is titled, Differentiation of Sinus Tachycardia from Supraventricular Tachycardia.
The first column has data variables. The second column has values for Sinus tachycardia and the third has values for Supraventricular tachycardia. Data follow. For History: Volume loss, dehydration and bleed; drugs, other stressor. Often vague and nondescript, if prolonged CHF or shock. For Heart rate less than one year: less than 220; greater than or equal to 220. For Heart rate greater than one year: less than 180 to 200; greater than 180 to 200. For QRS width: Narrow for age; Narrow in 9- percent. For P waves: Upright leads I, aVF; Rare, negative in II, III, aVF. For HR and R-R variability: Beat-beat, R-R varies, responds to stimulation; No variability, no response to stimulation. For HR changes: Slow increase or decrease; Abrupt onset and termination.

Back to Table

Table is titled, Wide Supraventricular Tachycardia, Aberrancy, versus Ventricular Tachycardia.
The table has three columns. The first holds data variables; the second is titled, Supraventricular Tachycardia; and the third, Ventricular Tachycardia. Data follow. For History: WPW in up to 30 percent in infancy; 70 percent structural cardiac disease. For Symptoms and BP: Not a useful differentiator; Not a useful differentiator. For Heart rate: greater than 220 infant, greater than 180 child; greater than 120. For P waves: Retrograde P waves possible; Dissociation of P and QRS. For other features: commonly across both columns: Features found useful in differentiating adult VT, absence of RS in all precordial leads, QRS concordance in precordial leads, QRS greater than or equal to 0.12 to 0.14 ms, vs, SVT, triphasic QRS with RBBB in V1 or V6, have not been studied in children.

Back to Table

Flowchart is titled, Unstable Tachycardia Management.
The first box reads: Identify and treat underlying cause. Sub-points are: Maintain patent airway; provide oxygen; cardiac monitor, BP, pulse oximetry; IV/IO access; 12-lead EKG if available. This leads to a decision box: Evaluate QRS greater than 0.08. Yes leads to the following direction. Wide complex: Probable ventricular tachycardia. This leads to: Cardiopulmonary compromise? AMS, hypotension, signs of shock. Yes leads to Synchronized cardioversion and No leads to consider adenosine if regular rhythm and monomorphic QRS. The No decision from Evaluate QRS leads to the following direction. Narrow complex: Evaluate with 12-lead EKG or monitor. This leads to: Portable sinus tachycardia, see table 8.6, SVT vs sinus tachy. This leads to: Consider vagal maneuvers. If IV access, adenosine fast push is 0.1 mg per kg subject to a max of 6 mg; or 0.2 mg per kg subject to a max of 12 mg. This leads to: If

adenosine ineffective or no IV, use synchronized cardioversion. First dose: 0.5 to 1 J per kg.

Back to Table

Table is titled, Unstable Tachycardia Management.
Table has three columns: Age, Total digitalizing dose IV, and Maintenance IV daily dose. Particulars follow. Row 1. Premature neonate; 15 to 25 mcg per kg. Term neonate; 20 to 30 mcg per kg. 1 to 24 months; 30 to 50 mcg per kg; 2 to 5 years; 25 to 35 mcg per kg; 5 to 10 years; 15 to 30 mcg per kg subject to a max of 1.5 mg. The common points for maintenance daily dose is: Maintenance dose is 20 to 30 percent of loading dose for premature neonate and 25 to 35 percent of loading dose for others, divide above dose Q12.

Back to Table

Table is titled, Select serious causes of chest pain in children.
The left top column has the following details: Ischemia from arteritis, Kawasaki's, coronary artery anomalies, HTN, reduction in oxygen. Structural anomalies, example: aortic stenosis, pulmonic stenosis, cardiomyopathy, HCM or dilated. Pulmonary or emboli, pneumothorax. The right top column has the following details: Arrhythmias reduction or increase in HR. Low BP with low coronary perfusion. Infectious or pericarditis, myocarditis endocarditis. Aortic dissection and sickle cell, chest syndrome. Life threatening conditions in only 1 to 6 percent of pediatric chest pain. The columns below have the following details. Chest pain etiologies at a pediatric ED: Musculoskeletal Respiratory and Idiopathic. 25 to 64 percent, Psychogenic, 9 to 13 percent. 13 to 21 percent, Trauma, 5 percent. 2 to 21 percent, GI or cardiac, 3 to 5 percent each.

Back to Table

Table is titled, Most common congenital defects diagnosed at different ages.
For 0 to 6 days: D-Transposition of great arteries, 19 percent; Hypoplastic LH, 14 percent; Tetralogy of Fallot, 8 percent; Coarctation - aorta, 7 percent. VSD, 3 percent; Other defects, 49 percent. For 7 to 13 days: Coarctation - aorta, 16 percent; VSD, 14 percent; Hypoplastic LH, 8 percent; D-Transposition of great arteries, 7 percent; Tetralogy of Fallot, 7 percent; Other defects, 48 percent. For 14 to 28 days. VSD, 16 percent; Coarctation - aorta, 12 percent; Tetralogy of fallot, 7 percent; D-Transposition of great arteries, 7 percent; Patent ductus, 5 percent; Other defects, 53 percent.

Back to Table

Table is titled, Pulse Oximetry in CHD.
Beyond first 24 hours of life, pulse oximetry can be used to screen for CHD. 90 percent Sp O subscript 2 in right hand or foot equal to positive screen or ECHO. 90 to 94 percent Sp O subscript 2 in right hand or foot OR greater than 3 percent difference leads to repeat screen in 1 h, max 3 times. 95 percent in right hand or foot AND less than or equal to 3 percent difference leads to negative screen.

Back to Table

Table is titled, Hyperoxia Test in Cyanotic CHD.
1. Obtain arterial blood gas ABG on room air. 2. Place patient on 100 percent oxygen for 10 minutes. 3. Repeat ABG. Cyanotic heart disease usually Pa O subscript 2 less than 50 mm Hg following 10 min of 100 percent O subscript 2. See disorders and hyperoxia test results, which follows. Those with lung disease usually can raise

their Pa O subscript 2 greater than 100 mm Hg.

Back to Table

Table is titled, Lesions with Ductal Dependent Systemic S or Pulmonary P flow.
Tetralogy of Fallot P, Epstein's anomaly P, Critical PS P, Tricuspid atresia P, Pulmonary valve atresia P. Hypoplastic left heart S, interrupted aortic arch S, Critical coarctation of aorta S, Critical AS S, d-TGA P.

Back to Table

Table is titled, Specific cardiac or noncardiac disorders and Hyperoxia test results.
Three columns are present: Disorders, Pa O subscript 2, percent sat, and Fi O subscript 2, 21 percent; Pa O subscript 2, percent of sat, and Fi O subscript 2, 100 percent; and Pa CO subscript 2. Data follow. No disease; greater than 70 percent, greater than 95 percent; greater than 300 or 100 percent; and 35. Lung or neurologic disease: 50 or 85 percent; greater than 150 or 100 percent; and 50. d-TGA plus or minus VSD, Tricuspid atresia plus PS or atresia, critical PS, Tetralogy of Fallot; less than 40 or less than 75 percent; less than 50 or less than 85 percent; 35. Truncus arteriosus, TAPVR, hypoplastic left heart, single ventricle; 40 to 60 or 75 to 93 percent; less than 150 or less than 100 percent; 35. Persistent pulmonary HTN of new born, LV outflow tract obstruct or AA hypoplasia, interrupted AA, critical coarctation, AS; Pre 70 or 95 percent, post less than 40 or less than 75 percent; variable; 35 to 50. d-TGA plus coarctation of aorta or interrupted aortic arch or plus pulmonary HTN; pre less 40 or less than 75 percent, post greater than 50 or less than 90 percent; variable; 35 to 50.

Back to Table

Table is titled, Chest Radiography in Acyanotic CHD.
For Normal pulmonary flow: PS, MS or MR, AS, coarctation of the aorta. Increase in pulmonary flow: ASD, VSD, PDA, left to right shunts with pulmonary HTN, AV canal.

Back to Table

Table is titled, Chest Radiography in Cyanotic CHD.
For decrease in pulmonary flow: Severe PS, pulmonary atresia, Tetralogy of Fallot, normal or boot-shaped heart, TGA with PS, tricuspid atresia, Ebstein's anomaly or massive heart, Eisenmenger's complex. Increase in pulmonary flow. TAPVR, Snowman sign - late finding, supracardiac venous return via dilated right and left superior vena cava, hypoplastic LH, TGA or egg-shaped heart tilted on its side with a narrow mediastinum egg on a string plus or minus VSD, truncus arteriosus.

Back to Table

Table is titled, Physiologic Murmurs.
The table has five columns: Murmur, Age, Location, Timing, and Cause. Data follow. Row 1. Still's; 3 to 6 years; Apex; Systole; Turbulent LV outflow. Next row: Pulmonary ejection; 8 to 14 years; second left ICS; Systole; RV outflow tract turbulence. Next row: Supraclavicular; 4 to 14 years; above clavicle; Systole; Brachiocephalic branching. Next row: Venous hum; 3 to 6 years; Base of neck; Entire; Venous return. Next row: Straight back pectus; All; Apex; Systole, RV filling with inspiration. Next row: Hemic exertion; All; Apex, left ICS; Systole; Rapid LC ejection. Next row: Neonatal pulmonary ejection: Less than 6 months; Right second ICS; Systole; Underdeveloped pulmonary arteries.

Back to Table

Table is titled, Evaluation and Etiology or Pediatric Syncope. Evaluation is primarily based on clinical presentation. ECG, pregnancy test females greater than 11 to 12; Hb, glucose, electrolytes, Holter if arrhythmia, CT head, abnormal neuro exam, CT chest, dissection, PE; ECHO, valvular heart disease. For Etiology of syncope in infants and children presenting to a pediatric ED: Casovagal, 50 percent; Orthostasis, 20 percent; Atypical seizure, 7 percent; Head trauma, 5 percent; Migraine, 5 percent; Miscellaneous, 13 percent.

Back to Table

Table is titled, Features associated with Life-threatening cause of syncope.
Family history of cardiomyopathy or sudden death, HCM, prolonged QT. Syncope during exercise or while supine, HCM, aortic plus pulmonic stenosis, pulmonary hypertension. Syncope plus chest pain or palpitations, HCM, ischemia, aortic stenosis. Congenital deafness or long QT. Abnormal ECG, examples pages xx - xx. Abnormal cardiac examination. Recurrent syncope. Fall directly onto face, rapid onset. CHD. Drugs with cardiac effects. Marfanoid appearance or collagen vascular disease in family.

Back to Table

A table lists Rash Patterns and Etiology, superscript 1.
Row 1: Acneiform; Acne vulgaris, drugs like steroid, Li, and INH, Cushing’s, chloracne. Row 2: Acrodermatitis, extremity; Papular acrodermatitis, smallpox, atopic dermatitis in infantile, tinea pedis, dyshidrotic eczema, poststreptococcal desquamation, Rocky Mountain spotted fever, drug rash. Row 3: Clothing covered;

Contact dermatitis, miliaria, psoriasis in summer, folliculitis. Row 4: Flexural creases; Atopic dermatitis in childhood, infantile seborrheic dermatitis, intertrigo, candidiasis, tinea cruris, ichthyosis, inverse psoriasis. Row 5: Linear Christmas tree distribution; Pityriasis rosea, secondary syphilis, drug reaction, guttate psoriasis, atopic dermatitis. Row 6: Sun exposed; Phototoxic drug rash, photocontact dermatitis, lupus, viral, exanthem, porphyria, xeroderma pigmentosum. Superscript is as follows. Superscript 1: Vesiculobullous, petechial or purpuric, eczematous, papulosquamous rashes, see pages xx–xx. Evaluation of patients with a petechial rash, see pages xx, xx.

Back to Table

A table lists other papulosquamus and eczematous rashes. There are three columns: Disorder, Skin lesions, Treatment. Row 1: Dyshidrotic eczema; Scaling vesicles, blisters, fissures, Feet bigger than hands, lateral digits, hyperhidrosis plus or minus localized atopic dermatitis; High-dose topical steroids equals by –oral steroids first, cold compress, Calcineurin inhibitors, psoralen, PUVA, stress-reduction therapy have also been tried. Row 2: Eczema herpeticum; Herpes clusters at site of atopic dermatitis; If young patient or moderate involvement, IV acyclovir. If well appearing and older, PO acyclovir. Row 3: Exfoliative dermatitis; General erythema and scaling with exfoliation head to toe, fluid loss, bullae, and sepsis, plus Nikolsky’s sign; Mainstay of treatment aimed at maintaining skin hydration, avoid scratching, applying topical steroids, avoiding precipitating factors and treating underlying cause; compresses with Burow’s solution or potassium permanganate also effective. Row 4: Pityriasis rosea; Papules, scales, Starts with a herald patch, erupts over 2 to 21 days over lines of cleavage of skin, Christmas tree pattern on back and if African American, may spare trunk; Self-limiting, with a duration of

6 to 8 weeks, Supportive care for pruritus. Row 5: Psoriasis; Round or oval red plaques with silvery scales, Scalp, trunk, extensor extremities, or areas of trauma; nail pitting, dystrophy, and fissuring of palms and soles may be present; Topical and systemic medication like MTX or cyclosporine, biologic agent, phototherapy, UV therapy, Psoralen, stress reduction, moisturizers, salicylic acid, urea, and climatotherapy. Row 6: Seborrheic dermatitis; Mild patchy scaling to thick adherent scaling, intermittent active phases with burning, itching and scaling in winter and early spring with remission in summer, over oil-bearing areas of head and neck; Antifungal gels, calcineurin inhibitors, sulfur or sulfonamide combinations, or propylene glycol, low-potency shampoos containing salicylic acid, tar, selenium, sulfur, or zinc can be used. Selenium sulfide at 2.5 percent, ketoconazole, and ciclopirox shampoos may help by reducing Malassezia yeast scalp reservoirs. Row 7: Syphilis, secondary; Diffuse or localized, maculopapular, nonpruritic, bilaterally symmetrical, with nontender LN-pathy, associated with constitutional symptoms and pain in bone and fatigue; Penicillin drug of choice, Doxycycline is the next best alternative. Row 8: Tinea; Begins as erythematous scaly plaque, with central resolution giving it an annular appearance; Topical antifungals like azoles and allylamines, Systemic antifungals if severe.

Back to Table

A table lists Papulosquamous and Eczematous Rashes, Vesiculopustular Rashes, superscript 1.
There are three columns: Rash, Skin lesions or distribution, Management. Row 1: Impetigo; Nonbullous: Honey-colored crust with moist erythematous base, Bullous: Fragile, thin-roofed, flaccid, and transparent bullae with clear, yellow fluid that turns cloudy and dark yellow, on rupture there is no crusting, with a collarette of

scales around the periphery over face, extremity, elbow, and trunk; Topical and systemic steroids. Row 2: Staphylococcal scalded skin syndrome or SSSS; Macular erythema with dermal exfoliation, generalized sunburn, circumoral erythema, periorifice crusting, Nikolsky's sign, sterile bullae affecting total body with sparing of mucosa; Fluid hydration, topical wound care and antibiotics to treat infection. Row 3: Herpes simplex; Vesicular lesions on the oral mucosa and tongue, which later rupture and coalesce and leave ulcerated plaques, with tender lymphadenopathy; Acyclovir. Row 4: Herpes zoster; Self-limited grouped vesicular lesions covering one or two adjacent dermatomes; Wet dressing, Burow's solution, calamine lotion, pain medications, antiviral treatment. Tricyclic Antidepressants or TAS, gabapentin, pregabalin, narcotic or non-narcotic pain meds can be used for post-herpetic neuralgia. Row 5: Erythema multiforme; Papules, wheals, target lesions involving entire surface of the body. No mucosal involvement in minor. More than two mucosal involvement in Stevens-Johnson syndrome; Oral antihistamines, analgesics, local skin care, and soothing mouthwashes, topical steroids, meticulous wound care and use of Burow's or Domeboro solution dressings, remove offending drug, treat infection. Row 6: Toxic epidermal necrolysis; Widespread erythema, necrosis, and bullous detachment of the epidermis and mucous membranes, resulting in exfoliation and possible sepsis and or death; Withdrawal of offending agent, isolation, fluid and electrolyte balance, nutritional support, protective dressing, pain management. Superscript are as follows. Superscript 1: Other conditions that may mimic or have vesicular lesions—scabies, more often papular, excoriated, or have vesicular lesions—scabies, more often papular, excoriated, or scaling. Threadlike burrows are seen in the classic form, dyshidrosis, ID reaction, insect bites, molluscum contagiosum, simulates vesicles, coxsackievirus, hand, foot, mouth.

Back to Table

A table lists Petechial and Purpuric Rashes. Superscript 1-3. There are three columns: Rash, Skin lesions, Treatment. Row 1: Idiopathic thrombocytopenic purpura and thrombotic thrombocytopenic purpura or TTP; Petechiae, ecchymosis, hematomas on exposed sites, bony prominences, and mucosa; Mild: no treatment, Moderate to severe: plus or minus intravenous IG or IVIG, plus or minus steroids. Row 2: Henoch-Schönlein purpura; Petechiae, purpura typically symmetrical in dependent body areas plus or minus joint pain, abdominal pain, plus or minus renal involvement; Adequate hydration, treat pain, steroids or immunosuppressive drugs if complications. Row 3: Acute leukemia; Petechiae, purpura, generalized or localized, adenopathy, hepatosplenomegaly, sternal tenderness; Treat as per protocol. Row 4: Aplastic anemia; Petechiae, purpura, ecchymosis, generalized or at sites of injury; Supportive care, immunosuppressive therapy, or HCT. Row 5: DIC; Generalized petechiae that tend to be palpable with meningococcemia, purpura, areas of skin necrosis; Replacement of platelets, cryoprecipitates and or fresh frozen plasma. Row 6: Factor deficiency, for example, hemophilia; Easy bruising, abnormal bleeding under the skin and mucous membrane plus or minus involvement of muscle and joints; Replacement of factor. Superscript is as follows. Superscript 1: See, Bleeding Disorders, pages xx–xx, and Evaluation of Patients with Petechiae, pages xx, xx. Superscript 2: Other purpuric rashes: vasculitis, Rickettsia, RMSF, histiocytosis X, scurvy, trauma, medicines, steroids, thiazides, dysproteinemias, Kaposi’s sarcoma, pyogenic granuloma. Superscript 3: See etiology and differential for fever and petechiae, page xx.

Back to Table

A table lists developmental milestones.
There are five columns: Age, Social, Language, Fine motor, Gross

motor. Row 1: 2 months; Social smile; Coos, gurgling sounds; Follows object 180 degrees; Holds head up. Row 2: 4 months; Spontaneous smile; Turns to voice, laughs; Brings objects to midline; Rolls front to back. Row 3: 6 months; Knows familiar Faces; Babbles; Passes object from one hand to the other; Sits independently. Row 4: 9 months; Stranger Anxiety; Says “mama or dada” Nonspecifically; Uses immature Pincer; Crawls pulls to stand. Row 5: 12 months; Separation anxiety; Follows one-step command with gesture, 3 words; Uses mature pincer; Walks. Row 6: 18 months; Independence; Says 10 to 25 words; Builds four-cube Tower; Runs stiffly, walks up stairs with assistance. Row 7: 2 years; Parallel play; Says 2 to 3 word Sentences; Displays Handedness; Runs. Row 8: 3 years; Cooperative Play; States first name, follows command with 2 to 3 steps; Builds eight-cube tower, undresses; Rides tricycle. Row 9: 4 years; Cooperative Play; Tells stories; Uses scissors; Hops and stands on one foot up to 2 seconds. Row 10: 5 years; Wants to Please and be like friends; Speaks clearly; Can print some letters and numbers; Stands on one foot more than 10 seconds.

Back to Table

A table lists weight, height, head circumference in fifth, fiftieth, and ninety-fifth percentiles.
There are seven columns: age, male height in centimeter, male weight in kilogram, male head circumference in centimeter, female height in centimeter, female weight in kilogram, and female head circumference in centimeter. Row 1: 1 month, 51.4 to 55.9 to 59.7, No data, no data, 50.8 to 54.3 to 58.4, no data, no data. Row 2: 3 months, 58.3 to 61.9 to 66.6, 5.35 to 6.95 to 8.45, 39.7 to 41.7 to 43.1, 56.7 to 61.0 to 64.8, 5.40 to 6.30 to 7.75, 39.0 to 40.3 to 42.6. Row 3: 6 months, 64.8 to 68.2 to 71.9, 7.00 to 8.39 to 10.70, 42.4 to 44.0 to 46.8, 63.3 to 66.7 to 70.9, 6.58 to 7.55 to 8.96,

40.8 to 42.6 to 45.0. Row 4: 9 months, 67.9 to 72.6 to 76.6, 8.05 to 9.30 to 10.89, 43.6 to 45.4 to 47.4, 66.8 to 71.0 to 75.5, 7.40 to 8.73 to 10.45, 42.6 to 44.3 to 46.2. Row 5: 12 months, 72.9 to 77.3 to 82.9, 8.90 to 10.55 to 12.35, 44.7 to 47.0 to 49.4, 70.0 to 76.2 to 80.5, 8.28 to 9.80 to 11.57, 43.5 to 45.6 to 48.0. Row 6: 18 months, 77.8 to 83.7 to 90.2, 9.98 to 11.91 to 15.45, 45.5 to 48.0 to 50.1, 76.1 to 81.6 to 87.5, 9.15 to 10.95 to 13.50, 44.0 to 46.5 to 49.2.

Back to Table

A table shows insulin preparations.
There are six columns. Insulin superscript 1; Preparation; Onset, h; Peak, h; Duration, h. Row entries are as follows. Row 1: Ultra-rapid acting analog; Faster aspart; 0.1 to 0.2; 1 to 3; 3 to 5; Better intended to match the time-action profile of prandial insulin. Useful for pumps and closed-loop approaches. Row 2: Rapid-acting analog, quicker effect than regular insulin to treat hyperglycemia; Aspart, glulisine, lispro; 0.15 to 0.35; 1 to 3; 3 to 5; Give immediately before meals, in exception of cases such as infants and toddlers who are reluctant to eat, give after food. Most often used as prandial or snack boluses in combination with longer-acting insulins, see basal-bolus regimens. Most often used in insulin pumps. Row 3: Regular or Soluble, short acting, identical to human insulin; Short acting; 0.5 to 1; 2 to 4; 5 to 8; Used either with intermediate-acting insulin in a twice daily regimen or as a premeal bolus injection in basal-bolus regimen, given 20–30 minutes before meals together with intermediate-acting insulin 2 to 3, or even 4 times daily or a basal analog given once or twice daily. Row 4: Intermediate; Isophane NPH; 2 to 4; 4 to 12; 12 to 24; Suitable for twice daily regimens, tailored basal substitution and for pre-bed dosage in basal-bolus regimens. Row 5: Long; Detemir superscript 2; 100 units per milliliter, Levemir; 1 to 2; 6 to 12; 20 to

24; Basal analogs have a more predictable insulin effect and less of a peak than NPH and allow basal dosing independent of meal time, once or twice a day. 30 to 45 percentage of TDD. Row 6: Long; Glargine superscript 2, Lantus; 2 to 4; Prolonged; 24; Basal analogs have a more predictable insulin effect and less of a peak than NPH and allow basal dosing independent of meal time, once or twice a day. 30 to 45 percentage of TDD. Row 7: Long; Glargine 300 units per milliliter cube; 2 to 6; Minimal peak; 30 to 36; Basal analogs have a more predictable insulin effect and less of a peak than NPH and allow basal dosing independent of meal time, once or twice a day. 30 to 45 percentage of TDD. Row 8: Long; Degludec superscript 4; 0.5 to 1.5; Minimal peak; Greater than 42; Basal analogs have a more predictable insulin effect and less of a peak than NPH and allow basal dosing independent of meal time, once or twice a day. 30 to 45 percentage of TDD. A table shows the criteria for cerebral edema. There are two columns. The data from the table are as follows. Diagnostic criteria: Abnormal motor or verbal response to pain; Decorticate or decerebrate posture; Cranial nerve palsy, especially III, IV, and VI; Abnormal neurogenic respiratory pattern, for example, grunting, tachypnea, Cheyne-Stokes respiration, apneusis. Major criteria: Altered mentation or fluctuating level of consciousness, GCS less than or equal to 13; Sustained heart rate deceleration, decline greater than 20 bpm not attributable to improved intravascular volume or sleep state; Age-inappropriate incontinence. Minor criteria: Vomiting; Headache; Lethargy or not easily arousable from sleep; Diastolic blood pressure greater than 90 millimeters Mercury; Age younger than 5 years.

Back to Table

A table shows etiology of hypoglycemia.
There are two columns. Row entries are as follows. Row 1:

Neonatal; Prematurity, SGA, infant of diabetic mother, birth asphyxia. Row 2: Decreased intake; Vomiting, malnutrition. Row 3: Decreased absorption; Diarrhea, malabsorption. Row 4: Glucose underproduction; Prematurity, SGA, malnutrition. There are three columns. Row entries are as follows. Row 1: Glucose underproduction; Ketotic hypoglycemia; Ketonemia and ketonuria, high BOHB and normal plasma lactate. Row 2: Inborn errors of metabolism; Glycogen storage disease; High plasma lactate and high BOHB. Row 3: Inborn errors of metabolism; Fatty acid oxidation defect; Low BOHB but elevated FFA. Row 4: Hyperinsulinemia; Endogenous, high C-peptide level or exogenous low C-peptide level; Low BOHB and FFA IGFBP-1 level decrease or remain stable with increased insulin. Row 5: Endocrine disorder; Panhypopituitarism, GH deficiency, cortisol deficiency; Evaluate levels of specific hormones. Row 6: Drug: ingestion or toxins or alcohol; Ethanol, salicylates, propranolol; Elevated level of medication present.

Back to Table

A table shows management of hypoglycemia.
There are three columns. Age, Dose and concentration, Other treatment. Row entries are as follows. Row 1: 0 to 30 days; 5 to 10 milliliters per kilogram of D subscript 10 W IV; Glucagon 0.02 to 0.03 milligrams per kilogram if 20 kilograms, 1 milligram if greater than 20 kilograms, administer IM, SC, or IV; Diazoxide IV if severe. Row 2: 1 to 24 months; 2 to 4 milliliters per kilogram of D subscript 25 W IV; Glucagon 0.02 to 0.03 milligrams per kilogram if 20 kilograms, 1 milligram if greater than 20 kilograms, administer IM, SC, or IV; Diazoxide IV if severe. Row 3: Greater than 2 years; 1 to 2 milliliters per kilogram of D subscript 50 W IV; Glucagon 0.02 to 0.03 milligrams per kilogram if , 20 kilograms, 1 milligram if greater than 20 kilograms, administer IM, SC, or IV; Diazoxide IV if severe.

Back to Table

A table shows minor heat illness.
Data from the table are as follows. Heat syncope: Postural hypotension from vasodilation, volume depletion, and decreased vascular tone; Management: Rehydrate with salt containing fluids, remove from heat and evaluate for serious disease. Heat cramps: Painful, contractions of large muscle groups of the legs, abdomen, or arms in those who are sweating liberally and drinking hypotonic solutions, for example, water; Management: Replace fluids, oral or IV rehydration. Do not use salt tablets. Heat tetany: Hyperventilation that may result in respiratory alkalosis, positive Chvostek sign, laryngospasm, or carpopedal spasm; Management: Move to cooler environment. Persistent hyperventilation may require partial rebreather oxygen mask set below 5 liters per minute. Heat exhaustion: Salt and water depletion causing orthostasis, and hyperthermia, usually , 104 degree Fahrenheit or 40 degree Celsius. Mental status and neurologic exam are normal. Lab: high hematocrit, electrolytes normal, sodium may be decreased in some; Management: Initiate treatment with NS 10 to 20 milliliters per kilogram IV and continue to hydrate as needed.

Back to Table

A table shows the clinical features and the risk factors of heart stroke.
There are two columns. Clinical feature and Risk factors. Data from the table are as follows. Clinical features: Hyperpyrexia, temperature greater than 104 to 105.8 degree Fahrenheit; Central nervous system dysfunction, seizures, altered mentation, decreased plantar responses, hemiplegia, ataxia; Loss of sweating, variably present. Risk factors: Very young or old age; Drugs that limit sweating, anticholinergics, amphetamines, cocaine, antihypertensive agents.

Back to Table

A table shows heart stroke management.
Data from the table are as follows. Administer oxygen and protect airway if comatose or seizing. Check blood glucose, and treat hypoglycemia. Measure temperature with continuous rectal probe or Foley catheter temperature sensor that is accurate at high temperatures. Begin IV NS cautiously as pulmonary edema is common and the mean fluid requirement in heat stroke is greater than 20 milliliters per kilograms in the first 4 hours. Consider central venous pressure monitoring to guide fluid resuscitation.

Back to Table

A table shows other heat-related disorders.
Data from the table are as follows. Malignant hyperthermia (MH): Autosomal dominant. Fever, late sign, hypercarbia, plus muscle rigidity after anesthetics or succinylcholine. Treatment: Stop agent, correct hypercarbia, give loading bolus of dantrolene 2.5 milligrams per kilogram IV. max 10 milligrams per kilogram. Neuroleptic malignant syndrome: Similar to MH, with fever, encephalopathy, vitals unstable, elevated enzymes, rigid muscle, but due to antipsychotics, for example, haloperidol, phenothiazines. Treatment: Stop agent, cool patient see heatstroke and administer bromocriptine 2.5 to 10 milligrams PO or NG three times per day. Benzodiazepines may be useful for agitation. Some experts recommend dantrolene 2.5 milligrams per kilogram IV, max 10 milligrams per kilogram although this is more effective in malignant hyperthermia. Avoid phenothiazines. Rhabdomyolysis: Syndrome with release of contents into circulation due to tissue hypoxia, direct injury, exercise, enzyme defects, metabolic disease, DKA, decreased K, decreased Na, or decreased phosphate, thyroid, toxins, infections, heatstroke. Complications: renal failure,

decreased K, increased or decreased Ca, increased or decreased phosphate, increased uric acid, compartment syndrome, DIC. Treatment: (1) IV NS to keep urine output greater than 2 to 3 milliliter per kilogram per hour, (2) alkalinize urine, (3) plus or minus mannitol if poor urine output: 0.25 to 0.5 grams per kilogram IV, plus add 12.5 grams to each L NS, (4) dialyze increased K, or uremia.

Back to Table

A table shows severity of hypothermia.
There are three columns. Severity, Temperature degree Fahrenheit (Celsius), Features. Row entries are as follows. Row 1: Mild; 90 to 95 (32 to 35); Shivering, vasoconstriction, plus slurred speech at less than 95 degree Fahrenheit. Row 2: Moderate; 82 to 90 (28 to 32); At less than 89 degree Fahrenheit altered mental status, mydriasis, shivering ceases, muscles are rigid, incoordination, bradypnea. Row 3: Severe; less than or equal to 82 (less than or equal to 28); Bradycardia in 50 percentage, Osborn waves on ECG, voluntary motion stops, pupils are fixed and dilated. Row 4: Severe; 79 (26); Loss of consciousness, areflexia, no pain response. Row 5: Severe; 77 (25); No respirations, appear dead, pulmonary edema. Row 6: Severe; 68 (20); Asystole.

Back to Table

A table shows management of hypothermia.
Data from the table are as follows. Evaluate for cause, for example, sepsis, hypoglycemia, CNS disease, adrenal crisis. Mild hypothermia, less than 32 degree Celsius: Administer humidified warmed O2. Passive external rewarming, warm blankets, hot packs and treatment of underlying disease is often the only treatment needed. Moderate hypothermia, 29 to 32 degree Celsius: Passive

rewarming 1 active internal rewarming. Drugs and cardioversion for cardiac arrest may be ineffective. Warm humidified O2 and warm IV fluids with gastric or peritoneal lavage if poor response to warm fluids or O2, less than 1 degree Celsius per hour temperature rise. Perform CPR and ALS, for example, defibrillation prn with meds at longer intervals. Severe hypothermia less than or equal to 29 degree Celsius: (1) Warm humidified O2, and warm IV fluids. (2) If no cardiac arrest, warmed peritoneal dialysis, 41 degree Celsius dialysate, or (3) pleural irrigation, 41 degree Celsius. (4) If core temperature less than 25 degree Celsius consider venous–venous bypass or extracorporeal membrane oxygenation. (5) Consider open pleural lavage for direct cardiac rewarming if core temperature less than 28 degree Celsius after 1 hour bypass in an arrest rhythm. If signs of life, and no cardiac arrest, avoid CPR and ALS. If cardiac arrest, CPR and ALS are OK, only defibrillate once, consider withholding medications until temperature greater than 29 to 30 degree Celsius. (6) Do not treat atrial arrhythmias. (7) Use NS to treat decreased BP. Use vasopressors cautiously prn. (8) Consider D subscript 10 over D subscript 25, naloxone, hydrocortisone 1 milligrams per kilogram IV, antibiotics as needed.

Back to Table

A table shows evaluation and management of Crotalidae envenomation.
There are three columns. Grade, Features of Crotalidae Envenomation, and Laboratory. Row entries are as follows. Row 1: None; plus or minus Fang marks, no pain, erythema or systemic symptoms; None. Row 2: Mild; Fang marks, mild pain or edema, plus or minus vesicles, all within 10 to 15 centimeters of bite. No systemic symptoms; No abnormalities. Row 3: Moderate; Fang marks, all local signs extend beyond wound site. plus systemic symptoms, vomiting, paresthesias, mild coagulopathy, without

bleeding; Hemoconcentration, thrombocytopenia, hypofibrinogenemia. Row 4: Severe; Fang marks, severe pain or edema, severe symptoms, decreased BP, respiratory distress, coagulopathy with bleeding; Significant anemia, prolonged clotting time, metabolic acidosis.

Back to Table

A table shows salient characteristics of black widow spider bites. There are two columns. Data from the table are as follows. Black widow spiders: Found in all of the United States, mostly South; Females approximately 5 centimeters with legs and 1.5 centimeters without legs; Only females are toxic; 1 over 5 have red hourglass on abdomen. Features of black widow bites: Mild to moderately painful bite; In 1 hour, redness, swelling, and cramping at bite, which later spreads; Often no local symptoms are appreciated. Pain is felt in the abdomen, flank, thighs, and chest and is described as cramping; decreased BP, shock, coma, respiratory failure.

Back to Table

A table shows management of black widow spider bites. There are two columns. Data from the table are as follows. Lorazepam, Ativan 0.05 to 0.1 milligrams per kilogram IV; Consider Latrodectus antivenin; Dose: 1 to 2 vials IV in 50 to 100 milliliters NS; Skin test prior to using; Allergy and serum sickness can occur; Calcium is ineffective. Indications superscript 1 for admission or antivenin: Respiratory or cardiac symptoms; Severe cramping or pain despite lorazepam use; History of decreased BP or cardiac disease.

Back to Table

A table shows management of brown recluse spiders.
There are two columns. Brown recluse spiders and Management. Data from the table are as follows. Brown recluse spiders: Live mostly in the southern and midwestern United States. Bites are mild or painless. Characterized by a brown violin-shaped mark on the cephalothorax. Bites are often innocuous resulting in a delay in seeking care. At first, lesions are red with central blister or pustule. Later discoloration appears and pustule drains creating an ulcer. Fever, chills, arthralgias, GI upset, DIC, or shock. Hemoglobinuria, renal failure. Management: Wound care, tetanus. Refer to surgeon for possible excision if greater than 2 centimeter and well-circumscribed border. Plus or minus hyperbaric oxygen, controversial. Dapsone limited to adults with proven brown recluse bites. Dapsone not recommended in children due to risk of methemoglobinemia. Antivenom not commercially available.

Back to Table

A flowchart shows marine puncture wounds.
The steps involved are as follows. The organism that causes puncture wounds are classified into two groups; One of them includes sea snakes, blue ring octopus, cone snails; It causes lymphatic venous occlusion and pressure immobilization; Supportive and respiratory care Sea snake antivenin. The other groups includes starfish, sea urchin, stingrays, catfish, weeverfish, scorpionfish; Immerse in hot water 45 degree Celsius into 30 to 90 minute or until pain subsides. Irrigate, after local or regional anesthesia. Debride plus obtain X-ray to look for spine; Provide supportive care and administer. Stone fish scorpionfish antivenin.

Back to Table

A flowchart shows marine exposures causing urticaria or vesicles.

The steps involved are as follows. Marine exposures divided into two groups that cause urticaria or vesicles. One of them includes hydroids, fire coral, jellyfish, anemones; Treatment for pain. Apply acetic acid 5 percentage, isopropyl alcohol, 40 to 70 percentage, or baking soda for 30 minute. Remove nematocysts with forceps; Supportive care for systemic reaction. Antivenin for box jellyfish, C. fleckeri. Consider systemic steroids. The other group includes sponges, bristleworms; Extract spicules with adhesive tape; Acetic acid 5 percentage or isopropyl alcohol; Topical steroids if mild reaction. Treat for allergic reactions.

Back to Table

A table shows formulas.
There are two columns. Row entries are as follows. Row 1: Anion gap: Na+ – (Cl– 1 HCO3–), Normal = 8–16 milliequivalent per liter. Row 2: Osmolality gap: Measured – calculated osmolality, Normal = 0 to 10 milliosmole per liter. Row 3: Calculated osmolality (285 to 295 milliosmole per kilogram): (Na multiplied by 2) plus (Glucose divided by 18) plus (BUN divided by 2.8).

Back to Table

A table shows causes for the increase in the anion gap, normal anion gap, and osmolality gap.
There are two columns. Data from the table are as follows. Causes of increased anion gap: Methanol, metformin; Uremia; Diabetes; Paraldehyde; Iron, INH; Ethanol, ethylene glycol; Salicylates, starvation, seizure; Toluene, large ODs, CN, CO, colchicine. Causes of normal anion gap, hyperchloremic acidosis.: Fistula, biliary or pancreatic; Uretrogastric conduit; Saline administration; Endocrine: Addison’s, hyper-parathyroidism; Diarrhea; Carbonic anhydrase inhibitor; Ammonium chloride; Renal tubular acidosis;

Spironolactone.Unnumbered Table A table shows causes of increased osmolal gap. There is a single column. Data from the table are as follows. Causes of increased osmolal gap: Alcohols, methanol, ethylene glycol, isopropanol; Sugars, glycerol, mannitol; Ketones, acetone, diabetic ketoacidosis.

Back to Table

A table shows hypoalbuminemia correction.
There are two columns. Hypoalbuminemia correction; For each change in serum albumin of 1 gram per deciliter increased or decreased, serum calcium changes 0.8 milligrams per deciliter in same direction.

Back to Table

A table shows clinical features of hypocalcemia.
There are three columns. Data from the table are as follows. Symptoms: Paresthesia, fatigue, seizures, tetany, vomiting, weakness, laryngospasm. Physical findings: Hyperactive reflexes; Chvostek-Trousseau (C-T) signs; Low blood pressure; Congestive heart failure. Electrocardiogram: Prolonged QT, greater than 450 milliseconds, especially Ca+2 less than 6 milligrams per deciliter; Bradycardia; Arrhythmias.

Back to Table

A flowchart shows hypocalcemia etiology superscript 1,2.
The steps involved are as follows. True hypocalcemia classified into two; Low ionized calcium; Normal ionized calcium, Hypoalbuminemia: Nephrotic syndrome, Malabsorption; Low ionized calcium classified into three; Low Magnesium from Diuretics, Gentamicin, Cisplatin, Malabsorption; Normal

magnesium; Normal magnesium includes high parathyroid hormone and PTH normal or low hypoparathyroidism; Hyper magnesium from administration; low magnesium and high parathyroid hormone includes low phosphorus: Vitamin D deficiency, pancreatitis anti-coagulation, post-thyroidectomy; high parathyroid hormone includes pseudohypoparathyroidism, rhabdomyolysis, hyperalimentation, renal tubular acidosis, chronic renal failure.

Back to Table

A table shows the drugs that cause hypocalcemia.
There are three columns. Data from the table are as follows. Cimetidine; Cisplatin; Citrate, transfusion; Dilantin, phenobarbital; Gentamicin, tobramycin. Glucagon; Glucocorticoids; Heparin; Loop diuretics, Lasix; Magnesium sulfate. Phosphates; Protamine; Norepinephrine; Sodium nitroprusside; Theophylline.

Back to Table

A table shows hypocalcemia treatment.
There are five columns. Drug, Preparation, Elemental, Route, and Drug dose (max. dose). Row entries are as follows. Check serum electrolytes, BUN, creatinine, albumin, magnesium, arterial pH. Row 1: Calcium gluconate; 10 percentage solution, 100 milligrams per milliliter; 9.8 milligrams per milliliter; IM, IV; 0.5 to 1 milliliters per kilogram, 5 to 10 milliliter. Row 2: Calcium chloride; 10 percentage solution, 100 milligrams per milliliter; 27 milligrams per milliliter; IV; 0.2 to 0.3 milliliter per kilograms, 5 to 10 milliliter. Row 3: Calcium gluconate; 500, 650, 975, 1,000 milligrams; No data; PO; 100 milligrams per kilograms qid, 500 milligrams per kilograms.

Back to Table

A table shows clinical features of hypercalcemia.
There are two columns with a heading Etiology Hypercalcemia. Row entries are as follows. Row 1: General; Weakness, polydipsia, dehydration. Row 2: Neurologic; Confusion, irritability, hyporeflexia, headache. Row 3: Skeletal; Bone pain, fractures. Row 4: Cardiac; Hypertension, QT shortening, wide T wave, arrhythmia. Row 5: GI; Anorexia, weight loss, constipation, ulcer, pancreatitis. Row 6: Urologic; Polyuria, renal insufficiency, nephrolithiasis.

Back to Table

A flowchart shows hypercalcemia.
The steps are as follows. True hypercalcemia; Normal ionized calcium, Hemoconcentration, Binding to albumin or globulin, myeloma; Increased ionized calcium, square of serum phosphorus is classified into two; High phosphorus; Low phosphorus; High phosphorus symptoms shows high parathyroid hormone chronic renal failure, Lithium therapy; Normal, low parathyroid hormone, milk alkali syndrome, Vitamin D intoxication, Acromegaly, Granulomatous disease, Thyrotoxicosis, Malignancy, Addison's disease; Low phosphorus symptoms include low parathyroid hormone, Renal transplant; Normal, high parathyroid hormone, Hyperparathyroidism, Posttransplant, Thiazides, lithium immobilization, Familial hypercalcemia, Malignancy with PTH production, MEN second syndrome.

Back to Table

A table shows hypercalcemia management.
Data from the table are as follows. Especially important for calcium greater than 12 milligrams per deciliter, hypotension, or cardiac arrhythmias. IV NS 20 milliliters per kilograms with 30 milliequivalent per liter of potassium chloride with repeat boluses to keep urine output greater than 2 to 3 milliliters per kilogram per hour and increase calcium excretion. Furosemide 1 to 2 milligrams per kilogram can be used to promote urinary calcium excretion, after adequate hydration) but rarely necessary. Calcitonin SC, 2 to 4 U per kilogram q 24 hours or IV along with bisphosphonate acids like etidronate, ibandronate, risedronate, Clodronate, Alendronate, Pamidronate. Zoledronic act by inhibiting bone resorption. Consider glucocorticoid steroid if sarcoid, vitamin A or D toxicity, or leukemia, mithramycin, metastatic bone disease. Dialysis may also be useful.

Back to Table

A table shows hypokalemia, less than 3.5 milliequivalent per liter. Data from the table are as follows. Labs: Electrolytes, blood gas, drug screen. ACTH, cortisol, renin, aldosterone, insulin and C-peptide based on clinical suspicion of diagnosis. Clinical features of hypokalemia: Lethargy, confusion, weakness; Areflexia, difficult respirations; Autonomic instability, low BP. ECG findings in hypokalemia: Examples, Potassium less than or equal to 3 milliequivalent per liter: low-voltage QRS, flat T waves, decreased ST segment, prominent P and U waves; Potassium less than or equal to 2.5 milliequivalent per liter: prominent U waves; Potassium less than or equal to 2 milliequivalent per liter: widened QRS. Treatment of hypokalemia: Ensure good urine output first. If mild, replace orally only; Parenteral potassium if severe hypokalemia, for example, cardiac or neuromuscular symptoms or DKA; Administer Potassium no faster than 0.5 to 1 milliequivalent per kilogram per hour using less than or equal to 40 milliequivalent per liter cautiously while continuously on cardiac monitor, unless life-threatening hypokalemia, give no more than 20 milliequivalent per dose.

Back to Table

A flowchart shows hyperkalemia etiology.
Data from the table are as follows. Hyperkalemia: Potassium greater than 5.5 in child and greater than 6 in new born in nonhemolyzed sample. The steps involved are as follows. Elevated potassium; Repeat venous level, divided into two; Normal potassium: RBC hemolysis, Clotted sample, Prolonged storage, Cooling of specimen, Leukocytosis, Tight tourniquet, Hereditary, spherocytosis; Shift from cell: Acidosis, Insulin deficiency, Hyperosmolality, Succinylcholine, Digoxin overdose. Decreased

renal excretion: Kidney failure, Mineralocorticoid deficiency, Impaired tubular secretion, Potassium sparing diuretics. Data from the table are as follows. Clinical features: Paresthesia, weakness; Ascending paralysis sparing head, trunk, and respiration; Life-threatening arrhythmias. Evaluation: Electrolytes, glucose, calcium, mag, BUN, creatinine, osmolality, CBG, anion gap, CPK, EKG. EKG changes: Potassium 5.0 to 6.0: peak T waves; Potassium 6.0 to 6.5: decreased PR and QT intervals; Potassium 6.5 to 7.0: decreased P, decreased ST segments; Potassium 7.0 to 7.5: increased intraventricular conduction; Potassium 7.5 to 8.0: QRS widens, ST plus T waves merge; Potassium greater than 8: sine wave appearance. Treatment: Stop meds that increase potassium, low potassium diet, CR monitor. No EKG change or symptoms: Kayexalate 0.5 to 1.0 grams per kilogram orally and rectally in 3 to 5 milliliter of 20 percentage sorbitol. EKG change or symptoms: cardio protect with calcium gluconate 10 percentage 10 milligrams per kilogram IV max of 2 grams, slowly, lowers potassium 1.2 milliequivalent per liter in 4 to 6 hours; Move K from ECF to ICF: Insulin plus glucose, 0.5 to 1.0 grams per kilogram IV plus insulin, 1 U/3 g glucose IV; Nebulized albuterol, 2.5 milligrams in children , 25 kilograms, 5 milligrams in children greater than 25 kilograms; Sodium bicarbonate: 1 to 2 milliequivalent per kilogram IV, may repeat. Lower total body potassium; Diuretics: Furosemide 1 milligram per kilogram IV; Kayexalate 1 gram per kilogram orally or rectally, lowers potassium 1.2 milliequivalent per liter in 4 to 6 hours. Hemodialysis

Back to Table

A table shows clinical features of hyponatremia.
There are two columns. The data from the table are as follows. Lethargy, apathy, confusion; Depressed reflexes, muscle cramps; Pseudobulbar palsies. Cerebral edema; Seizures; Hypothermia.

Back to Table

A flowchart shows the algorithm for evaluation of hyponatremia. The steps involved are as follows. Check serum osmolality; If less than 280, True Hyponatremia, then Check urine osmolality; If urine osmolality less than 100 mOsm/kg, then normal water excretion, Primary polydipsia, Low solute intake; If it is greater than 100, then impaired water excretion; Exclude hypothyroidism and adrenal insufficiency; Check urine sodium; If urine sodium less than 20 milliequivalent per liter; Hypovolemia: GI loss (V/D), Blood loss, Third spacing, for example, burns, pancreatitis, peritonitis rhabdomyolysis, Rx: Isotonic saline, Specific treatment; Hypervolemia: Heart failure, Cirrhosis, Nephrotic, Syndrome, Capillary leak due to sepsis, Protein losing enteropathy, Decreased albumin, Rx: Diuretics; If urine sodium greater than 20 milliequivalent per liter; Hypovolemia: Renal loss, obstructive uropathy, PCKD, Prox RTA, Loop diuretics, Mineralocorticoid deficiency, Rx: Isotonic saline, Specific treatment; Euvolemia: SLADH, Low thyroid, Adrenal insufficiency, Stress, Drug use, Rx: Fluid restriction, Salt supplementation; Hypervolemia: Renal failure, RX: Fluid and salt restriction, dialysis, Specific treatment; If serum osmolality greater than or equal to 280, then it is classified into two ranges; If 280 to 295, Normal osmolality, Hyperlipidemia, Hyperproteinemia; If greater than 295, Increased osmolality, Hyperglycemia, 1.6 milliequivalent per liter for every 100 milligrams per deciliter, over 100 milligrams per deciliter.Unnumbered Figure Continuation of the flowchart showing the algorithm for evaluation of hyponatremia. The steps involved are as follows. Symptomatic with seizure, ataxia coma, etc.; No, ICU if less than 125; If euvolemic or overload, restrict 1 over 3 to 2 over 3 maintenance. Only use 0.9 NS; If dehydrated; 130 to 135: IV or oral; less than 130: 0.9 NS at maintenance; If yes; Rx with 3 percentage sodium chloride, 3 to 5 milliliter per kilogram over 15 to 30 minutes. Administer until

seizure stops or sodium greater than 120 1 milliliter per kilogram of 3 percentage by 1 milliequivalent per liter.

Back to Table

A table shows clinical features of hypernatremia.
The data from the table are as follows. Lethargy, irritability, coma; Seizures; Spasticity, hyperreflexia; Doughy skin; Late preservation of intravascular volume, and vital signs.

Back to Table

A flowchart shows hypernatremia, etiology, diagnosis, management. The steps involved are as follows. Sodium plus water loss with low total body sodium; Renal losses, osmotic diuresis, mannitol, glucose, urea; Diagnostic Test: U sodium greater than 20 milliequivalent per liter, U subscript osm hypotonic; Management: Hypotonic saline. Sodium plus water loss with low total body sodium; Extrarenal loss excess sweat, diarrhea; Diagnostic Test: U sodium less than 10 per liter, U subscript osm greater than 600 to 800 milliosmole per liter; Management: Hypotonic saline. Water loss with normal total body sodium; Renal loss diabetes insipidus nephrogenic, central, Serum osm greater than 295 milliosmole per liter, Serum sodium greater than 145 milliequivalent per liter, U subscript osm less than 150 milliosmole per liter; Diagnostic Test: U sodium varies U subscript osm often less than 100 to 150 milliosmole per liter; Management: Water replacement D subscript 5 W. Water loss with normal total body sodium; Extrarenal loss, Respiratory and skin loss; Diagnostic Test: U sodium varies U subscript osm greater than 600 to 800 milliosmole per liter milliosmole per liter; Management: Water replacement D subscript 5 W. Excess sodium with increased total body sodium; Primary hyperaldosteronism, Cushing’s syndrome, hypertonic dialysis,

hypertonic sodium bicarbonate, sodium chloride tablets, improperly mixed formulas; Diagnostic Test: U sodium greater than 20 milliequivalent per liter, U subscript osm isotonic or hypertonic; Management: Diuretic water replacement D subscript 5 W.

Back to Table

A table shows classification and management of dehydration. There are four columns. Classification, Isotonic, Hypotonic, and Hypertonic superscript1. Row entries are as follows. Row 1: Sodium milliequivalent per liter; 130 to 150; less than 130; greater than 150. Row 2: Cause; Usually GI2 and ECF3 fluid loss; Dilute fluid or water replacement; Too dilute formula, increased sodium intake, ICF3 greater than ECF3 loss. Row 3: Deficit; Sodium = water loss; Sodium greater than water loss; Water greater than sodium loss. Row 4: BP; Depressed; Very depressed; May be preserved. Row 5: RR; Increased; Increased; Minimal increase. Row 6: Skin or Turgor; Dry, Poor; Clammy, Very poor; Doughy, Fair. Row 7: Mentation; Lethargy; Coma or seizure; Irritable or seizure. Row 8: Rehydrate4; Normal saline; Normal saline; D5 1/2NS with potassium. Row 9: Unique feature, exclude hypoglycemia in all patients; Most common. Oral rehydration is appropriate for children if, 5 to 10 percentage dehydration if able to take liquids PO; Consider 3 percentage NS if seizures, life-threatening symptoms; NS can paradoxically increased sodium. Lower sodium less than 2 milliequivalent per liter per hour or less than 10 milliequivalent per liter per day. Too rapid Rx = congestive heart failure, CNS edema, renal damage; Plus or minus decreased calcium.

Back to Table

A table shows maintenance fluid calculation.
The data from the table are as follows. By Body Weight. 4 milliliters

per kilogram per hour, 100 milliliters per kilogram per day for 1st 10 kilogram, plus 2 milliliter kilogram per hour, 50 milliliters per kilogram per day for 2nd 10 kilogram, plus 1 milliliters per kilogram per hour, 25 milliliters per kilogram per day for each kilogram above 20 kilograms. Maintenance sodium requirements equal to 2 to 3 milliequivalent per 100 milliliter maintenance fluid administered; Maintenance potassium requirements equal to 2 milliequivalent per 100 milliliter maintenance fluid administered. Some experts, not all recommend isotonic saline, normal saline/NS over hypotonic saline, for example, 1 over 2 NS with appropriate potassium, etc., for maintenance fluids to decrease iatrogenic hyponatremia.

Back to Table

A table shows composition of oral and intravenous solutions. There are six columns. Solution, Sodium milliequivalent per liter, Potassium milliequivalent per liter, Chloride milliequivalent per liter, Bicarbonate milliequivalent per liter 1, and Glucose grams per deciliter. Row entries are as follows. Row 1: Extracellular fluid; 142; 4; 103; 27; approximately 0.1. Row 2: 0.9 NS; 154; 0; 154; 0; 0. Row 3: D5NS; 154; 0; 154; 0; 5. Row 4: 5 percentage albumin; 130 to 160; 0; 130 to 160; 0; 0. Row 5: Hypertonic 3 percentage NS; 513; 0; 513; 0; 0. Row 6: 0.45 NS; 77; 0; 77; 0; 0. Row 7: 0.3 NS; 51; 0; 51; 0; 0. Row 8: 0.2 NS; 34; 0; 34; 0; 0. Row 9: LR; 130; 4; 109; 28; 0. Row 10: Infant Carvajal’s2; 81; 0; 61; 20; 4.65. Row 11: Child Carvajal’s2; 132; 3.8; 109; 27; 4.8. Row 12: WHO solution3; 90; 20; 80; No data; 2.0. Row 13: Pedialyte; 45; 20; 35; 30; 2.5. Row 14: Rehydralyte; 75; 20; 65; 30; 2.5. Row 15: Resol; 50; 20; 50; 34; 2.0. Row 16: Ricelyte; 50; 25; 45; 10; 3.0. Row 17: Infalyte; 50; 20; 40; No data; 2.0. Row 18: Gatorade; 28; 2; No data; No data; 2.1. Row 19: Ginger ale; 4; 0.2; No data; No data; 9.0. Row 20: Coke or Pepsi; 3 by 2; 0.1 over 0.9; 13.4 over 7.3; 10.0 by 10.0; 10.5 by 10.5. Row 21: Apple or Grape juice; 1 to 4;

15 to 30; No data; No data; 12.0 over 15.0. Row 22: Jell-O; 24; 1.5; No data; No data.

Back to Table

A table shows treatment of dehydration by oral rehydration.
There are two columns. The data from the table are as follows. Oral rehydration: Wheat- and rice-based oral electrolyte solutions are superior to glucose solutions for rehydration, decreased stool frequency volume. WHO recommendations: First, hydrate with 100 milliliters per kilogram WHO formula over 4 hours. Then, 50 milliliters per kilogram of water or breast milk over next 2 hours. If still dehydrated, 50 milliliters per kilogram WHO formula next 6 hours. Then, 100 milliliters per kilogram of WHO formula over next 24 hours, then 150 milliliters per kilogram per day of WHO formula. Give additional free water with WHO formula or hypernatremia may occur.

Back to Table

A table lists common GI therapeutic agents.
There are three columns: Drug, Available forms, and Dosing. Row entries are as follows. Row 1: Bisacodyl or Dulcolax; Suppository: 10 milligrams. Tab: 5 milligrams; Oral, that is, greater than or equal to 3 to 10 years: 5 milligrams per day. Oral, that is, greater than 10 years: 5 to 15 milligrams per day. Rectal, that is, greater than or equal to 2 to 10 years: 5 milligrams QD. Rectal, that is, greater than 10 years: 5 to 10 milligrams QD. Row 2: Cimetidine; Solution: 300 milligrams per 5 milliliter. Tab: 200, 300, 400, 800 milligrams; Infant: 5 to 10 milligrams per kilogram per day div Q 6 hours to Q 12 hours. Child: 20 to 40 milligrams per kilogram per day div Q 6 hours to Q 8 hours, max 400 milligrams per dose.Adolescents greater than or equal to 16 years: 400 milligrams, 4 times per day

or 800 milligrams BID. Row 3: Docusate sodium or Colace; Syrup: 60 milligrams per 15 milliliter Solution: 12.5 milligrams per 5 milliliter, 50 milligrams per 5 milliliter, 50 milligrams per 15 milliliter. Cap or Tab: 50, 100, 250 milligrams. Cap as calcium: 240 milligrams. Suppository: 100 milligrams per 5 milliliter; 283 milligrams per 5 milliliter; Oral, that is, 6 months to 2 years: 12.5 milligrams TID. Oral greater than or equal to 2 to 12 years: 50 to 150 milligrams per kilogram per day div QD or QID. Oral, that is, greater than or equal to 12 years: 500 milligrams per day div BID or TID. Rectal, that is, 2 to 12 years: 100 milligrams per day. Rectal, that is, greater than or equal to 12 years: 283 milligrams QD. Row 4: Famotidine or Pepcid; Suspension: 40 milligrams per 5 milliliter. Cap or Tab: 10, 20, 40 milligrams. Chewable tab: 10, 20 milligrams. Injectable: 20 milligrams per 2 milliliter; Under Peptic ulcer: 1 to 16 years: 0.25 milligram per kilogram IV BID or 0.5 milligram per kilogram, PO QHS, that is, maximum of 40 milligrams per day. GERD: less than 3 months: 0.5 milligram per kilogram PO daily times 8 weeks. Greater than or equal to 3 to 12 months: 0.5 milligram per kilogram PO Q12 hours times 8 weeks. 1 to 16 years: 1 milligram per kilogram div BID, that is, maximum of 40 milligrams per dose. Row 5: Glycerin; Infant suppository; Insert plus retain greater than 15 minutes bid or daily prn. Row 6: Lactulose; Solution: 10 grams per 15 milliliters; 1 to 2 grams per kilogram per day, that is, 1.5 to 3.0 milliliter per kilogram per day. Row 7: Lansoprazole or Prevacid; Cap or Dissolving tab: 15, 30 milligrams; GERD: greater than or equal to 3 months: 7.5 milligrams BID or 15 milligram daily. 1 to 11 years: If less than or equal to 30 kilograms, 15 milligrams once daily. If greater than 30 kilograms, 30 milligrams once daily. Greater than or equal to 12 years: 15 milligrams once daily.

Back to Table

A table lists etiologies for crying in infants asterisk.
There are two columns: Diagnosis, and Frequency in percentage, that is, total n is equal to 237. Row entries are as follows. Crying with no other diagnosis; 65 or 27. Viral illness; 49 or 21. Gastroesophageal reflux; 30 or 13. Colic; 14 or 6. Other superscript 1; 14 or 6. Gastroenteritis; 12 or 5. Atypical colic that is, not meeting formal definition above; 11 or 5. Constipation; 11 or 5. Bronchiolitis; 8 or 3. Feeding disorder or difficulty 7 or 3. Otitis media; 7 or 3. Vaccine adverse event; 3 or 1. Reducible inguinal hernia; 3 or 1. Clavicle fracture; 2 or less than 1. Urinary infection or UTI; 2 or less than 1.

Back to Table

A table lists organic causes of constipation in children.
There are two columns. Row entries are as follows. Anatomic malformation; Imperforate anus, anal or colonic stenosis, anteriorly displaced anus, spinal cord dysplasia. Drugs or Environmental exposures; Opiates, anticholinergics, antidepressants, antacids, laxative abuse, chemotherapy, lead poisoning, botulism. Metabolic or Endocrine; Diabetes, hypercalcemia, hypokalemia, hypothyroidism, porphyria, multiple endocrine neoplasia type 2B. Neurogenic; Hirschsprung’s disease, anal sphincter achalasia, pseudo-obstruction, for example, visceral myopathy, visceral neuropathy. Spinal cord abnormalities; Myelomeningocele, spinal cord tumor, trauma, tethered cord. Systemic disease or other; Celiac disease, cystic fibrosis, milk protein intolerance, connective tissue disorders, for example, scleroderma, systemic lupus erythematosus or SLE, Ehlers-Danlos, and psychiatric disorder, for example, anorexia nervosa, or pelvic mass.

Back to Table

A flowchart shows diagnosis or management of functional constipation in children less than 6 months.
First, constipation diagnosed per Rome III criteria, symptom duration greater than 1 month, absence of organic pathology, no alarming signs. Then further on, is he or she exclusively breastfed when greater than 2 weeks old? If yes, likely to be normal. Reevaluate after 2 to 4 weeks. If not exclusively breastfed, verify proper formula preparation, keep a diary, education regarding stool patterns in infants. If patient continues to be symptomatic, and there is no fecal impaction, consider maintenance therapy, that is, see the following. If patient continues to be symptomatic, and or or there is fecal impaction, start medications. First line: Oral PEG with or without electrolytes: 1 to 1.5 grams per kilogram per day, max 100 grams per day, times 3 to 6 days. Alternative: If PEG is not available, 1 enema per day, that is, bisacodyl or sodium docusate times 3 to 6 days. Then start maintenance therapy for at least 2 months until symptom-free for 1 month. First line: Oral PEG 0.4 gram per kilogram per day, max 17 grams a day. Mix with 4 to 8 ounce fluid.Alternative: If PEG is not available, oral lactulose 1 to 2 grams per kilograms per day. If medications are not effective, refer to GI specialist. If symptoms return after a symptom-free period, may restart medications. Refer to GI specialist after two relapses.

Back to Table

A flowchart shows diagnosis or management of functional constipation in children greater than or equal to 6 months.
First, constipation diagnosed per Rome III criteria, symptom duration greater than 2 months if age greater than or equal to 4 years, absence of organic pathology, no alarming signs. If there is no fecal impaction, start with maintenance therapy, that is, see the following, education, diary, and toilet training. Reevaluate after 2 weeks. If there is fecal impaction, start medications. First line: Oral

PEG with or without electrolytes: 1 to 1.5 grams per kilogram per day, max 100 grams per day, times 3 to 6 days. Alternative: If PEG is not available, 1 enema per day, that is, bisacodyl or sodium docusate times 3 to 6 days. If treatment for fecal impaction is not effective, refer to a pediatric gastroenterologist. If treatment is effective for fecal impaction, continue with maintenance therapy, education, diary, and toilet training. Reevaluate after 2 weeks. Maintenance therapy: First line: PEG 0.4 gram per kilogram per day mixed with 4 to 8 ounce fluid. Alternative: If PEG is not available, lactulose 1 to 2 grams per kilogram per day. If maintenance therapy is effective, continue for 2 months until symptom free for 1 month. If symptoms return, refer to pediatric GI specialist. If maintenance therapy is not effective, titrate medication dosages, reeducate, and reassess. If symptoms persist, refer to GI specialist. If symptoms resolve after medication adjustment, continue maintenance therapy until symptom free for 1 month. If symptoms return, refer to pediatric GI specialist.

Back to Table

A flowchart shows American Academy of Pediatrics practice guideline for managing acute gastroenteritis.
First, obtain history and perform physical examination. Obtain current weight OR estimate percentage dehydration, that is, see page xx. Is one of following present? First, greater than or equal to 10 percent dehydration. Second, shock or altered mental status. Third, Ileus. If yes, then 20 milliliters per kilogram NS or LR IV over 10 to 15 minutes. May repeat twice, that is, 3 boluses total. Begin oral hydration. Hospitalize. If no, 6 to 9 percent dehydrated by weight loss or clinical estimate that is, page xx. Now, if its yes, oral rehydration at 50 to 100 milliliters per kilogram over 4 hours PLUS replace ongoing loss. Continue breastfeeding. This leads to the question, is patient tolerating oral therapy? If no, begin IV therapy

or options that follow. If yes, continue oral therapy for 4 to 6 hours or until rehydrated. Resume regular foods and replace ongoing loss with glucose electrolyte solution. Now, after 6 to 9 percent dehydrated by weight loss or clinical estimate, if it's a no, then it leads to 3 to 5 percent dehydrated by weight loss or clinical estimate. Now if it is a no, then it leads to less than 3 percent dehydrated by weight loss or clinical estimate that is, page xx. Continue regular diet. Consider added glucose electrolyte. But if it is a yes, oral rehydration at 50 to 100 milliliters per kilogram over 4 hours PLUS replace ongoing loss. Continue breastfeeding. This leads to the question, is patient tolerating oral therapy? If no, begin IV therapy or options that follow. If yes, continue oral therapy for 4 to 6 hours or until rehydrated. Resume regular foods and replace ongoing loss with glucose electrolyte solution.

Back to Table

A table lists upper gastrointestinal bleeding—etiology.
There are three columns: age, most frequent causes, and features. Row entries are as follows. Row 1: Newborn or Infants; Swallowed maternal blood, Vitamin K deficiency, Stress ulcers, that is, hospitalized infants, Gastritis or Esophagitis, Intestinal duplications and vascular anomalies, and milk protein allergy, that is, rarer cause; See Apt-Downey test, which follows. Row 2: Toddlers; Mallory-Weiss tears, Foreign body ingestion, Accidental ingestion of caustic chemicals, Gastritis, Frequent NSAID use, H. pylori infection, Henoch-Schönlein purpura, Hemolytic uremic syndrome or HUS, Perianal streptococcal cellulitis, and Varices; Mallory-Weiss tears: history of cough, retching, or vomiting. Varices: look for liver cirrhosis, portal vein thrombosis, portal HTN. Row 3: Older children or adolescents; Gastric ulcer, gastritis, esophagitis, varices, Pill esophagitis, Inflammatory bowel disease, that is, Crohn’s, ulcerative colitis, Enteric infections, Anal fissures, hemorrhoids, and

Hemophilia; no data.

Back to Table

A table lists most common causes of lower GI bleed presenting to a pediatric ED.
There are three columns: age, most frequent causes, and features. Row entries are as follows. Row 1: Newborn or infant; Cow's milk protein allergy, Anal fissures, Volvulus, Necrotizing enterocolitis, Hirschsprung's disease, Intussusception, and Intestinal duplications, vascular lesions; Milk protein allergy: associated with proctocolitis, hematochezia, may also be allergic to soy protein. Volvulus: bilious emesis, prematurity. Intussusception: lethargy, currant jelly stools, that is, late sign. Vascular lesion: Dieulafoy lesion, AVM, hemangioma. Row 2: Children; Enteric infection, Meckel's diverticulum, Intussusception, Vasculitis or Henoch-Schönlein, Hemolytic uremic syndrome, Lymphoid hyperplasia, Polyps, Rectal prolapse, Streptococcal perianal infection, and food coloring; HUS: after infection of E. coli O157 ratio H7. Lymphoid hyperplasia: common in IgA-deficient patients or hypogammaglobulinemia. Food coloring: fruit punch, beet, candies, licorice, blueberries spinach, iron. Row 3: Adolescents; Inflammatory bowel disease, that is, Crohn's and ulcerative colitis, Enteric colitis, Hemorrhoids, Anal fissure, Frequent NSAID use, and Vascular malformations; no data.

Back to Table

A table lists risk factors for severe hyperbilirubinemia superscript 1. The table shows the following information. Predischarge total serum bilirubin or transcutaneous bilirubin in the high-risk or high-intermediate risk zone, that is, see chart on page xx. Lower gestational age or jaundice in first 24 hours. Exclusive

breastfeeding, that is, especially if nursing poorly or excess weight loss greater than 8 to 10 percent. Isoimmune or other hemolytic disease, that is, G6PD deficient, hereditary spherocytosis. Prior jaundiced sibling, cephalohematoma or excess bruising, or East Asian race. Maternal diabetes, oxytocin use, and male sex are minor risk factors.

Back to Table

A table lists evaluation of neonatal Jaundice greater than 35-week gestation.
There are two columns. Row entries are as follows. Row 1: Jaundice for or less than 24 hours; transcutaneous bilirubin or TcB or total serum bilirubin or TSB. Row 2: Excessive jaundice for age; Measure TcB and or or TSB. Row 3: Jaundice requiring phototherapy, or a rapidly rising TSB not explained by history and physical examination; Blood type, Coombs test, that is, if cord blood not tested, CBC, peripheral smear, direct or conjugated bilirubin. Depending on age, TSB level: repeat TSB 4-24 hours. Optional: reticulocyte count, G6PD, and end tidal carbon monoxide or ETCO. Row 4: TSB nearing exchange levels or no phototherapy response; Reticulocyte count, G6PD, albumin, and ETCO, if available. Row 5: High direct or conjugated bilirubin, that is, above lab normal cutoffs; urinalysis and urine culture. Evaluate for sepsis, bowel or biliary disease if indicated by history and physical examination. Row 6: Jaundice at greater than or equal to 3 weeks or sick infant; Direct or conjugated bilirubin, direct bilirubin elevated assess for cholestasis, check thyroid, galactosemia screens, assess for hypothyroidism.

Back to Table

A table lists Transcutaneous Bilirubin or TcB cutoffs for high, low, and minimal risk superscript 1 for significant Hyperbilirubin

superscript 2,3 levels in newborns born at greater than or equal to 35 weeks.
There are four columns: Hours since birth, High risk level in milligram per deciliter, Low risk level in milligram per deciliter, and minimal risk level in milligram per deciliter. Row entries are as follows. Row 1: 12; 6.5; 4.5; 4.2. Row 2: 18; 7.7; 5; 4.8. Row 3: 24; 8; 5.8; 5.3. Row 4: 36; 9.3; 8; 7.8. Row 5: 48; 11; 9.5; 8.8. Row 6: 60; 12.5; 11; 10. Row 7: 72; 13.5; 13; 12.5.

Back to Table

A table lists bilirubin cutoffs in milligram per deciliter for initiating therapy in jaundiced newborns born at greater than or equal to 35 weeks.
There are six columns: Age, 24 hours, 48 hours, 72 hours, 96 hours, and 5 to 7 days. Row entries are as follows. Under cutoff for starting phototherapy superscript 1,2; Total serum bilirubin in milligram per deciliter. Row 1: Low risk, that is, greater than or equal to 38 weeks and well; 12; 15; 17.5 to 18; 20; 21. Row 2: Medium risk, that is, greater than or equal to 38 weeks plus risk, 35 to 37 6 by 7 weeks plus well; 10; 13; 15.5; 17; 18. Row 3: High risk, that is, 35 to 37 6 by 7 weeks plus risk; 6.5 to 7; 11; 13.5; 14.5; 15. Now, under cutoff for starting exchange transfusion superscript 1,3; Total serum bilirubin in milligram per deciliter. Row 4: Low risk; 19; 22; 24; 25; 25. Row 5: Medium risk; 16.5; 19; 21; 22; 22. Row 6: High risk; 15; 17; 18.5; 19; 19.

Back to Table

A table lists normal RBC indices, that is, mean plus minus 2 standard deviations.
There are six columns: Age, Hb in gram per deciliter, Hct in percentage, MCV in fork length, MCH in picogram, and MCHC in

gram by deciliter. Row entries are as follows. Birth; 16.5 plus minus 3.0; 51 plus minus 9; 108 plus minus 10; 34 plus minus 3; 33 plus minus 3. 1 to 3 days; 18.5 plus minus 4.0; 56 plus minus 14; 108 plus minus 13; 34 plus minus 3; 33 plus minus 4. 1 week; 17.5 plus minus 4.0; 54 plus minus 12; 107 plus minus 19; 34 plus minus 6; 33 plus minus 5. 2 weeks; 16.5 plus minus 4.0; 51 plus minus 12; 105 plus minus 19; 34 plus minus 6; 33 plus minus 5. 1 month; 14.0 plus minus 4.0; 43 plus minus 12; 104 plus minus 19; 34 plus minus 6; 33 plus minus 4. 2 months; 11.5 plus minus 2.5; 35 plus minus 7; 96 plus minus 19; 30 plus minus 4; 33 plus minus 4. 3 to 6 months; 11.5 plus minus 2.0; 35 plus minus 6; 91 plus minus 17; 30 plus minus 5; 33 plus minus 3. 0.5 to 2 years; 12.0 plus minus 1.5; 36 plus minus 3; 78 plus minus 8; 27 plus minus 4; 33 plus minus 3. 2 to 6 years; 12.5 plus minus 1.0; 37 plus minus 3; 81 plus minus 6; 27 plus minus 3; 34 plus minus 3. 6 to 12 years; 13.5 plus minus 2.0; 40 plus minus 5; 86 plus minus 9; 29 plus minus 4; 34 plus minus 3. 12 to 18 years that is, female; 14.0 plus minus 2.0; 41 plus minus 5; 90 plus minus 12; 30 plus minus 5; 34 plus minus 3. 12 to 18 years that is, male; 14.5 plus minus 1.5; 43 plus minus 6; 88 plus minus 10; 30 plus minus 5; 34 plus minus 3.

Back to Table

A table lists anemia differential diagnosis.
There are two columns. Row entries are as follows. Row 1: Microcytic; Iron deficiency, that is, RDW greater than 14 percent, thalassemia, that is, RDW less than 14 percent, chronic inflammation, sideroblastic anemia, lead poisoning, B6 deficiency. Row 2: Macrocytic; Folic acid or B12 deficiency, Fanconi’s syndrome, hepatic disease. Row 3: Normocytic, that is, high reticulocyte count; Extrinsic disorders: Antibody-mediated hemolysis, fragmentation hemolysis, DIC, hemolytic uremic

syndrome, artificial heart valves, liver and renal disease. Intrinsic disorders: Membrane disorders. Like spherocytosis, and elliptocytosis, enzyme deficiencies like glucose-6-phosphate dehydrogenase or pyruvate kinase deficiency, hemoglobin disorders like SS, SC, S-thalassemia. Row 4: Normocytic, that is, low reticulocyte count; Diamond-Blackfan, transient erythroblastopenia of childhood, aplastic crisis, bone marrow infiltrate like leukemia, and metastatic disease, renal disease, infection, malnutrition.

Back to Table

A table lists low-risk criteria for outpatient management of fever in sickle cell patients.
There are two columns: Greater than 12 months and chest X-ray without infiltrate. Row entries are as follows. Row 1: Well appearing; No ceftriaxone in past 8 weeks. Row 2: Fever less than 39.5 degree Celsius; No history of bacteremia or sepsis. Row 3: Normal vital signs; No splenic sequestration in past 4 weeks. Row 4: Tolerating P.O.; No recurrent visits for febrile illness. Row 5: No concern for sequestration, vasoocclussive crisis or chest syndrome; No history of noncompliance in past. Row 6: No hypoxia; Fully immunized. Row 7: No central venous device in place; High likelihood of follow-up, that is, has transportation and phone, not currently in shelter, no missed clinic appointments in past. Row 8: Baseline hemoglobin levels; No allergy to cephalosporin. Row 9: Reticulocyte greater than 1 percent, platelets greater than 100,00 per microliter; Remain clinically stable 3 hours after antibiotic is received. Row 10: WBC 5,000 to 30,000, negative UA; Endemic Streptococcus pneumoniae in the community is sensitive to antibiotics.

Back to Table

A table lists causes of acute chest syndrome.

There are three columns: Cause, 0 to 9 years, and 10 to 19 years. Row entries are as follows. Row 1: Infarction without known precipitant; 15.9 percent; 22.9 percent. Row 2: Viral; 10.9 percent; 2.7 percent. Row 3: Mycoplasma; 8.8 percent; 3.7 percent. Row 4: Fat embolism plus minus infection; 7.3 percent; 8.5 percent. Row 5: Chlamydia; 5.8 percent; 8 percent. Mixed infections; 4.9 percent; 1.6 percent. Bacteria; 4 percent; 6.4 percent. Mycobacteria, that is, TB and avium complex; 0.9 percent; 0. Unknown; 41.3 percent; 42 percent.

Back to Table

A table lists causes of abnormal bleeding tests superscript 1. There are two columns: Lab value and causes. Row entries are as follows. Row 1: Thrombocytopenia, Low platelet count, that is, less than 150,000 per milliliter; Spurious clotted sample. Pseudothrombocytopenia secondary to response to EDTA occurs in 1 in ratio to 1,500 people. This will correct if repeated with heparin tube. Decreased production of platelets, that is, due to drugs, toxins, or infections, splenic sequestration or platelet pooling, platelet destruction, that is, due to collagen vascular disease, drugs, post-transfusion, infection, ITP, DIC, TTP, HUS, or vasculitis. Row 2: Platelet dysfunction, with normal count; Adhesion defects, for example, von Willebrand disease or aggregation defects, for example, thrombasthenia. Row 3: Increased Bleeding time or BT, that is, greater than 9 minutes. Abnormal PFA-100, that is, platelet function test; All platelet disorders, DIC, ITP, uremia, liver failure, aspirin, abnormal PFA-100. Row 4: Increased partial thromboplastin time or PTT, that is, greater than 35 seconds; Coagulation pathway defects, that is, common factors II, V, X, intrinsic VIII, IX, XI, XII, von Willebrand, DIC, liver failure, heparin. Row 5: Increased Prothrombin time or PT, that is, greater than 12 to 13 seconds; Coagulation pathway defects, that is, common

factors II, V, X, extrinsic VII, DIC, liver failure, warfarin, circulating anticoagulants, that is, lupus anticoagulant. Row 6: Increased Thrombin time or TT, that is, greater than 8 to 10 seconds; DIC, liver failure or uremia, heparin, hypofibrinogenemia. Row 7: Increased Fibrinogen, Increased Fibrin split products or FSP; DIC.

Back to Table

A table lists replacement factors.
There are two columns: Medication and dose, that is, consult hematology for dosing recommendations, see recommendations for factor 8, 9 deficiencies on pages xx, xx. Row entries are as follows. Amicar; Aminocaproic acid: 25 to 100 milligrams per kilogram PO or IV every 6 to 8 hours for up to 7 days. Cryoprecipitate; Cryoprecipitate: 2 to 4 bags per 10 kilogram, 1 bag is equal to 50 to 100 units factor VIII activity. DDAVP; Desmopressin: 0.3 microgram per kilogram in 50 milliliters NS IV over 30 minutes or via nasal spray, that is, 1 puff if less than 50 kilograms, 2 if greater than 50 kilograms; useful if baseline activity greater than 10 percent. Activated factor VIIa; Recombinant activated human factor VII or recombinant FVIIa, 90 to 120 micrograms per kilogram q 2 to 3 hours IV. Factor VIII; Standard half-life products include: Advate, Hemofil-M, Koate, Kovaltry, Novoeight, Nuwiq, Recombinate, and Xyntha. There are now longer half-life products available that include: Adynovate, Afstyla, and Eloctate. Refer to prescribing information in the product insert for the use of factor replacement. Consult hematology. 1 unit per kilogram factor VIII increased activity level by 2 percent, that is, factor VIII half-life is equal to 12 hours. Factor IX; Standard half-life products include: AlphaNine SD, BeneFIX, Ixinity, Mononine, and Rixubis. There are now longer half-life products available that include Alprolix and Idelvion—refer to the product information for the use of factor replacement. Bispecific factor VIII; Emicizumab is a bispecific monoclonal

antibody used to replace activated factor VIII in patients who have hemophilia A without factor VIII inhibitors. Source: Mahlangu J, Oldenburg J, Paz-Priel I, et al. Emicizumab prophylaxis in patients who have hemophilia A without inhibitors. N Engl J Med. 2018;379(9):811 to 822. Emicizumab (ACE910) is an activated factor VIII used in patients with hemophilia A with factor VIII inhibitors. Source: Oldenburg J, Mahlangu JN, Kim B, et al. Emicizumab prophylaxis in hemophilia A with inhibitors. N Engl J Med. 2017;377(9):809–818.

Back to Table

A table lists treatment of von Willebrand disease or VWD.
The table shows the following information. Row entries are as follows. Row 1: Nose bleed; Nasal DDAVP on side not bleeding. If no response in 1 hour, IV DDAVP. If no response, pack, ENT consult, VWF. Row 2: Major bleed; CNS or GI bleed, major trauma: VWF. Row 3: Menorrhagia; DDAVP injection. Consider Amicar 1 DDAVP: 1 spray each nostril one time during acute episode. Row 4: Oral bleed; Nasal DDAVP and aminocaproic acid. Row 5: Surgery; Minor: DDAVP SC or IV plus Amicar. Major: VWF.

Back to Table

A table lists factor VIII deficiency treatment.
There are four columns: Bleed type, percentage activity desired, Dose superscript 3 in units per kilogram, and duration of therapy. Row entries are as follows. Under Severe superscript 1: CNS injury; 80 to 100; 40 to 50; 14 days. GI bleed; 80 to 100; 40 to 50; 3 days more than bleed. Major trauma; 80 to 100; 40 to 50; Depends on injuries. Retroperitoneal; 80 to 100; 40 to 50; 6 days. Retropharyngeal; 80 to 100; 40 to 50; 4 days. Pending surgery; 80 to 100; 40 to 50; Variable. Under Moderate superscript 2: Mild head

trauma; 40 to 50; 20 to 25; Variable. Deep muscle; 40 to 50; 20 to 25; Every day until resolution. Hip or groin injury; 40 to 50; 20 to 25; Repeat once in 1 to 2 days.

Back to Table

A table lists risk factors for pulmonary emboli and deep venous thrombi in children.
The table shows the following information. There are two columns. Row entries are as follows. Under risk factors, Central venous catheter; 33 percent. Birth control pill, abortion or miscarriage; 5 percent. Cancer; 23 percent. Obesity; 3 percent. Congenital heart disease; 15 percent. Lupus; 2 percent. Trauma; 15 percent. Sickle cell anemia; 2 percent. TPN administration; 8 percent. Liver failure; 2 percent. Infection; 7 percent. Other; 4 percent. Nephrotic syndrome; 6 percent. No risk factor identified; 4 percent. Recent surgery; 6 percent.

Back to Table

A table lists antimicrobials for neutropenia.
The table shows the following information. Alternate dosing may be needed if less than 3 to 6 months old. Cefepime 50 milligrams per kilogram, that is, max 6 grams per day, IV q 8 hours, or ceftazidime 150 milligrams per kilogram per day, max 6 grams per day, IV divided q 8 hours, or imipenem 60 to 100 milligrams per kilogram per day divided q 6 hours that is, max 4 grams per day, or aminoglycoside PLUS antipseudomonal beta-lactam ADD vancomycin 10 milligrams per kilogram, that is, max 500 milligrams, IV q 6 hours if any of the following: low BP, central catheter, chemotherapy plus any mucosal damage for example, oral ulcerations, prophylaxis with quinolones before fever, known colonization with penicillin-resistant pneumococci, known gram-

positive blood culture before susceptibility testing.

Back to Table

A table lists hyperviscosity or hyperleukocytosis syndrome.
The table shows the following information. Under Etiology, increase serum proteins with sludging and decrease circulation. Common causes: leukemia especially ALL. Under diagnosis, WBC, especially blasts, greater than 100,000 cells per millimeter cube. Increase Serum viscosity—Ostwald viscometer. Serum protein electrophoresis. Under clinical features, fatigue, headache, somnolence. Dyspnea, interstitial infiltrates, hypoxia, RV failure, renal failure. Decrease vision, seizure, deafness, myocardial infarction. Retinal bleed and exudates. Under management, IV Normal Saline or NS, plasmapheresis. Platelets if count less than 20,000 per millimeter cube. Phlebotomy with NS, and exchange transfusion that is, keep Hb less than or equal to 10 grams per deciliter. Antileukemic therapy.

Back to Table

A table lists passive hepatomegaly.
The table shows the following information. Under clinical features, associated with tumor infiltrate, especially neuroblastoma and less than 4 weeks old. May cause mechanical compromise of lungs, heart, GI or renal systems, or disseminated intravascular coagulation. Under management, treat persistent emesis, hypoxia, leg edema, renal insufficiency, or DIC; Chemotherapy; Low-dose radiation 150 centigray per day times 3; Surgical enlargement of abdominal wall.

Back to Table

A table lists spinal cord compression superscript 1.
The table shows the following information. Back pain; 80 percent. Weakness; 67 percent. Local back tenderness; 67 percent. Paraplegia; 57 percent. Loss of bowel or bladder control; 57 percent. Sensory abnormality; 14 percent. Diagnosis—Stat MRI is diagnostic study of choice. Plain films are abnormal in only 35 percent, bone scan in 54 percent. Use CT and MRI instead. Management— First, Dexamethasone 1 milligram per kilogram IV, then 0.25 to 0.5 milligram per kilogram PO q 6 hours, second, surgical decompression, especially previously unknown tumor type, third, radiation or chemotherapy depending on cancer sensitivity.

Back to Table

A table lists superior vena cava syndrome superscript 1.
The table shows the following information. Under clinical features, headache, swollen face, altered mental status, syncope, dyspnea, plethora, and venous distention of the face, neck, and arms with trachea compression. Under diagnosis, CXR first, then CT or MRI. Obtain an ECG and echo if possible cardiac involvement and pulmonary function testing if lung involvement. Under management, radiation, that is, can increase swelling, cause respiratory deterioration, distort histology. Diuretics or steroids are unproven but are often used. Cyclophosphamide 6 vincristine and anthracycline if non-Hodgkin’s or Hodgkin’s lymphoma suspected. Consult for stent of SVC.

Back to Table

A table lists management of symptomatic, intermediate, or high-risk tumor lysis patients.
The table shows the following information. Hydration with NS to keep urine output 80 to 100 milliliters per meter square per hour.

Diuretics may be needed. NaHCO3 is not recommended. Rasburicase or Elitek: 0.1 to 0.2 milligram per kilogram IV in 30 minutes but not if G6PD deficient. Allopurinol if Elitek not used. IV Calcium if symptomatic low Ca. Treat K plus greater than or equal to 7 millimoles per liter. Phosphate buffers if high P. Consider dialysis for K plus greater than or equal to 7 millimoles per liter, uremia, fluid overload, severe hyperphosphatemia.

Back to Table

A table lists blood products.
There are five columns: component, indication, dose, adverse effects, and special features. Row entries are as follows. Row 1: Albumin 5 percent superscript 1; Shock; 10 to 20 milliliters per kilogram; Rare volume overload, fever, urticaria; Stable storage, no filter, no disease transmission. Row 2: Plasmanate superscript 1; Shock; See above; Rare volume overload, fever, urticaria, hypotension; Stable storage, no filter, no disease transmission. Row 3: Hetastarch 6 percent or Hespan superscript 1; Volume expansion; 10 to 20 milliliters per kilogram; Pruritus, coagulopathy; Stable leukopheresis, no disease transmission. Row 4: Dextran superscript 1; Volume expansion; 10 milliliters per kilogram; Allergy, bleed, renal failure; Same as hetastarch. Row 5: Whole blood superscript 2; Hemorrhagic shock; 10 milliliters per kilogram will increase Hemoglobin 1 gram per deciliter; Transfusion reactions, hemolysis, disease transmission; Thrombocytopenia, coagulopathy, leukopenia. Row 6: Packed RBCs superscript 2; increase O2 carrying capacity and shock; 3 milliliters per kilogram will increase Hemoglobin 1 gram per deciliter; Less allergic and febrile reactions than whole blood; Administer 10 to 15 milliliters per kilogram. Row 7: Washed RBCs; decrease allergic reactions; 3 milliliters per kilogram will increase Hemoglobin 1 gram per deciliter; Rare; Takes 1 hour to wash and greater than 70 percent of RBCs lost. Row 8:

Leukocyte poor RBCs; 99.9 percent of WBCs are removed; 3 milliliters per kilogram will increase Hemoglobin 1 gram per deciliter; Rare; Use if 2 febrile nonhemolytic reactions to washed RBCs. Row 9: Apheresis platelets; Poorly functioning or decreased platelets; 5 to 10 milliliters per kilogram; Transfusion reactions are rare; No cross-matching, ABO compatibility is preferred. Row 10: FFP; Coagulopathy with bleeding; 10 to 25 milliliters per kilogram; Transfusion reactions are rare; No cross-matching, ABO group compatibility preferred.

Back to Table

A table lists Stage I and Stage 2 Hypertension Cutoffs. The first set of readings is Stage 1 at 95th percentile and the second set of readings is Stage 2, which is 95th plus 12 millimeters of Mercury. The table has three column headings, Age in years, Blood Pressure percentiles and Systolic and Diastolic Blood Pressure in Males and Systolic and Diastolic Blood Pressure in Females. Row 1: 2, 1st Stage: 95th, 106, 59, 106, 64. 2nd Stage: 95th plus 12 millimeters of Mercury, 118, 71, 118, 76. Row 2: 5, 1st Stage: 95th, 109, 69, 110, 71. 2nd Stage: 95th + 12 millimeters of Mercury, 121, 81, 122, 83.

Back to Table

A table lists Drugs administered in Hypertensive Emergencies. The table has five column headings: Drug, maximum dose, route and preparation, mechanism, onset and lasting time and features. The most common drugs are: Row 1: Esmolol, 100 to 500 micrograms per kilogram per minute, IV, Beta 1 blocker, less than 1 minute, can cause or worsen bronchospasm and severe bradycardia. Row 2: Hydralazine, 0 point 2 to 0 point 6 milligrams per kilogram per dose with a maximum of 0.4 milligram per

kilogram per dose by IV or IM, direct vasodilator, 5 to 30 minutes lasting 4 to 12 hours, causes tachycardia. Administer q 4 hours when given IV bolus. Row 3: Labetalol, 0.2 to 1.0 milligram per kilogram per dose with a maximum of 40 milligram per dose, IV or IM bolus, Infusion: 0.25–3 milligram per kilo per hour, alpha or beta blocker, 2 to 5 minutes lasting 3 to 5 hour half-life, contraindicated in asthma and heart failure.

Back to Table

A table lists the immunization schedule.
There are three columns: Age, Month which is further divided into Birth, 1, 2, 4, 6, 12, 15, 18 and 24, Year which is further divided into 4-6, 11-12, and 16-18. Row entries are as follows. Hepatitis B :HB first dose is administered at birth, second dose between 1 and 2 months and the third dose is given between 12 and 15 months. Rotavirus : RV first dose is given at 2 months, second at 4 months and third dose at 6 months. DTP: first dose is given at 2 months, second at 4 months, third at 6 months, fourth dose between 15 and 18 months and fifth dose between 4 and 6 years. The Tdap vaccine is given between 11 and 12 years. H. influenza B: the first dose is given at 2 months, second at 4 months, third at 6 months, and the fourth between 12 and 15 months. Pneumococci 13 superscript 1: the first dose of PCV is given at 2 months, second at 4 months, third at 6 months, and the fourth between 12 and 15 months. PCVS23 superscript 2 is given between 2 yrs to 18 years. Polio: The first dose of IPV is given at 2 months, second at 4 months, and third between 6 and 18 months and a booster dose between 4 to 6 years. MMR: The first dose of MMR is between 12 to 15 months and a booster dose between 4 to 6 years. Varicella: The first dose of VAR is between 12 and 15 months and a booster dose between 4 to 6 years. Meningococcal superscript 3: MCV dose between 2 months and 6 years if high risk, with asplenia or complement

deficient, and two doses between 11 to 12 years and 16 to 18 years. Papillomavirus: HPV superscript 4 dose between 11 to 12 years. Influenza or IIV superscript 5: Dose given between 6 to 18 years. Hepatitis A superscript 6: Doses given at 12 years and 18 years.

Back to Table

A table lists Hepatitis B exposure and appropriate treatment.
The table shows four column headings: Type of exposure, Status of source, Treatment if exposed patient is unvaccinated and Treatment of exposed patient if vaccinated. Row 1: Percutaneous or mucosal, HBsAg+, HBIG superscript 1 or HBV superscript 2, HBV and HBIG if exposed HBsAb–. Row 2: Known source, High risk for HBsAg+, HBV and HBIG if source HBsAg+, HBV and HBIG if source HBsAg+ and exposed HBsAb–. Row 3: Perinatal superscript 3, Mother is HBsAg+, HBV and HBIG within 12 hours of birth, HBV. Row 4: Mucosal or sex or perinatal, Unknown, HBV, HBV. Row 5: Sex, HBsAg+, HBIG or HBV, HBV.

Back to Table

A table lists tetanus immunization for various conditions.
The table shows three column headings: Prior immunization, all other wounds and clean or minor wounds. Row 1: Uncertain or less than three doses, Tdap superscript 1 or TIG superscript 2, Tdap or DTap or Td. Row 2: three doses or more, Tdap if more than 5 years since last dose, Tdap if more than 10 years since last dose.

Back to Table

A table lists Postexposure Rabies Prophylaxis
The table shows two column headings: Animal, and treatment

depending on its status. Row 1: Dogs, cats, ferrets, if healthy and can observe for 10 days, then prophylaxis if animal shows signs of rabies. If rabid or suspected, then RIG and HDCV, if unknown, then RIG and HDCV if high risk. Row 2: Bats, skunks, raccoons, coyotes, foxes and mongooses, all regarded as rabid unless geographic area known to be free of rabies, RIG and HDCV. Row 3: Rodents, rabbits, hares and livestock, consult public health but rarely require rabies prophylaxis.

Back to Table

A table shows regimens and Drug Choices for Adult and Pediatric HIV PEP.
There are two columns: Age of patients and treatment regimen. Row 1: Adults and adolescents more than or equal to 13 years with normal renal function, Tenofovir DF 300 milligrams and emtricitabine 200 milligrams daily with raltegravir 400 milligrams twice daily or dolutegravir 50 milligrams daily, Or Tenofovir DF 300 milligrams and emtricitabine 200 milligrams daily with darunavir 800 milligrams daily and ritonavir 100 mg daily. Row 2: Children 2–12 years, Tenofovir DF, emtricitabine and raltegravir with drug dosed to age and weight, Or Tenofovir DF, emtricitabine and lopinavir/ritonavir with drug dosed to age and weight, Or Zidovudine and lamivudine with raltegravir or lopinavir/ritonavir. Row 3: Children 3–12 years, Tenofovir DF, emtricitabine and darunavir/ritonavir with drug dosed to age and weight. Row 4: Children 4 weeks to less than 2 years, Zidovudine oral solution, lamivudine oral solution with raltegravir or lopinavir/ritonavir oral solution with drug dosed to age and weight, Or Zidovudine and lamivudine with raltegravir or lopinavir/ritonavir. Row 5: Children birth to 27 days, consult a pediatric HIV specialist.

Back to Table

A table shows Drugs and Dosing for PEP.
The table has two column headings, drugs and dosing. Row 1: Tenofovir DF, 8 milligrams per kilogram maximum 300 milligrams QD for children 2–11 years. Row 2: Emtricitabine, 6 milligrams per kilogram maximum 200 milligrams QD for children 3 months–17 years, 3 milligrams per kilogram QD for children 0–3 months. Row 3: Raltegravir, 400 milligrams BID for children 6–12 years and weighing more than 25 kilograms, Chewable tablets: 75 milligrams BID for children 2–12 years weighing 11 to less than 14 kilograms, 100 milligrams BID for children 2–12 years and weighing 14 to less than 20 kilograms, 150 milligrams BID for children 2–12 years and weighing 20 to less than 28 kilograms, 200 milligrams BID for children 2–12 years and weighing 28 to less than 40 kilograms, 300 milligrams BID for children 2–12 years and weighing more than or equal to 40 kilograms.

Back to Table

A table lists the Empiric Antimicrobial Therapy.
There are two columns. The row entries are as follows. Row 1: Abscess; Drainage required, see specific site in text for antibiotics, e.g., brain, parapharyngeal. See methicillin-resistant Staphylococcus aureus or MRSA if skin. Row 2: Acne Retin-A, Epiduo gel, and Tazorac are not approved less than 12 years old or if pregnant No tetracycline derivatives if less than or equal to 8 years old; Mild—Topical benzoyl peroxide or BP or topical retinoid. Moderate—Topical combination therapy or retinoid plus BP OR retinoid plus BP plus antibiotics, abx. Severe—oral abx plus topical retinoid plus BP plus or minus topical abx. Example product formulations or combinations. Topical retinoid: tretinoin, adapalene, tazarotene. Topical BP plus retinoid: EpiDuo Gel. Topical BP plus Abx: Acanta, BenzaClin, Benzamycin, and Duac gel. Topical retinoid plus Abx: Veltin or Ziana Gel. Oral abx: Doxycycine 50 to

150 milligrams every day, erythromycin 250 to 500 milligrams every day, tetracycline 500 milligrams bid, minocycline IR 50 to 100 milligrams every day. Row 3: Adenitis; See cellulitis face options; consider cat scratch, mycobacteria. Row 4: Aeromonas; Diarrhea—ciprofloxacin or levofloxacin times 3 to 5 days. Dose: page xxx. Row 5: Amebiasis; See Entamoeba histolytica. Row 6: Ancylostoma; Ancylostoma braziliense—See cutaneous larval migrans, Ancylostoma duodenale—See Hookworms. Row 7: Anthrax exposure; See page xxx for exposure prophylaxis and disease treatment. Row 8: Appendicitis Regimens are for suspected perforation, e.g., pain more than 36 to 48 hours, temp more than 101 degree Farenthiet, diffusely tender; 1st line: Piperacillin-tazobactam OR ertapenem OR moxifloxacin, Alternative agents: ciprofloxacin or levofloxacin plus metronidazole OR cefepime plus metronidazole, Refer to Lexicomp for dosing. Row 9: Arthritis, septic; See Septic arthritis. The row entries are as follows. Row 1: Ascaris lumbricoides, roundworm; 1st line: Mebendazole or Vermox, 100 milligrams PO bid times 3 days OR albendazole 200 milligrams PO times 1 day if less than or equal to 13 kg, or 400 milligrams PO times 1 day if greater than 13 kilograms. 2nd line: greater than or equal to 15 kilograms ivermectin 150 to 200 micrograms per kilogram per dose times 1 day. Row 2: Avian “flu”; See influenzae. Row 3: Balanitis; Mild—Topical antibiotic, mupirocin 2 percent ointment bid, and or or antifungal, clotrimazole 1 percent cream or miconazole 2 percent cream four times per day. Addition of 1 percent hydrocortisone may be beneficial. Moderate to severe— Clindamycin OR Augmentin plus Bactrim, dose page xxx. Row 4: Bell’s palsy, Consider otic or mastoid disease; Herpes is the cause in a large number of cases: prednisone 1 to 2 milligram per kilogram per day, max 60 milligrams, times 7 to 10 days AND, acyclovir 10 milligram per kilogram per dose PO 4 times per day OR if more than or equal to 50 kilograms, valacyclovir, Valtrex, 1

gram PO three times per day times 7 to 10 days. Debate exists as to efficacy of antivirals superscript 1. Row 5: Bites, animals Oral dosing pages xxx, xxx Need to consider tetanus and rabies prophylaxis; Dog or Cat – PO: Augmentin 22.5 milligrams per kilogram PO bid OR clindamycin plus levofloxacin. IV: ampicillin–sulbactam OR clindamycin plus levofloxacin. Rat – prophy: penicillin VK or doxycycline more than 8 years old; if clinical evidence of infection: IV penicillin, cefuroxime, cefotaxime, or doxycycline. Reptiles– 1st line: augmentin. Alternatives: cefpodoxime plus metronidazole OR levofloxacin plus clindamycin. Row 6: Bite, human Consider MRSA coverage, page xxx, If question of joint involvement, consult orthopedic or hand surgeon; PO: Augmentin 22.5 milligram per kilogram PO bid OR clindamycin plus, either ciprofloxacin OR TMP-SMX, IV—Ampicillin or Sulbactam, cefoxitin, or piperacillin-tazobactam. PCN allergic: clindamycin plus, either ciprofloxacin OR TMP-SMX. Row 7: Bordetella pertussis; Azithromycin, 1 to 5 months: 10 milligrams per kilogram per day times 5 days. More than or equal to 6 months: 10 milligrams per kilogram per day PO on day 1, then 5 milligrams per kilogram per day, OR clarithromycin OR TMP-SMX. See dose on page xxx. Only decreases disease if given in catarrhal stage. Antibiotics can decrease recurrence and transmission. Row 8: Botulism; See Clostridium botulinum. Row 9: Bowel perforation; See appendicitis regimens. Row 10: Brain abscess; Ceftriaxone AND vancomycin AND metronidazole, meningitis doses. Substitute aztreonam for ceftriaxone if penicillin allergy. The row entries are as follows. Row 1: Bronchitis; Antibiotics are not indicated unless cystic fibrosis, bronchopulmonary dysplasia, chronic aspiration, lung hyperplasia, or ciliary dyskinesia. If cough persists more than 4 weeks, consider reactive airway disease, foreign body aspiration, cystic fibrosis, sinusitis, pertussis, or tuberculosis. Row 2: Bubonic plague; See plague on page xx for exposure or disease or

treatment and antimicrobials page xxx. Row 3: Campylobacter jejuni; Diarrhea—Azithromycin 10 milligrams per kilogram per day PO times 3 days, max 500 milligrams per day, OR erythromycin 40 milligrams per kilograms per day PO divided four times per day times 5 days, max 2 grams per day. Row 4: Candida; Thrush: neonate—Nystatin 1 milliliter per cheek four times per day apply with cotton swab. Child- 400,000 to 600,000 units swish and swallow four times per day until clear for 48 hours. Suspension: 100,000 units per milliliter. Pharyngeal candidiasis—fluconazole 6 milligrams per kilogram PO times 1, max 400 milligrams per day, then 3 milligrams per kilogram per day, max 200 milligrams per day, times 7 to 14 days, 21 days for esophageal, if less than 14 days old, dose every 72 hours, otherwise every 24 hours. Row 5: Cat scratch disease; Azithromycin OR TMP-SMX, see dose on pages xxx–xxx. Mild disease resolves without treatment. Row 6: Cellulitis bite; See bite recommendations. Row 7: Cellulitis—face, periorbital, or orbital; Mild, immunized, healthy, no MRSA—Augmentin or clindamycin. Ill, unimmunized, sinusitis, or MRSA— vancomycin 1, either ampicillin or sulbactam OR ceftriaxone OR aztreonam. ADD metronidazole to ceftriaxone or aztreonam containing regimen if dental infection is source. Row 8: Cellulitis trunk or extremity See MRSA page xxx; Mild–moderate, and methicillin resistance not suspected—Cephalexin OR dicloxacillin OR macrolide, dose pages xxx–xxx. Mild–moderate, methicillin resistance possible— Linezolid or Zyvox OR Septra OR clindamycin, see dose pages xxx–xxx Moderate to severe—Oxacillin OR nafcillin 25 to 50 milligrams per kilogram IV every 6 hours, max 12 grams per day, OR ertapenem or Invanz if more than 3 months, 15 milligrams per kilogram IV or IM every 12 hours, max 1 gram per day, OR cefazolin 25 to 33 milligrams per kilogram IV every 6 to 8 hours, max 6 grams per day, AND treat MRSA. Row 9: Cervical adenitis; See cellulitis face options; consider cat scratch, mycobacteria. The row entries are as

follows. Row 1: Chlamydia trachomatis urethritis, cervicitis See PID if needed also treat empirically for gonorrhea; Adolescents: Azithromycin 1 gram PO times 1 dose OR doxycycline 100 milligrams PO bid times 7 days. Pregnancy: Azithromycin 1 grams PO times 1 dose. Infants or children less than 45 kilograms, anogenital tract: erythromycin base or ethylsuccinate: 12.5 milligrams per kilogram per dose four times per day times 14 days. Dosing is for urethritis, cervicitis, or asymptomatic stage only See conjunctivitis for neonatal recommendations. Row 2: Cholecystitis; See Appendicitis choices on page xxx. Row 3: Cholera; See Vibrio cholera. Row 4: lostridium botulinum first provide respiratory support; Infant botulism—age, 1 year: Human botulinum immunoglobulin, BabyBIG. Age. 1 year: Heptavalent equine serum botulinum antitoxin. Contact 770 to 488 to 7100 or CDC, 1–800-CDC-INFO, via each state's health department for agent. AVOID antibiotics— may lyse C. botulinum in gut and increase toxin load. Foodborne botulism—Heptavalent equine serum botulinum antitoxin. See previous contacts. Row 5: C. difficile; Clostridium difficile—See pseudomembranous colitis. Row 6: Conjunctivitis Macrolides, esp. erythromycin, may cause pyloric stenosis less than 6 weeks; Neonate—If gonorrhea, ceftriaxone 25 to 50 milligrams per kilogram IM times1 dose, max 125 milligrams, OR cefotaxime 100 milligrams per kilogram per day IV divided every 12 hours times 1 day. If severe infection, therapy may need to be continued for more than 1 day. ADD azithromycin 20 milligrams per kilogram PO times 3 days or erythromycin 7.2 to 15 milligrams per kilogram PO four times per day for 14 days. More than 2 weeks—Erythromycin, Ilotycin, 0.5 percent ointment apply every 4 hours until clear times 2 days OR gentamicin, Garamycin, 0.3 percent ointment or solution apply every 3 to 4 hours times 7 to 10 days OR Polytrim, if more than 2 months, 1 drop every 3 to 6 hours times 7 to 10 days OR tobramycin, Tobrex, 0.3percent solution or ointment

—apply every 3 to 4 hours times 7 to 10 days. More than or equal to 1 year—Azithromycin, AzaSite, 1 drop twice a day times 2 days, then 1 drop every days times 5 days OR besifloxacin 0.6 percent, Besivance, 1 drop three times per day times 7 days OR ciprofloxacin, Ciloxan, 0.3 percent solution 1 to 2 drops every 2 hours times 2 days, then every 4 hours times 5 days OR moxifloxacin, Vigamox, 0.5 percent solution 1 drop three times per day times 7 days OR above more than 2 weeks old regimen. Row 7: Corneal ulcer; See keratitis, bacterial, recommendations. Do not patch eye if Pseudomonas is a concern, e.g., contact lenses; also, consult ophthalmology and ensure Pseudomonas coverage if contact lens wearer. The row entries are as follows. Row 1: Cryptosporidium parvum; if immunocompetent—Nitazoxanide, Alinia: 100 milligrams per 5 milliliter or 500 milligrams tab available. Use 5 milliliter if 1 to 3 years old, 10 milliliter if 4 to 11 years, 500 milligrams, or 25 milliliter if more than or equal to 12 years old administered every 12 hours with food for 3 days. Efficacy not established more than 12 years old. If HIV1—treat with antiretrovirals; nitazoxanide may not be effective. Row 2: Cutaneous larval migrans; Albendazole, Albenza, 15 milligrams per kilogram PO times 1, max 400 milligrams; 200 milligrams tab, OR ivermectin, Stromectol, 200 micrograms per kilogram PO times 1, if more than or equal to 15 kilograms only. Row 3: Cyclospora; TMP-SMX times 7 to 10 days, page xxx. Row 4: Dacryocystitis; See cellulitis face. Row 5: Dental infection, Outpatient—Penicillin VK, amoxicillin-clavulanic acid, or clindamycin, page xxx. Inpatient—Ampicillin or sulbactam, Unasyn 50 to 100 milligrams per kilogram IV every 6 hours, max dose: ampicillin 8 grams per day, OR clindamycin 25 to 40 milligrams per kilogram per day IV divide every 8 hours, max 2.7 grams per day. Row 6: Diarrhea; See Salmonella, Shigella, Escherichia coli, Campylobacter, Yersinia, traveler’s, Vibrio. Row 7: Diphtheria Rare disease, primarily in

persons from developing countries; Antitoxin—1. Laryngeal-pharyngeal: 20,000 to 40,000 units IM; 2. nasopharyngeal: 40,000 to 60,000 units IM; 3. extensive disease more than 3 days or neck swelling 80,000 to 120,000 units IM. Call CDC or state health department: 404–639-8257, 770–488-7100. Antibiotics—Erythromycin OR penicillin G IV times 14 days. Exposure to infected person, household or habitual contact—Erythromycin 40 to 50 milligrams per kilogram per day times 7 to 10 days, max 2 grams per day, OR penicillin G benzathine 600,000 units IM, if less than 30 kilograms, or 1,200,000 units IM, if 30 kilograms times 1. Culture for C. diphtheriae and observe times 7 days with follow-up cultures 2 weeks later. Row 8: Discitis; See Osteomyelitis and MRSA. Row 9: E. coli diarrhea; Rifaximin, Xifaxan, if more than or equal to 12 years old: 200 milligrams PO three times per day times 3 days OR Septra OR cefixime OR azithromycin, Zithromax, times 5 days, see dosing, pages xxx–xxx, OR STEC Shiga toxin E. coli 0157:H7; does not improve with antibiotics. Row 10: Ehrlichiosis, disease detail on page xxx; Doxycycline 4.4 milligrams per kilogram per day PO or IV divided bid, max 200 milligrams per day, for more than or equal to 3 days after defervescence for total of 5 to 10 days of therapy; rifampin, chloramphenicol, and possibly fluoroquinolones have been recommended as alternatives, consult infectious disease experts for dosing or indications. The row entries are as follows. Row 1: Encephalitis; See herpes simplex. Row 2: Endocarditis, prophylaxis indicated next; Unknown organism—Penicillin G 150,000 units per kilogram per day divided every 4 to 6 hours, max 24 million units per day, OR ceftriaxone, Rocephin, 100 milligrams per kilogram every 24 hours, max 4 grams per day, AND gentamicin 2 to 2.5.5 milligrams per kilogram IV every 8 hours AND vancomycin 60 milligrams per kilogram per day divided every 8 hours; alter regimen once sensitivity known. Penicillin allergic—Daptomycin, Cubicin, 6 to 8 milligrams per kilogram every 24

hours, not FDA approved for peds, OR gentamicin 2 to 2.5.5 milligrams per kilogram every 8 hours AND vancomycin 40 to 60 milligrams per kilogram per day divided every 6 hours, max 2 grams per day. Row 3: Endocarditis— Prophylaxis See indications page xx; Administer PO drugs 1 hour and IV or IM 30 minutes preprocedure: amoxicillin 50 milligrams per kilogram PO OR azithromycin 15 milligrams per kilogram PO OR clindamycin 20 milligrams per kilogram PO or IV OR ceftriaxone, Rocephin, 50 milligrams per kilogram IV or IM OR ampicillin 50 milligrams per kilogram IV per IM. Row 4: Entamoeba histolytica; Asymptomatic amebiasis—Iodoquinol 30 to 40 milligrams per kilogram per day PO divided every 8 hours, max 2 gram per day, times 20 days OR paromomycin, Humatin, 25 to 35 milligrams per kilogram per day PO divided every 8 hours times 7 days, max 2 grams per day. Mild to moderate intestinal disease—Metronidazole, Flagyl, 35 to 50 milligrams per kilogram per day PO or IV divided every 8 hours times 7 to 10 days OR tinidazole, Fasigyn or Tindamax, 50 milligrams per kilogram per day, if more than 3 years old, PO every 24 hours, max 2 grams per day, times 3 to 5 days AND complete therapy of iodoquinol or paromomycin as per Asymptomatic amebiasis. Severe intestinal or extraintestinal disease—Metronidazole IV regimen above OR tinidazole oral regimen above, PLUS paromomycin as per Asymptomatic amebiasis. Row 5: Enterobius vermicularis or pinworms; primary: Mebendazole 100 milligrams PO times 1 OR pyrantel pamoate 11 milligrams per kilogram base, max of 1 gram. Alternative: albendazole 15 milligrams per kilogram PO times 1, max 400 milligrams. Repeat dose in 2 weeks to kill incubating parasites. Row 6: Epididymo-orchitis, consider torsion; Prepubertal—Treat as urinary tract infection, see page xxx. Postpubertal—Treat as per gonorrhea, uncomplicated disease recommendations, AND doxycycline times 10 to 14 days. Row 1: Epiglottitis; Ceftriaxone 75 to 100 milligrams

per kilogram IV, max 2 grams per day, every 24 hours. Row 2: Esophagitis; See Candida—esophageal. Row 3: Giardia lamblia; Primary: Tinidazole, if more than 3 years old, 50 milligrams per kilogram per day PO times 1 dose, max 2 grams per day. Alternative: Metronidazole 15 to 30 milligrams per kilogram per day divided three times per day times 5 to 7 days, max 250 milligrams per dose, OR Nitazoxanide bid for 3 days, 100 milligrams per dose if 1 to 3 years old; 200 milligrams per dose if 4 to 11 years; 500 milligrams per dose if more than or equal to 12 years, OR Albendazole, if more than or equal to 2 years old, 10 milligrams per kilogram per day once daily times 5 days, max 400 milligrams per dose. Row 4: Gingivitis; See herpes simplex—gingivostomatitis. Row 5: Gonorrhea, also treat for Chlamydia; Arthritis, dermatitis—Ceftriaxone, Rocephin, 50 milligrams per kilogram IV or IM, max 1 grams per day, every 24 hours' time 7 days. Meningitis or endocarditis—Ceftriaxone 50 milligrams per kilogram IV every 12 hours, max 4 grams per day, times 14 days if meningitis OR times 28 days if endocarditis. Ophthalmia neonatorum or conjunctivitis—Ceftriaxone 50 milligrams per kilogram IM or IV times 1, max neonatal dose 125 milligrams, otherwise max dose 1 gram. PID—see pelvic inflammatory disease. Uncomplicated, cervicitis or urethritis or pharyngitis or proctitis,—ceftriaxone 125 milligrams IM OR cefixime, Suprax, 8 milligrams per kilogram PO times 1, max 400 milligrams. Row 6: Helicobacter pylori; 2 antibiotics, amoxicillin, clarithromycin, or metronidazole, PLUS, proton pump inhibitor—lansoprazole, esomeprazole, pantoprazole, omeprazole, or bismuth subsalicylate, times 14 days super script 2. Row 7: Herpes simplex keratitis, contact ophthalmologist for treatment coordination and recommendation; Encephalitis superscript 3—non-HIV-exposed or -positive, 3 months to 12 years: Acyclovir 10 to 15 milligrams per kilogram per dose IV every 8 hours times 21 days. More than or equal to 12 years: 10 milligrams per kilogram per dose every 8

hours for 21 days. Genitalis—first episode— Acyclovir, 12 years old: 40 to 80 milligrams per kilogram per day PO divided into 3 to 4 doses per day times 5 to 10 days, max 1,200 milligrams per day; more than or equal to 12 years old: 200 milligrams five times daily, or 400 mg three times per day times 7 to 10 days. OR unapproved options—(1) famciclovir if more than or equal to 45 kilograms or adolescents: 250 milligrams PO three times per day times 7 to 10 days OR (2) valacyclovir 20 milligrams per kilogram per dose, max 1000 milligrams per dose, bid times 7 to 10 days. Row 1: blank; • Genitalis—recurrence, Acyclovir less than 12 years old: 20 milligrams per kilogram per dose, max 400 milligrams per dose, three times per day. more than or equal to 12 years old 200 milligrams five times daily, or 400 milligrams three times per day, or 800 milligrams bid times 5 days, or 800 milligrams three times per day times 2 days OR unapproved options (1) famciclovir, adolescents, 1 gram PO bid times 1 day or 500 milligrams times 1, then 250 milligrams bid times 2 days total or 125 milligrams bid times 5 days, 1b, 125 milligrams PO bid times 5 days OR (2) valacyclovir, 50 kilograms: 20 milligrams per kilogram per dose, max 1000 milligrams per dose, bid times 5 days; more than or equal to 50 kilograms: 1000 milligrams once daily times 5 days. Genitalis—suppressive therapy—Use each agent for 1 year; acyclovir 20 milligrams per kilogram per dose, max 400 milligrams per dose, bid, OR unapproved options (1) famciclovir, adolescents only, 250 milligrams PO bid OR (2) valacyclovir 20 milligrams per kilogram per dose, max 1000 milligrams, once daily. Gingivostomatitis and labialis—Acyclovir 20 milligrams per kilogram per dose four times per day times 5 to 7 days, max 1.2 grams per day; for herpes labialis— acyclovir 5 percent cream or ointment, topically 5 times per day times 4 days OR penciclovir 1 percent cream every 2 hours while awake times 4 days OR docosanol 10 percent 5 times per day until healed OR famciclovir 1.5 grams PO

times 1 dose, adolescents only. Keratitis4—ganciclovir 0.15 percent gel 1 drop 5 times per day until corneal ulcer heals then 1 drop three times per day times 7 days, only approved more than or equal to 2 years old, OR trifluridine 1 percent 1 drop every 2 hours, max 9 gtt per day, while awake until re-epithelialization of corneal ulcer occurs, then 1 drop every 4 hours for another 7 day, many experts recommend adding oral therapy, such as acyclovir 80 milligrams per kilogram per day, max dose 400 milligrams, divided 5 times per day times 7 to 14 days. Topical therapy might cause corneal toxicity —close follow up by an ophthalmologist is recommended. Topical steroids are relatively contraindicated; they are sometimes used during stromal, not epithelial, stage to decrease scarring. Row 2: Herpes simplex; Neonatal disease superscript 3,4—Acyclovir 20 milligrams per kilogram IV every 8 hours times 14 days for disseminated disease, and for 21 days if CNS or Neurologic involvement. Premie neonates—20 milligrams per kilogram IV every 8 to 12 hours; ADD topical antiviral if neonate eye disease, trifluridine dosing as per keratitis, mentioned previously. Row 1: Herpes zoster; Immunocompetent or Healthy host and more than or equal to 12 years old— Acyclovir 800 milligrams 5 times per day times 5 to 7 days OR valacyclovir 1 gram PO three times per day times 5 days. See varicella for chicken pox disease or exposure management. Disseminated or immunocompromised or severe chicken pox—Acyclovir 10 milligrams per kilogram per dose IV every 8 hours times 7 to 10 days. Row 2: HIV exposure; See pages xx–xxx. Row 3: Hookworm; Mebendazole, Vermox, 100 milligrams PO bid times 3 days or 500 milligrams PO times 1, OR albendazole, Albenza, 15 milligrams per kilogram PO times 1, max 400 milligrams, OR pyrantel pamoate 11 milligrams per kilogram per day times 3 days, max 1 gram per day. Test for cure in 2 weeks, and if disease still present, repeat treatment. Row 4: Impetigo MRSA, page xxx; Localized disease or limiting person-to-person

spread: topical Retapamulin OR mupirocin apply three times per day. More extensive superscript 5 disease or systemic symptoms: Augmentin, 90 milligrams per kilogram per day in two divided doses for 10 days, OR cefadroxil OR cephalexin OR azithromycin PO for 5 days, dose on page xxx; see MRSA if this is a concern. Row 5: Influenza treatment6 Start therapy at any time if any of the following are present: progressive symptomatic illness, less than 2 years of age, chronic medical condition, immunocompromised, hospitalized, pregnant, within 2 weeks post-partum. Can consider therapy if symptom onset less than or equal to 2 days for patients not at risk of influenza complications. Peramivir—not approved, CDC recommended emergency use, see CDC website for updates. Influenza A or B—Oseltamivir, Tamiflu, administered bid times 5 days, see dosing on page xxx. Severe disease, not responding, unable to take orals or inhaled medicines—IV Peramivir: 0 to 30 days: 6 milligrams per kilograms every 24 hours IV; 31 to 90 days: 8 milligrams per kilograms every 24 hours IV; 91 to 180 days: 10 milligrams per kilograms every 24 hours; 181 days to 5 years: 12 milligrams per kilograms every 24 hours; 6 to 17 years: 10 milligrams per kilograms every 24 hours, max 600 milligrams per kilograms per day; do not use if Tamiflu resistant and downward facing arrow dose if renal insufficiency. Row 1: Influenza prophylaxis; Influenza A or B —Oseltamivir, Tamiflu; use same dose as administered for treatment but only administer every 24 hours. Row 2: IV catheter-port-central line infection superscript 3, 4, 7, 8; Vancomycin 15 milligrams per kilogram IV every 6 hours AND ceftriaxone 50 to 100 milligrams per kilogram IV every 24 hours OR cefepime 50milligrams per kilogram per dose IV every 8 hours OR piperacillin-tazobactam 240 to 300 milligrams piperacillin per kilogram per day divided in 3 to 4 doses; maximum daily dose: 16 grams per day. Can add gentamicin 2 to 2.5 milligrams per kilogram IV every 8 hours for severe cases. Immunodeficient or

neutropenic: see neutropenic fever. Row 3: Keratitis Coordinate care with ophthalmologist for most cases; Bacterial—Bacteria cause 65 to 90 percent of all keratitis cases. Consider Nocardia and Mycobacterium after refractive surgery, or LASIK. Treatment: (1) Fortified tobramycin, 14 milligrams per milliliter, AND fortified cefazolin, 50 milligrams per milliliter, OR fortified vancomycin, 15 to 50 milligrams per milliliter, OR (2) Fortified cefazolin 1 third or fourth generation fluoroquinolone topically OR (3) gatifloxacin, Zymar, or moxifloxacin, Vigamox. Dosing: One drop is applied every 5 to 15 minutes 3 first hour. Then, antibiotic is applied every 30 minutes, but alternated so that a drop is instilled every 15 minutes, for 6 to 12 hours. Then, administer one 1 drop of each every hours while awake times 24 to 72 hours, then slowly reduce to every 6 to 8 hours times 10 to 14 days. Zymar or Vigamox not approved, 1 year old. Viral—See herpes simplex and herpes zoster. Parasitic—Acanthamoeba can cause infection in contact lens wearer, esp. if wear overnight; specialized treatment. Row 4: Lice; See pediculus humanus capitis, pediculosis. Row 5: Ludwig’s angina; See retropharyngeal abscess antibiotics, consult surgeon. Row 6: Lyme disease superscript 9 See page xxx for detail regarding early vs. late disease; Early, all PO—Doxycycline 4.4 milligrams per kilogram per day divided bid, max 00 milligrams per dose, times 10 days OR amoxicillin 50 milligrams per kilogram per day divided three times per day, max 500 milligrams per day, times 14 days OR cefuroxime 30 milligrams per kilogram per day divided bid, max 500 milligrams per dose, times 14 days. If unable to take beta-lactam or doxycycline: Azithromycin 10 milligrams per kilogram per day once daily for 7 days. Administer doxycycline or amoxicillin for 14 days for isolated facial palsy. Administer oral agent for 28 days for arthritis. Early disease with meningitis or carditis or more than mild early arthritis or later stage disease—Ceftriaxone 75 to 100 milligrams per kilogram per day IV every 24 hours, max 2 gram OR penicillin

G 200,000 to 400,000 units per kilogram per day IV, max 24 million units per day, divided every 4 hours times 14 to 28 days. Row 1: Mastoiditis9 CT brain and mastoids; Acute—1st episode: Cefuroxime, Zinacef, 150 milligrams per kilogram per day IV or IM divided every 8 hours, max 6 grams per day, OR ceftriaxone, Rocephin, 50 milligrams per kilogram per day IV or IM administered every 24 hours, max 2 grams per day, times 10 days. Consider coverage of MRSA, page xxx. Acute exacerbation of chronic Otitis Media—vancomycin 15 milligrams per kilogram per day every 6 to 8 hours 1 piperacillin-tazobactam 300 milligrams per kilogram tazobactam per day divided every 6 to 8 hours. Chronic—Cefepime, Maxipime, 100 to 150 milligrams per kilogram per day divided every 8 hours IV, max 6 grams per day, OR meropenem, Merrem if more than 3 months—20 milligrams per kilogram IV every 8 hours, max 3 grams per day. If severe infection: 40 milligrams per kilogram IV every 8 hours—max 6 grams per day. OR ceftazidime, Fortaz, 100 to 150 milligrams per kilogram per day IV or IM divided every 8 hours, max 6 grams per day, PLUS MRSA coverage, page xxx, and 6 surgery. Row 2: Measles super script 10; Exposure—measles vaccine, if administered within 72 hours of exposures, if susceptible and more than or equal to 6 months. Susceptible equals all persons unless they had documented measles, born before 1957, lab evidence immunity, or completed appropriate live-virus vaccination. DO NOT give if neomycin allergy, TB, immunosuppressed, steroid use, hematological cancer, pregnant, less than or equal to 3 months from blood or immunoglobulin use. Use of live vaccine less than or equal to 72 hours after exposure prevents disease. Use immunoglobulin, IG, within 6 days of exposure for any of the following: immunosuppressed, pregnant women without evidence of measles immunity, infants, 6 months of age, or infants 6 to 11 months if unable to receive MMR vaccine. Infants: IGIM 0.5 lowercase milliliter per kilogram, max 15 milliliter.

Pregnant women without evidence of measles immunity and severely immunocompromised hosts: IVIG 400 milligrams per kilogram. Give measles vaccine 6 months after IGIM, if child is at least 12 months of age. Treatment: Vitamin A times 2 days, as follows; less than 6 months: 50,000 IU once daily; 6 to 11 months: 100,000 IU once daily; .ore than or equal to 12 months: 200,000 IU once daily times 2 days. Row 1: Meningitis preterm to less than 1 month old superscript 11; Empiric Therapy: Ampicillin plus cefotaxime, OR, Ampicillin plus gentamicin. Add acyclovir if history or physical exam findings are concerning for HSV encephalitis. Ampicillin dosing: PNA less than or equal to 7 days 200 to 300 milligrams per kilogram per day every 8 hours. PNA more than 7 days 300 milligrams per kilogram per day every 6 hours. Cefotaxime: PNA less than or equal to 7 days and more than or equal to 2 kg: 100 to 150 milligrams per kilogram per day every 8 to 12 hours. PNA more than 7 days and more than or equal to 2 kg: 150 to 200 milligrams per kilogram per day every 6 to 8 hours. Gentamicin dosing: 0 to 4 weeks old plus birth weight, bw less than 1,200 grams, 2.5 milligrams per kilogram every 18 to 24 hours. Less than week old and bw more than 1,200 g, use 2.5 milligrams per kilogram every 12 hours. 1 to 4 weeks old and bw 1,200 to 2,000 g, 2.5 milligrams per kilogram every 8 to 12 hours. 1 to 4 weeks old and bw more than 2,000 g, 2.5 milligrams per kilogram every 8 hours. Row 2: Meningitis superscript 11 1 month–50 years If possible administer dexamethasone before antibiotics; 1 to 2 months old—Cefotaxime 225 to 300 milligrams per kilogram per day divided every 6 to 8 hours, max 12 grams per day, AND vancomycin 15 milligrams per kilogram per day IV every 6 hours. 2 months to 8 years—ceftriaxone 100 milligrams per kilogram per day IV divided every 12 to 24 hours, max 4 grams per day, AND vancomycin 15 milligrams per kilogram IV every 6 hours. Add acyclovir if history or physical exam findings are concerning for HSV

encephalitis. Add dexamethasone 0.4 milligrams per kilogram IV every 12 hours times 2 days if Haemophilus influenzae type b or Streptococcus pneumoniae suspected, controversial. Row 3: Meningococcemia; See Neisseria meningitidis disease. Row 4: Community-acquired MRSA, CA-MRSA superscript 3, 4; Outpatient therapy—clindamycin 30 to 40 milligrams per kilogram day PO every 6 to 8 hours, max single dose: 450 milligrams, OR if more than or equal to 2 months, sulfamethoxazole-trimethoprim 8 to 12 milligrams trimethoprim per kilogram per day. PO every 12 hours. Row 3: MRSA Inpatient treatment; Empiric Inpatient Therapy—vancomycin 15 milligrams per kilogram dose every 6 to 8 hours. Row 4: Molluscum contagiosum superscript 3; No consensus on management. Most effective and quick cure: physical destruction of lesions, curettage, cryodestruction with liquid nitrogen, electrodesiccation, and chemical agents, to elicit a local inflammatory response. Topical cantharidin 0.7 percent, Cantharone, topical salicylic acid with, lactic acid or acetic acid, Compound W, Duofilm, Duoplant, Mediplast, Mosco Corn and Callus Remover, Occlusal HP, multiple wart removing products. Row 1: Mumps; Vaccine is NOT effective in preventing disease after exposed. Row 2: Necator; Necator americanus—See hookworms. Row 3: Necrotizing fasciitis superscript 12, surgical consult, See MRSA page xxx; Vancomycin 15 milligrams per kilogram every 6 to 8 hours PLUS piperacillintazobactam 100 milligrams piperacillin per Kilogram per dose IV every 6 hours, max of 4 grams piperacillin per dose, PLUS clindamycin 13 milligrams per kilogram per dose IV every 8 hours, max 900 milligrams per dose. Row 4: Neisseria meningitidis superscript 3,4,13; Exposure defined—Prophylaxis if household contacts, same childcare or nursery, share toothbrush, close social contact, ate or slept in same dwelling in past 7 days or if sat directly next to diseased person on flight more than 8 hours. No prophylaxis for healthcare worker unless mouth-to-mouth

resuscitation, intubated, or suctioned patient before antibiotic administration. • Exposure treatment—Rifampin 10 milligrams per kilogram PO every 12 hours times 2 days, max daily dose 600 milligrams; if, 1 month old, 5 milligrams per kilogram PO every 12 hours times 2 days OR ceftriaxone 125 milligrams if less than or equal to 15 years old, or 250 milligrams IM if less than or equal to 15 years old. Disease—See Meningitis for empiric coverage. Definitive therapy: Penicillin G IV, 300,000 U per kilogram per day IV; maximum, 12 million units per day, divided every 4 to 6 hours, OR ceftriaxone 100 milligrams per kilogram per day divided every 12 to 24 hours; maximum daily dose: 4,000 milligrams per day. Treat for 5 to 7 days. Row 5: Neutropenic fever superscript 4, 13 Fever: Single oral temp. More than or equal to 38.3 degree Celsius or 101 degree Fahrenheit, OR more than or equal to 38 degree Celsius or 100.4 degree Fahrenheit, for more than or equal to 1 hour. Neutropenia: less than 500 cells per mm superscript 3 OR, 1,000 cells per mm superscript 3 and predicted to drop less than 500 mm superscript 3; Cefepime 50 milligrams per kilogram IV every 8 hours, max 6 gram per day, OR meropenem 20 milligrams per kilogram IV every 8 hours, max 1 gram per day, OR piperacillin or tazobactam 300 to 400 milligrams tazobactam per kilogram per day divided every 6 to 8 hours, max 4 grams tazobactam per dose. ADD vancomycin 15 milligrams per kilogram IV every 6 hours if: downward facing arrow BP, central catheter, chemotherapy plus mucosal damage, quinolone or sulfonamide use before fever onset, known colonization with pneumococci resistant to penicillin, or known gram-positive blood culture, or cellulitis, MRSA. ADD macrolide if pneumonia, Zithromax, Biaxin; OR antifungal, OR antiparasitic if these infections are a concern. Row 6: Omphalitis; less than or equal to 2 months old—vancomycin AND gentamicin, see meningitis dosing. More than 2 months old—vancomycin AND ceftriaxone, see meningitis dosing. Add metronidazole to above

regimens if anaerobic coverage is needed, e.g., foul smelling discharge, born to mothers with amnionitis. Row 1: Onychomycosis; See tinea unguium. Row 2: Osteomyelitis superscript 13 Consider pseudomonas if foot or rubber sole puncture or immune deficiency; Vancomycin 15 milligrams per kilogram per dose every 6 to 8 hours plus ceftazidime or cefepime. Cephalosporin dosing: cefepime 50 milligrams per kilogram IV every 8 hours, max 6 grams per day, OR ceftazidime 50 milligrams per kilogram IV every 8 hours, max 6 grams per day. Row 3: Otitis externa super script 4, 13; Ear drops: ciprofloxacin plus dexamethasone – 4 drops into affected ear twice daily OR ciprofloxacin plus hydrocortisone – 3 drops into affected ears twice daily OR ofloxacin 5 to 10 drops into affected ears once daily. Duration: 7 days • If “malignant”: chronic, ill or Pseudomonas suspected— See chronic mastoiditis antibiotic choices and doses, page xxx. Row 4: Otitis media; See CDC or AAP or AAFP recommendations page xxx. Row 5: Papillomavirus superscript 13 If flat anogenital warts test for syphilis, VDRL or RPR, Respiratory papillomatosis—Best treated by ENT with lasers, intralesional interferon, cidofovir, or indole-3-carbinol; Flat warts on skin—Topical salicylic acid, over the counter, tretinoin, Retin-A, 0.025 to 0.1 percent cream applied daily, AVOID these medicines on mucosa, cryotherapy, or laser surgery. Anogenital warts, condylomata acuminata,—imiquimod 5 percent, Aldara; only approved more than or equal to 12 years, apply every hours 3 times per week—wash off in 6 to 10 hours UNAPPROVED agents in children (1) podofilox 0.5 percent, Condylox, apply bid 3 consecutive days/week for up to 4 weeks OR (2) podophyllin 10 to 25 percent, Podocon-25, Podofin, Podofilm, — apply initially for 30 minutes to test skin sensitivity, apply one drop at a time and allow to dry until affected area covered. In 1 to 4 hours wash off. Consider application of petroleum jelly or talcum powder to nonaffected area to avoid skin

contact. Repeat once a week for up to 6 weeks. Use lowest dose possible, 5 to 10 percent, and do not apply to bleeding, friable lesions to decrease systemic toxicity. Row 6: Parapharyngeal; Parapharyngeal abscess: See retropharyngeal abscess. 7: Row Pediculus humanus capitis super script 4, 16, 17, pediculosis or lice. First Line: permethrin 1 percent lotion or shampoo. Apply sufficient quantity to saturate hair or scalp to shampoo-washed and towel-dried hair or scalp. Also apply behind the ears and at the base of the neck. Leave on times 10 minutes. Repeat in 7 to 10 days. Treatment failure with permethrin: Benzyl alcohol, Ulesfia, 5 percent lotion, use only if more than or equal to 6 months old—Saturate dry scalp and hair, rinse off with water after 10 minutes, repeat in 1 week, 1 bottle per 8 ounces, OR ivermectin 0.8 percent solution, ivermectin not approved, 15 kilograms, OR malathion 0.5 percent shampoo times 10 minutes, reapply in 1 week OR spinosad 0.9 percent suspension 10 minutes, reapply in 1 week. Row 1: blank; Resistance to topical therapy —sulfamethoxazole or trimethoprim, TMP, 5 milligrams TMP per kilogram per dose bid PO times 10 days, max 320 TMP per day, best if combined with permethrin OR ivermectin, Stromectol, 200 micrograms per kilogram PO on days 1 and 10 if more than 15 kg. Row 2: Pelvic inflammatory disease 18, PID, Age more than 12 years Inpatient, CDC, treatment Choose Regimen A, B, or C; Regimen A—Cefoxitin, or Mefoxin, 2 grams IV every 6 hours OR cefotetan 2grams IV every 12 hours, AND doxycycline 100 milligrams PO or IV every 12 hours times 14 days. Regimen B—Clindamycin 900 milligrams IV every 8 hours AND gentamicin 2 milligrams per kilogram times 1, then 1.5 milligrams per kilogram IV every 8 hours. Regimen C—Ampicillin or Sulbactam, Unasyn, 3 grams IV every 6 hours AND doxycycline 100 milligrams IV every 12 hours. Switch to oral outpatient medications that follow once clinically improved for 24 hours. Row 3: PID, Outpatient, CDC superscript 18 treatment

Choose Regimen A or B; Regimen A—Ceftriaxone 250 milligrams IM times 1 AND doxycycline 100 milligrams PO bid times 14 days plus minus ADD metronidazole 500 milligrams PO bid times 14 days. Regimen B—Cefoxitin 2 grams IM times 1 AND probenecid 1 g PO times 1 AND doxycycline 100 milligrams PO bid times 14 days plus minus ADD metronidazole 500 milligrams PO bid times 14 days. Row 4: Perforated bowel; Or peritonitis; see appendicitis perforation regimens. Row 5: Peritonsillar; Peritonsillar abscess—see retropharyngeal abscess. Row 6: Pertussis; See Bordetella pertussis, pages xxx, antibiotics, xxx, or disease. Row 7: Pinworm; See Enterobius vermicularis. Row 8: Pharyngitis superscript 19 Group A strep. Do not use erythromycin, 48 percent resistance; Penicillin G benzathine less than 27 kilograms: 600,000 units IM times 1; more than or equal to 27 kilograms: 1.2 million units IM times 1, OR azithromycin times 3 to 5 days OR first generation cephalosporin OR amoxicillin 50 milligrams per kilogram once daily, max 1000 milligrams per dose times 10 days OR penicillin VK, children: 250 milligrams 2 to 3 times daily; adolescents 500 milligrams 2 times daily times 10 days. PCN Allergy, nonimmediate hypersensitivity: cephalexin 20 milligrams per kilogram perdose bid times 10 days, max 500 milligrams per dose, or cefadroxil 30 milligrams per kilogram per dose once daily, max 1000 milligrams per dose times 10 days. PCN Allergy, immediate hypersensitivity: azithromycin 12 milligrams per kilogram per dose once daily, max 500 milligrams per dose times 5 days OR clarithromycin 7.5 milligrams per kilogram perdose 2 times per day, max 250 milligrams per dose times 10 days. Row 1: Plague, Yersinia pestis super script 20 Side effects vs. disease risk must be considered before drug selection. Streptomycin not widely available; Disease detail—see page xx. Exposure—if exposed to known or suspected plague source within the previous 6 days,—doxycycline or ciprofloxacin times 7 days—dosing page xxx. Treatment— (1)

streptomycin 15 milligrams per kilogram per dose IM twice daily OR (2) gentamicin 2.5 milligrams per kilogram per dose every 8 hours. Alternative agents to consider: ciprofloxacin, levofloxacin, moxifloxacin, tetracycline, doxycycline, and chloramphenicol. Row 2: Pneumocystis jiroveci superscript 4,13,21, carinii - Treatment Most require admittance due to high infant or child mortality rates; First line: sulfamethoxazole or trimethoprim, 15 to 20 milligrams TMP per kilogram per day PO or IV divided every 6 to 8 hours times 14 to 21 days. Alternatives: pentamidine 4 milligrams per day IV times 14 to 21 days, OR 1 of following, specialized dosing or cautions: trimethoprim plus dapsone OR atovaquone, Mepron OR primaquine plus clindamycin. ADD Solumedrol 1 milligrams per kilogram IV every 12 hours OR prednisolone OR prednisone PO 1 milligrams per kilogram per day bid if pO2, 70 millimeter Hg. Row 3: Pneumonia superscript 4, 22 Aspiration; Ampicillin or sulbactam, Unasyn, 150 to 200 milligrams ampicillin per kilogram per day IV divided every 6 hours, max 2000 milligrams ampicillin per dose, OR Clindamycin 30 to 40 milligrams per kilogram per day IV divided every 6 to 8 hours, max dose 2.7 grams per day. Row 4: Pneumonia 0 to 3 months old super script 4, 13 If severe, add MRSA coverage, page xxx; 0 to 4 weeks—Ampicillin 100 to 300 milligrams per kilogram per day IV divided every 8 to 12 hours AND, gentamicin—see meningitis dosing or cefotaxime 50 milligrams per kilogram per dose every 12 hours if less than or equal to 1 week old or every 8 hours if more than 1 week old. More than 4 weeks–3 months—Ampicillin 100 to 200 milligram per ms per kilogram day divided every 6 hours AND cefotaxime 50 milligrams per kilogram IV every 6 hours, max 12 grams per day. If Chlamydia is cause, use erythromycin 12.5 milligrams per kilogram per dose PO or IV four times daily times 14 days. Beware of pyloric stenosis risk with EM. Row 5: Pneumonia superscript 23 Community acquired. 3 months old Limited evidence suggests that

linezolid has better alveolar penetrance compared to vancomycin; Inpatient more than 3 months old—Cefotaxime 100 to 200 milligrams per kilogram per day divided every 6 to 8 hours, max 12 grams per day, or ceftriaxone 50 milligrams per kilogram per day administered every 24 hours, max 2 grams per day, AND azithromycin, Zithromax or clarithromycin, Biaxin or erythromycin; see doses on pages xxx and 122, AND if moderate–severe disease, significant effusion, cavitary lesion, or other MRSA risk, linezolid, Zyvox, 10 milligrams per kilogram IV every 8 hours, if full term, more than 1 week old, or vancomycin 15 milligrams per kilogram IV every 6 hours, max 1 gram per dose. Row 1: blank; Outpatient, less than 5 years old — First line: Amoxicillin 90 milligrams per kilogram per day divided every 12 hours, max 4000 milligrams per day. Alternative: amoxicillin or clavulanate 90 milligrams per kilogram per day, amoxicillin component, divided every 12 hours Amoxicillin allergy: cefpodoxime, cefuroxime or cefprozil; see dosing page XXX. NOTE: Mycoplasma and Chlamydia pneumonia can occur less than or equal to 4 years. If these organisms are suspected, fully immunized infant/child, wheezing, afebrile, interstitial pattern etc., substitute azithromycin as first line OR add azithromycin as a second agent. See doses on pages xxx. Outpatient, more than or equal to 5 years old: Amoxicillin 90 milligrams per kilogram per day divided every 12 hours, max 4000 milligrams per day. Add azithromycin if unable to distinguish bacterial from atypical CAP. Alternative: amoxicillin or clavulanate 90 milligrams per kilogram per day, amoxicillin component, divided every 12 hours. Amoxicillin allergy: cefpodoxime, cefuroxime or cefprozil; see dosing page XXX. Row 2: Pneumonia Cystic fibrosis If penicillin allergy, consider quinolone; Ceftazidime, Fortaz 50 milligrams per kilogram IV every 8 hours, max 6 grams per day, or ticarcillin clavulanate, Timentin 200 to 300 milligrams per kilogram per day of ticarcillin IV divided 4 to 6 hours, max ticarcillin 18 grams per day. AND gentamicin or

tobramycin 2.5 milligrams per kilogram IV every 8 hours. Row 3: Pneumonia Hospital acquired superscript 24, cover S. aureus, 6 MRSA, Pseudomonas, and other gram-negative bacilli; Cefepime or Maxipime 50 milligrams per kilogram IV every 8 hours, max 2 grams per dose, OR meropenem, Merrem if more than 3 months, 20 milligrams per kilogram IV every 8 hours, max 3 grams per day; if severe infection 40 milligrams per kilogram IV every 8 hours, max 6 grams per day, OR piperacillintazobactam superscript 25, Zosyn, 240 to 300 milligrams per kilogram per day, piperacillin component, divided every 6 to 8 hours, max 16 grams per day, OR fluoroquinolone. Plus minus, 2nd antipseudomonal antimicrobial, e.g., aminoglycoside: gentamicin 2 to 2.5 milligrams per kilogram IV every 8 hours. 6 MRSA coverage, if MRSA risk factors, or more than 10 percent of S. aureus isolates in unit are methicillin resistant, or MRSA prevalence unknown, or presence of necrotizing pneumonia, empyema, or lung abscess: Vancomycin 15 milligrams per kilogram IV every 6 hours, max 1 gram per dose, OR linezolid, Zyvox, 10 milligrams per kilogram per dose IV every 8 hours, max 600 milligrams per dose. Row 1: Pseudomembranous colitis Only patients with severe disease require treatment with any listed medication; Children less than 5 years old often are asymptomatic carriers of C. difficile, most common in infants under 1 year of age, so do not automatically treat positive stool studies less than 5 years old. Mild to moderate: Metronidazole, Flagyl 30 milligrams per kilogram per day PO or IV divided every 6 hours, max 500 milligrams per dose. Severe: Vancomycin 40 milligrams per day PO divided every 6 hours, max 125 milligrams per dose times 10 days. Severe and complicated: Vancomycin 40 milligrams per kilogram per day PO divided every 6 hours, max 125 milligrams per dose, PLUS metronidazole 30 milligrams per kilogram per day IV every 6 hours, max 500 milligrams per dose times 10 days. If complicated with ileus or toxic colitis: vancomycin 40 milligrams per kilogram per

day PO every 6 hours, max 500 milligrams per dose, PLUS metronidazole 30 milligrams per kilogram per day IV every 6 hours, max 500 milligrams per dose, PLUS vancomycin 500 milligrams per 100 milliliter normal saline enema every 8 hours as needed times 10 days. Row 3: Pterygoid abscess; See retropharyngeal abscess. Row 4: Pyelonephritis; See urinary tract infection recommendations, page xxx. Row 5: Q fever, inhaled biologic with flulike symptoms, fever, endocarditis, hepatitis; 9 to 40 days incubation. Acute Q fever: Doxycycline superscript 26 100 milligrams orally twice daily, children more than or equal to 8 years of age, or 4.4 milligrams per kilogram per day orally divided twice daily for children less than 8 years, max dose 100 milligrams times 14 days. Children younger than 8 years of age with mild illness: doxycycline 4.4 milligrams per kilogram per day orally divided twice daily times 5 days superscript 27. Doxycycline allergic: trimethoprim-sulfamethoxazole 4 to 20 milligrams per kilogram per day, trimethoprim component, orally divided every 12 hours, max 160 mg trimethoprim per dose, Chronic Q fever: limited evidence in children; combination doxycycline and hydroxychloroquine, minimum duration of 18 months. Risk of disease must be weighed against risk of dental staining from the use of doxycycline in children less than or equal to 8 years old. Row 6: Rabies; See page xx for exposure recommendations. Row 1: Retropharyngeal abscess; Clindamycin 40 milligrams per kilogram per day divided every 6 hours to every 8 hours superscript 28 OR. Ampicillin-sulbactam 50 milligrams per kilogram per dose, ampicillin component every 6 hours, max 2000 milligrams ampicillin per dose superscript 29 OR. Ceftriaxone 50 to 75 milligrams per kilogram every 24 hours, max 2000 milligrams, PLUS metronidazole 10 milligrams per kilogram per dose every 8 hours superscript 30. Row 2: Rocky Mountain Spotted Fever Do not wait for lab confirmation to treat; First line: Doxycycline 4.4 milligrams per kilogram per day

orally or IV divided bid, max 100 milligrams per dose superscript 31. Tetracycline allergy—contact infectious disease expert and consider rapid desensitization procedures in an inpatient setting, or chloramphenicol, increased risk of death, 50 to 100 milligrams per kilogram per day IV divided every 6 hours, max 4 grams per day. Continue antibiotics until afebrile times 3 days or total duration of 7 to 10 days. Row 3: Roundworm; See Ascaris lumbricoides. Row 4: Salmonella Gastroenteritis, non-typhi; Sepsis or focal infection—Cefotaxime 100 to 200, 225 to 300 if meningitis, milligrams per kilogram per day IV divided every 6 to 8 hours, max dose 12 grams per day, OR ceftriaxone 100 milligrams per kilogram IV divided every 12 hours to every 24 hours, max 4 grams per day, times 7 to 10 days. Diarrhea—Treat only if septic, age less than 3 to 6 months, immunocompromised, hemoglobinopathy, or bacteremia. Give an initial dose of ceftriaxone 100 milligrams per kilogram, max 2000 milligrams. Step down oral therapy with azithromycin superscript 32 20 milligrams per kilogram for the first dose, followed by 10 milligrams per kilogram per day times 3 days if immunocompetent, 14 days if immunocompromised. Row 5: SARS; See coronavirus, page xxx. Row 6: Scabies superscript 4; Permethrin, drug of choice, 5 percent cream, Elimite, to entire body, 1 scalp in infants, for 8 to 14 hours then wash off, OR crotamiton 10 percent lotion or 10 percent cream, Eurax, apply a thin layer from neck to toes once daily for 3 days followed by a cleansing bath 48 hours after the last application; treatment may be repeated in 7 days, OR ivermectin, Stromectol, 200 micrograms per kilogram per dose PO times 2 doses administered at least 7 days apart, ivermectin not approved less than 15 kilograms, OR 6 percent sulfur in petroleum ointment massaged into all skin surfaces from neck to toes times 2 to 3 days with cleansing of each application after 24 hours, OR lindane, not recommended in children less than 50 kilograms due to safety concerns, consider alternative agents, 1

percent lotion to body overnight then wash off. Row 1: Sepsis; Treat per meningitis or neutropenia depending on source See management algorithm or goal directed therapy, page xxx. Row 2: Septic arthritis Surgical drainage and orthopedic consult Consider Pseudomonas if foot puncture or immune deficient; Cefazolin 50 milligrams per kilogram per dose IV every 8 hours. If community-acquired MRSA represents more than 10 percent of S. aureus in geographic area: clindamycin 40 milligrams per kilogram per day divided every 6 hours–every 8 hours superscript 33, 34. If clindamycin resistance is more than 10 percent in S. aureus isolates: vancomycin superscript 35. Consider empiric coverage for Kingella in children less than 36 months using a cephalosporin such as cefuroxime, 50 milligrams per kilogram per dose every 8 hours, or ceftriaxone, 100 milligrams per kilogram per day. Row 3: Shigella diarrhea; Most infections are self-limited, and rehydration is the mainstay of management. Antimicrobial therapy is indicated in severe disease or immunocompromised patient's superscript 36. Azithromycin, Zithromax, 10 milligrams per kilogram PO daily times 3 days OR ciprofloxacin 15milligrams per kilogram per dose, max 500 milligrams per dose, PO bid times 3 days OR sulfamethoxazole-trimethoprim, use only if susceptible, 10 milligrams per kilogram, trimethoprim component, max 160 milligrams TMP per dose, per day divided bid times 3 days, immunocompetent. Row 4: Shunt infection; See ventricular shunt. Row 5: Sinusitis Obtain CT of sinus or orbits, and consult ENT if orbital or periorbital cellulitis; First line: Amoxicillin-clavulanate 45 to 90 milligrams per kilogram per day PO divided bid superscript 37. Ceftriaxone 50 milligrams per kilogram IV or IM, if cannot tolerate PO, 38. Penicillin allergic: Clindamycin 30 to 40 milligrams per kilogram per day divided every 8 hours PLUS cefixime 4 milligrams per kilogram per dose bid or cefpodoxime 10 milligrams per kilogram per day OR levofloxacin 10 to 20 milligrams per kilogram

per day PO divided every 12 to 24 hours Continue antibiotics for a total of 10 to 28 days or until symptom free, then 7 days. Row 6: Smallpox; See page xx for detail regarding disease. Exposure—(1) Vaccine within 2 to 3 days of exposure provides some protection. Limited availability through CDC. Tecovirimat superscript 39, available only through US Strategic National Stockpile: 13 to 25 kilograms: 200 milligrams PO bid, 25 to 40 kilograms: 400 milligrams PO bid, more than or equal to 40 kilograms: 600 milligrams PO bid, duration equals 14 days. There are two columns. Row 1. Sporotrichosis: Source. Soil or thorny plants, example, roses, hay, straw. Typical incubation is 7 to 30 days, max is 3 months. Cutaneous or Lymphocutaneous, footnote 40. Itraconazole or Sporanox 6 to 10 milligrams per kilogram per day. PO divided bid, max 200 milligrams per dose times 3 to 6 months. Alternative treatment: Potassium iodide, initial dose: 50 milligrams PO three times per day; increase as tolerated to 50 milligrams per kilograms per day and lesser, max 2500 milligrams per dose, three times per day. Continue at maximum tolerated dosage for several weeks after lesions resolve. Disseminated sporotrichosis or severe pulmonary infection. Amphotericin B 0.7 milligrams per kilogram per dose IV once daily followed by a prolonged course of itraconazole. Row 2. Staphylococcus: See MRSA, page xxx, and specific infection. Row 3. Submandibular abscess: See peritonsillar abscess. Row 4. Syphilis, footnote 41, or as a congenital disease: Congenital disease, 4 weeks old and lesser, possible congenital syphilis, normal physical examination, normal CSF, X-rays, CBC or platelets: Aqueous crystalline penicillin G 50,000 units/kg/dose IV every 12 hours for the first 7 days of life followed by 50,000 units per kilogram per dose IV every 8 hours thereafter for a total of 10 days, or penicillin G procaine 50,000 units per kilogram per dose IM times 10 days, or if mother received appropriate regimen of penicillin more than 1 month before delivery and there is clinical

serologic follow-up, penicillin G benzathine 50,000 units per kilogram per dose IM times 1 dose. Proven or probable disease. Aqueous crystalline penicillin G 50,000 units per kilogram per dose IV every 12 hours for the first 7 days of life followed by 50,000 units per kilogram dose IV every 8 hours thereafter for a total of 10 days or procaine penicillin G 50,000 units per kilogram dose IM once daily times 10 days. Congenital disease greater than 4 weeks. Aqueous crystalline penicillin G 50,000 units per kilogram dose IV every 4 to 6 hours times 10 days. Row 5. Syphilis, early acquired, late, latent, and neurosyphilis: Early acquired, primary, secondary, early latent, acquired in prior 12 months: Penicillin G benzathine 50,000 units per kilogram IM times 1, max 2.4 million units. Consult with an infectious disease specialist if penicillin allergic. No pediatric data for use of doxycycline. Late more than 1 year or unknown latency. Penicillin G benzathine 50,000 units per kilogram, max dose 2.4 million units, IM every week times 3. Neurosyphilis. Aqueous crystalline penicillin G 50,000 units per kilogram per dose every 4 to 6 hours times 10 to14 days, max dose 24 million units per day. There are two columns. Row 1. Tick bite, footnote 42: Early localized disease: 8 years and lesser: Doxycycline 4 milligrams per kilogram day PO divided bid, max 100 milligrams per dose, times 14 days. Greater than 8 years, or unable to tolerate doxycycline: Amoxicillin 50 milligrams per kilograms per day PO divided three times per day, max 1.5 grams per day, times 14 days or cefuroxime 30 milligrams per kilogram day divided bid, max 1 gram per day, times 14 days. Disseminated disease: Isolated facial palsy: same PO therapy as for early localized disease, times 14 to 21 days. Arthritis: same PO therapy as for early localized disease, times 28 days. Recurrent arthritis: repeat first oral arthritis regimen or ceftriaxone 50 to 75 milligrams per kilogram IV once daily, max 2 grams per day, times 14 days. Alternatives to ceftriaxone: penicillin G 200,000 to 400,000 units per kilogram per

day IV divided every 4 hours, max 18 to 24 million units per day, or cefotaxime 150 to 200 milligrams per kilogram per day IV divided every 8 hours to every 6 hours, max 6 grams per day. AV block or carditis: PO regimen, as per early localized disease, if asymptomatic times 14 or 21 days, or ceftriaxone, or alternatives listed above, 50 to 75 milligrams per kilogram per dose IV once daily, followed by PO therapy, times 14 days. Meningitis: ceftriaxone, or alternative regimens listed above, 50 to 75 milligrams per kilogram per dose IV once daily times 14 days or doxycycline 4 to 8 milligrams per kilogram per day PO divided bid times 14 to 21 days. Encephalitis or other late neurologic disease: ceftriaxone, or alternative regimens listed above, 50 to 75 milligrams per kilogram per dose once daily times 14 to 28 days. Row 2. Tinea capitis or kerion, Monitor patients closely for liver, hematologic, and electrolyte disorders: Griseofulvin microsize, liquid: 1 month to 2 years or lesser of age: 15 to 25 milligrams per kilogram per day PO once daily or divided bid, max 1 gram per day, times 6 weeks and greater. Greater than 2 years: 20 to 25 milligrams per kilogram per day PO once daily or divided bid, max 1 gram per day, times 6 weeks and greater. Or Griseofulvin ultramicrosize tablets: Greater than 2 years: 10 to 15 milligrams per kilogram per day PO once daily, max 750 milligrams per day, times 6 weeks and greater. Or terbinafine, tablets, may be crushed: 4 to 6 milligrams per kilogram per day PO once daily, max 250 milligrams, or 10 to 20 kilograms 62.5 milligrams PO once daily, 20 to 40 kilograms 125 milligrams PO once daily. There are two columns. Row 1. No data: Greater than 40 kilograms: 250 milligrams PO once daily. Duration: T tonsurans, 2 to 6 weeks, M canis, 8 to 12 weeks. Or fluconazole, not FDA approved for tinea capitis, lower cure rates, 6 milligrams per kilogram per day PO once daily, max 400 milligrams per day, times 3 to 6 weeks. Topical treatment with selenium sulfide, ketoconazole, or ciclopirox shampoos may be

useful as an adjunct. Row 2. Tinea corporis, cruris, pedis: Topical options, ketoconazole daily, econazole daily. 2 years and greater: miconazole bid, clotrimazole bid, tolnaftate bid, naftifine daily, cream, tinea corporis, sertaconazole daily, tinea corporis. 10 years and greater: ciclopirox, cream, suspension, bid. 12 years and greater: naftifine daily, cream or gel, tinea pedis and tinea cruris, luliconazole daily, terbinafine daily, cream bid for tinea pedis, butenafine daily, bid for tinea pedis, oxiconazole 1 to 2 times daily, sertaconazole bid, tinea pedis. Duration: 2 to 4 weeks. Oral, if extensive lesions or failure of topical therapy, griseofulvin, terbinafine, or fluconazole, see Tinea capitis. Row 3. Tinea unguium: Topical therapies, preferred due to decreased adverse effects, ciclopirox 8%, 12 years and older, daily times 4 to 8 weeks, tavaborole 5 percent solution, 6 years and older, daily times 48 weeks. Oral treatment: Terbinafine, tablets: 10 to 20 kilograms: 62.5 milligrams PO once daily. 20 to 40 kilograms: 125 milligrams PO once daily. More than 40 kilograms: 250 milligrams PO once daily. Duration equals 6 weeks for fingernails, 12 weeks for toenails. Row 4. Tinea versicolor, Pityriasis versicolor: Uncomplicated: Topical therapy, selenium sulfide shampoo once daily times 3 to 7 days or clotrimazole cream bid times 2 to 3 weeks. Other topical therapies include ketoconazole, bifinazole, miconazole, econazole, oxiconazole, clotrimazole, terbinafine, ciclopirox, and zinc pyrithione. Oral, for extensive lesions or resistant infection, fluconazole 300 milligrams PO once weekly times 2 to 4 weeks, or ketoconazole or Nizoral, if 2 years old and older, 3.3 to 6.6 milligrams per kilogram per day PO every 24 hours times 10 days. There are two columns. Row 1. Tracheitis, bacterial: Nafcillin or oxacillin 100 to 150 milligrams per kilogram per day IV divided every 4 to 6 hours, max 12 grams per day, or vancomycin 40 milligrams per kilogram per day IV divided every 6 to 8 hours, max 4 grams per day. Plus a third generation cephalosporin such as

ceftriaxone 50 to 75 milligrams per kilogram per day, max 2000 milligrams or if greater than 2 months old and penicillin allergic, clindamycin 20 to 40 milligrams per kilogram per day IV divided every 6 to 8 hours, max 2700 milligrams per day. If MRSA suspected, see methicillin-resistant S. aureus. Row 2. Traveler's diarrhea: See E. coli antibiotic regimens. Row 4. Trichomonas: Metronidazole or Flagyl: More than 45 kilograms: 45 milligrams per kilogram per day PO divided three times per day times 7 days, max 2 grams per day. 45 kilograms and higher: 2 grams PO times 1 or 500 milligrams PO bid times 7 days if single dose unsuccessful. Or tinidazole: More than 3 years: 50 milligrams per kilogram PO times 1, max 2 grams per dose. Adolescents: 2 grams PO times 1, or 2 grams PO daily times 5 days if treatment failure. Row 5. Tularemia: Gentamicin 5 to 6 milligrams per kilogram per day IV or IM divided every 8 hours to every 12 hours times 7 to 10 days, or ciprofloxacin, mild disease, 15 milligrams per kilogram per dose, max 400 milligrams per dose, IV every 12 hours times 10 days. See page xx for detail presentation and diagnosis. Row 6. Urethritis, Adolescent dosing only 13 years and older: Nongonoccocal urethritis: azithromycin or Zithromax 1 gram PO times 1, or doxycycline 100 milligrams PO bid times 7 days, or erythromycin base 500 milligrams PO four times per day times 7 days or levofloxacin 500 milligrams PO once daily times 7 days. M. genitalium: azithromycin 1 gram PO times 1, or moxifloxacin 400 milligrams PO daily times 7 to 14 days, treatment failure. Other causes: N. gonorrhoeae, C. trachomatis, Trichomonas, HSV, adenovirus. Row 7. Urinary tract infection, footnote 43, See pages xxx, xxx, for expert guidelines regarding management and pages xxx–xxx for oral dosing: Inpatient. Ceftriaxone 50 to 75 milligrams per kilogram per day IV divided every 12 to 24 hours, do not use older than 28 days old, or gentamicin 2 to 2.5 milligrams per kilogram IV every 8 hours, see meningitis dosing for gentamicin in neonates, 1 ampicillin 50

milligrams per kilogram per dose IV every 6 hours, especially if gram positive bacteria or Enterococcus, or piperacillin-tazobactam IV 240 to 300 milligrams per kilogram per day, piperacillin component, divided every 6 hours to every 8 hours, max 16 grams per day. There are two columns. Row 1. No data: Outpatient options, cephalexin 50 to 100 milligrams per kilogram per day PO divided every 6 hours to every 8 hours, max 4 grams per day, or cefixime 8 milligrams per kilogram per day PO divided every 12 hours to every 24 hours, max 400 milligrams per day, or sulfamethoxazole-trimethoprim 6 to 12 milligrams per kilogram per day, trimethoprim component, PO divided every 12 hours, max 160 milligrams TMP per dose, or amoxicillin-clavulanate 20 to 40 milligrams per kilogram per day PO divided every 8 hours, or nitrofurantoin, Furadantin, Macrodantin, 5 to 7 milligrams per kilogram per day PO divided every 6 hours, nitrofurantoin, Macrobid-adolescents, 100 milligrams PO every 12 hours. Treat 14 days if fever or toxic, 7 to 14 days if no fever or toxicity. Use of short courses, 3 to 5 days, in pediatrics is controversial and might only be appropriate in adolescents with uncomplicated disease. Row 2. Vaginosis, bacterial, footnote 44: Children 45 kilograms and above or adolescents. Metronidazole 500 milligrams PO bid times 7 days, or metronidazole vaginal gel 0.75 percent Metrogel, 1 applicatorful, 5 grams, intravaginally daily times 5 days, or clindamycin 2 percent cream 5 grams intravaginally times 7 days, or tinidazole 2 grams PO once daily times 2 days, or tinidazole 1 grams PO once daily times 5 days, or clindamycin 300 milligrams PO bid times 7 days. Row 3. Varicella disease: Generally, supportive care only. Acetaminophen for fever or prodromal symptoms and or antihistamines for relief of pruritis. Nonimmunocompromized children 2 years and older, initiate within 24 hours of rash onset, Acyclovir 20 milligrams per kilogram per dose PO every 6 hours times 5 days, max 3200 milligrams per day, or valacyclovir 60

milligrams per kilogram per day PO divided every 8 hours, max 3 grams per day, times 5 days; use in preadolescent children is not routinely recommended. Consider use in adolescents, greater risk for more severe disease, or chronic cutaneous or pulmonary disorder, or on chronic salicylates or on steroids 6 second household case. Immunocompromised or severe disease, Acyclovir 30 milligrams per kilogram per day IV divided every 8 hours times 7 to 10 days. Row 4. Varicella exposure: Healthy, non-pregnant patients 12 months or older. Vaccine: Administer vaccine 0.5 milliliters IM to susceptible children within 3 to 5 days of exposure if no prior immunization. There are two columns. Row 1. No data: Varicella immune globulin, VZIG or VARIZIG. Give to exposed patients if they are, 1. immunocompromized, 2. neonates whose mother has varicella, 5 days pre to 2 days after delivery, 3. premature infants born less than 28 weeks who are exposed during neonatal period whose mothers do not have evidence of immunity, 4. premature infants born more than 28 weeks or who weigh 1,000 grams or lesser at birth and were exposed during the neonatal period regardless of maternal history of varicella disease or vaccination, 5. pregnant women without evidence of immunity. VZIG or VARIZIG is given within 4 to 10 days of exposure if above risk factors present. VZIG dose. 2 kilograms and lesser: 62.5 units, 2.1 to 10 kilograms: 125 units, 10.1 to 20 kilograms: 250 units, 20.1 to 30 kilograms: 375 units, 30.1 to 40 kilograms: 500 units, greater than 40 kilograms: 625 units, max 625 units, or IVIG, if VZIG unavailable: 400 milligrams per kilogram IV times 1, within 4 to 10 days of exposure. Acyclovir. Acyclovir 20 milligrams per kilogram four times per day, max single dose 800 milligrams, during period of risk, if VZIG or VARZIG contraindicated, mildly immunocompromised without evidence of immunity or patients for whom varicella prevention is desired. Row 2. Vascular catheter: See IV catheter. Row 3. Ventricular CSF shunt, footnote 45, infection.

Consult neurosurgeon: Vancomycin 60 milligrams per kilogram per day IV divided every 6 hours, max 4 grams per day, plus an anti-pseudomonal beta-lactam, cefepime 50 milligrams per kilogram IV every 8 hours, max 2 grams per dose, or ceftazidime 150 milligrams per kilogram per day IV divided every 8 hours, max 6 grams per day), or meropenem 40 milligrams per kilogram per dose IV every 8 hours, max 2 grams per dose. Beta-lactam allergy: add aztreonam 90 to 120 milligrams per kilogram per day divided every 6 hours to every 8 hours, max 8 grams per day, or ciprofloxacin 15 milligrams per kilogram per dose IV every 12 hours, max 400 milligrams per kilogram per dose. Intrathecal antibiotics and externalization of shunt may be needed and is best guided by a neurosurgeon. Row 4. Vibrio species, footnote 46: Management is typically supportive. Diarrhea is usually mild and self-limited. Sepsis with or without hemorrhagic bullae, wound infections: third generation cephalosporin, ceftazidime 150 milligrams per kilogram per day IV divided every 8 hours, or ceftriaxone 50 to 100 milligrams per kilogram per day IV divided every 12 hours to every 24 hours, plus doxycycline, 8 years and older, 2.2 milligrams per kilogram per dose IV or PO every 12 hours, max 200 milligrams per day, or ciprofloxacin 10 milligrams per kilogram per dose IV every 12 hours, max 400 milligrams per dose. There are two columns. Row 1. No data: Sulfamethoxazole-trimethoprim 6 to 12 milligrams TMP per kilogram day PO divided every 12 hours plus gentamicin 2 to 2.5 milligrams per kilogram per dose IV every 8 hours, children whom doxycycline or ciprofloxacin are contraindicated. Severe diarrhea: doxycycline 2.2 milligrams per kilogram per dose PO every 12 hours, max 200 milligrams per day, or ciprofloxacin 10 to 15 milligrams per kilogram per dose PO twice a day, max 750 milligrams per dose. Row 2. Warts: See Papillomavirus. Row 3. Yersinia enterocolitica: Immunocompromised patients, neonates, and those with sepsis or extra intestinal disease require treatment.

Third generation cephalosporin, ceftriaxone 50 to 100 milligrams per kilogram per day IV divided every 12 hours to every 24 hours, or cefotaxime 150 to 180 milligrams per kilogram per day IV divided every 8 hours. Alternatives include sulfamethoxazole-trimethoprim, aminoglycosides, fluoroquinolones, tetracycline, or doxycycline. Row 4. Yersinia pestis: See Plague page xx for disease, and 114 for antimicrobials.

Back to Table

A table lists the common oral antimicrobial doses and mixtures. There are three columns: Antimicrobial, formulations, dose or frequency, superscript 1. Row entries are as follows. Row 1: Acyclovir; 200, 400, 800, 200 milligrams per 5 milliliters; See herpes page xxx, varicella page xxx. Row 2: Albendazole or Albenza; 200 milligrams; See infection, max 400 per day. Row 3. Amoxicillin or Amoxil; Susp: 125, 200, 250 and 400 milligrams per 5 milliliters, caps: 250, 500 milligrams, tabs: 500, 875 milligrams; 30 to 50 milligrams per kilogram per day, bid to three times per day, 80 to 90 milligrams per kilogram per day DRSP superscript 2. Row 3: Amoxicillin or clavulanate, Augmentin; Susp asterisk: 125, 200, 250 and 600 milligrams per 5 milliliters, tabs asterisk: 250, 500, 875 milligrams, chew tabs asterisk: 200 milligrams; 45 milligrams per kilogram per day, bid, 80 to 90 milligrams per kilogram per day if DRSP, superscript 2. Asterisk: dosing is in mg of amoxicillin. Row 4: Ampicillin or Principen; Susp: 125 and 250 milligrams per 5 milliliters, caps: 250, 500 milligrams; 50 to 100 milligrams per kilogram per day, four times per day. Row 5: Azithromycin, superscript 3, or Zithromax; Susp: 100 and 200 milligrams per 5 milliliters, tabs: 250, 500 milligrams; Pneumonia or Otitis media 10 milligrams per kilogram times 1 on first day, then 5 milligrams per kilogram daily times 4, Pharyngitis 12 milligrams per kilogram per day times 5 days 20 milligrams per kilogram per day times 3 days,

max dose 500 milligrams. There are three columns: Antimicrobial, formulations, dose or frequency, superscript 1. Row entries are as follows. Row 1: Cefaclor or Ceclor, Second generation; Susp: 125, 250, and 375 milligrams per 5 milliliters, caps: 250 milligrams, 500 milligrams; 20 to 40 milligrams per kilogram per day, three times per day, max 500 milligrams per dose. Row 2: Cefadroxil or Duricef, First generation: Susp: 250, 500 milligrams per 5 milliliters, cap: 500 milligrams, tab: 1000 milligrams; 30 milligrams per kilogram per day, bid, max 1,000 milligrams per dose. Row 3: Cefdinir or Omnicef, Third generation; Susp: 125 and 250 milligrams per 5 milliliters, cap: 300 milligrams; 14 milligrams per kilogram per day, every 12 to 24 hours, max 600 milligrams per kilogram per day. Row 4: Cefditoren or Spectracef, Third generation; Tab: 200, 400 milligrams, only use for 12 years old and older; 200 to 400 milligrams bid, max 400 milligrams per dose. Row 5: Cefixime or Suprax, Third generation; Susp: 100, 200, 500 milligrams per 5 milliliters, caps: 400 milligrams, chew tab: 100 and 200 milligrams; 8 milligrams per kilogram per day, every 12 to 24 hours, UTI: 16 milligrams per kilogram on day 1, max 400 milligrams per day. Row 6: Cefpodoxime or Vantin, Third generation; Susp: 50 and 100 milligrams per 5 milliliters, tabs: 100, 200 milligrams; 10 milligrams per kilogram per day, bid, max 200 to 400 milligrams per dose. Row 7: Cefprozil or Cefzil, Second generation; Susp: 125 and 250 milligrams per 5 milliliters, tabs: 250 milligrams, 500 milligrams; 15 to 30 milligrams per kilogram per day, bid, max 500 milligrams per dose. Row 8: Ceftibuten or Cedax, Third generation; Susp: 180 milligrams per 5 milliliters, caps: 400 milligrams; 9 milligrams per kilogram per day, daily, max 400 milligrams per dose. Row 9: Cefuroxime or Ceftin, Second generation; Susp: 125 milligrams per 5 milliliters, tabs: 250, 500 milligrams; 20 to 30 milligrams per kilogram per day, bid, max 500 milligrams per dose. Row 10: Cephalexin or Keflex, First generation; Susp: 125 and 250

milligrams per 5 milliliters, caps or tabs: 250, 500, 750 milligrams capsule; 25 to 50 milligrams per kilogram per day, four times per day, max 500 milligrams per dose. Row 11: Clarithromycin or Biaxin; Susp: 125 and 250 milligrams per 5 milliliters, tabs: 250, 500 milligrams; 15 milligrams per kilogram per day, bid, max 500 milligrams per dose. Row 12: Clindamycin or Cleocin; Solution: 75 milligrams per 5 milliliters, caps: 75, 150, 300 milligrams; 8 to 25 milligrams per kilogram per day, three times per day per bid, 30 to 40 milligrams per kilogram per dose if DRSP, superscript 3, max 1800 milligrams per day. Row 13: Dicloxacillin or Dynapen; Caps: 250, 500 milligrams; 12.5 to 25 milligrams per kilogram per day, four times per day, max 250 milligrams per dose. Use 50 to 100 milligrams per kilogram per day if completing osteomyelitis therapy, Max dose 500 milligrams. Row 14: Doxycycline older than 8 years or Vibramycin; Tab or Cap: 50, 75, 100, 150 milligrams, Susp: 25 milligrams per 5 milliliters, Syrup: 50 milligrams per 5 milliliters; 4.4 milligrams per kilogram per day, bid, max 200 milligrams per day. There are three columns: Antimicrobial, formulations, dose or frequency, superscript 1. Row entries are as follows. Row 1: Erythromycin or ERYC, EES, E-mycin; Susp: 200 and 400 milligrams per 5 milliliters; Tab: 250, 400, 500 milligrams; 30 to 50 milligrams per kilogram per day, 3 to 4 times per day, max 2000 to 4000 milligrams per day. Row 2: Erythromycin or Sulfisoxazole or Pediazole; Susp: 200 milligrams EM and 600 milligrams SS per 5 milliliters; 50 milligrams EM per kilogram per day, four times per day, max EM dose 500 milligrams. Row 3: Fluconazole or Diflucan; Susp: 10 and 40 milligrams per milliliter, tabs: 50, 100, 150, 200 milligrams; 6 to 12 milligrams per kilogram per dose times 1, then 3 to 12 milligrams per kilogram per dose once daily, max 600 milligrams per dose. Row 4: Griseofulvin, Microsize, Grifulvin V, Ultramicrosize tablets, Gris-PEG; Susp: 125 milligrams per 5 milliliters, micro, tabs: micro 500 milligrams, tabs: ultra 125

milligrams, 250 milligrams; Micro: 20 to 25 milligrams per kilogram per day, every day to bid. Ultra: 10 to 15 milligrams per kilogram per day, every day. Max dose, micro, 1 gram. Max dose, ultra, 750 milligrams. Row 5: Itraconazole or Sporanox, Tolsura; Cap: 100 milligrams, 65 milligrams, solution: 10 milligrams per milliliter; 5 milligrams per kilogram per day every 12 hours, see specific infection. Row 6: Ivermectin or Stromectol; Tab: 3 milligrams; 200 micrograms per kilogram per dose, see specific infection. Row 7: Linezolid or Zyvox; Tab: 600 milligrams, Susp: 100 milligrams per 5 milliliters; 30 milligrams per kilogram per day, three times per day, if older than 12 years. Administered bid if 12 years and younger. Max dose 600 milligrams. Row 8: Mebendazole or Emverm; Tabs: 100 milligrams chewable; Dosing variable, see specific infection. Row 9: Metronidazole or Flagyl; Tabs: 250, 500 milligrams, cap: 375 milligrams. Suspension can be compounded; 15 to 50 milligrams per kilogram per day divided three times per day, max 2250 milligrams per day. Row 10: Nitrofurantoin such as Macrodantin, Macrobid, Furadantin; Susp: 25 milligrams 5 milliliters, caps: 25, 50, 100 milligrams; Furadantin, Macrodantin: 5 to 7 milligrams per kilogram per day, four times per day. Macrobid in adolescents: 100 milligrams bid, max dose 100 milligrams. Row 11: Nystatin or Bio-Statin; Susp: 100,000 units per milliliters, tabs: 500,000 units, caps: 500,000 units, 1,000,000 units; Infants: 200,000 to 400,000 units four times per day or 100,000 units to each side of mouth four times per day. Child: 400,000 to 600,000 units four times per day. Max dose 600,000 units. There are three columns: Antimicrobial, formulations, dose or frequency, superscript 1. Row entries are as follows. Row 1: Oseltamivir or Tamiflu; Caps: 30, 45, 75 milligrams, Susp: 6 milligrams per milliliters; Treatment: 8 months and younger: 3 milligrams per kilogram per dose bid, Infants 9 months and older: 3 to 3.5 milligrams per kilogram per dose bid, Children and adolescents: 15 kilograms and lesser: 30 milligrams bid,

greater than 15 to 23 kilograms: 45 milligrams bid, greater than 23 to 40 kilograms: 60 milligrams bid, more than 40 kilograms: 75 milligrams bid. Row 2: Penicillin V Potassium; Susp: 125 and 250 per 5 milliliters, tab: 250, 500 milligrams; 25 to 75 milligrams per kilogram per day every 6 hours to every 8 hours, max dose 2 grams per day. Row 3: Pyrantel pamoate or Reese's Pinworm Medicine; Tab: 62.5 milligrams, Susp: 50 milligrams per milliliters; Pinworms, roundworms 11 milligrams per kilogram times 1, Hookworm 11 milligrams per kilogram times 3 days, max dose 1 gram. Row 4: Rifampin or Rifadin; Caps: 150, 300 milligrams. Suspension can be compounded; 10 to 20 milligrams per kilogram per day, bid, max dose 600 milligrams. Row 5: Terbinafine or Lamisil; Tab: 250 milligrams, suspension can be compounded; Tinea capitis: less than 25 kilograms, 125 milligrams per day, 25 to 35 kilograms, 187.5 milligrams per day. More than 35 kilograms, 250 milligrams per day. Row 6: Trimethoprim or sulfa-methoxazole, such as Bactrim, Sulfatrim; Susp: 40 milligrams TMP and 200 milligrams SMX per 5 milligrams, tabs: 80 bar 400 and 160 bar 800 milligrams; 6 to 12 milligrams TMP per kilogram day, bid, max dose 160 TMP, superscript 4. Row 7: Vancomycin, such as Vancocin, Firvanq; Caps: 125, 250 milligrams, solution: 25 milligrams per milliliters, 50 milligrams per milliliters; 40 milligrams per kilogram per day divided every 6 hours to every 8 hours, max dose 2000 milligrams per day. Text under the table lists the superscripts. 1: Max dose. maximum individual, single, oral dose. 2: DRSP, drug-resistant S. pneumonia, for pneumonia and otitis media. 3. 20 milligrams per kilogram times 1 dose required for Chlamydia. 4. Higher doses needed for severe UTI, Shigella, and pneumocystis infections.

Back to Table

A flow diagram shows the fever pathway for 0 to 28 days.

Age 0 to 28 days of age. Temperature is greater than or equal to 38 Celsius or 100.4 Fahrenheit, and no signs of a focal infection brought in from home. Is patient well-appearing? If no, send fill sepsis evaluation studies, then send full HSV evaluation studies, start acyclovir ampicillin cefotaxime, and admit patient. If the patient is well-appearing, send full sepsis evaluation studies after 0 to 6 days, then send full HSV evaluation studies, start acyclovir ampicillin cefotaxime, and admit patient. If the patient is well-appearing, send full sepsis evaluation studies between 7 and 28 days, then send full HSV evaluation studies if 7 to 21 days or 22 to 28 days, and meets criteria for full HSV evaluation. Then start acyclovir if 7 to 21 days or 22 to 28 days and undergoing full HSV evaluation. If there is a low risk of bacterial infection, do not give antibiotics, and admit patient. If there is a high risk, then start ampicillin and cefotaxime, and admit patient. There are two columns. Row 1. Well-Appearing Definition: HR less than 160. RR less than 60. No oxygen requirement. Reassuring exam. Near baseline po intake. May tolerate occasional elevated HR/RR in setting of fever if not sustained. Does not require warmer or isolette use. Clinical judgement is to be used when determining well–appearing status. There are two columns. Row 1. Full Sepsis Evaluation Studies: Catheterized urinalysis and urine culture. CSF bacterial culture, cell count, protein, glucose, Enterovirus PCR CSF, HSV PCR CSF. Blood Culture times 1, minimum 1.0 milliliters. CBC with differential. Procalcitonin, IF 7 to 28 days. Enterovirus PCR from plasma during peak season, June to October or if CSF WBC greater than 13. Chest x-ray, IF respiratory symptoms. Respiratory viral testing, RPAN, IF respiratory symptoms. Row 2. Herpes Simplex Virus, HSV, FULL Evaluation Studies: FULL Evaluation Studies on all 0-21 days: HSV PCR whole blood, HSV PCR CSF, HSV PCR swab of conjunctivae, nasopharynx, mouth, anus and lesions, if present, COMP, comprehensive metabolic

panel. If patient less than 3 days of age then PCR swab will be changed to culture in the lab. Row 3. No data: If 22-28 days old AND 1 of the following criteria: Ill- appearing. Maternal active HSV lesions at time of delivery. Vesicles on skin exam, including scalp. Hepatitis, elevated AST or ALT, if otherwise obtained. Abnormal neurologic status, seizure. CSF WBC greater than 13. Row 4. Medications: Acyclovir, 20 milligrams per kilogram per dose IV Q8. Ampicillin, 50 milligrams per kilogram per dose IV or IM Q6. Cefotaxime, 50 milligrams per kilogram per dose IV or IM Q8. Consider Cefepime,50 milligrams per kilogram per dose IV Q8, instead of Cefotaxime if history of prolonged hospitalization more than 72 hours. Consider Vancomycin, 15 milligrams per kilogram per dose IV Q8, if history of MRSA. Row 5. Bacterial Infection Checklist: If any Yes then considered High Risk. If lab not obtained then disregard question. Born at less than 37 weeks gestation? History of prior hospitalization? Prolonged more than 4 days newborn nursery course? Urinalysis positive for nitrites, leukocyte esterase, or WBC more than 5 per HPF? Is the procalcitonin elevated more than 0.5 nanograms per milliliter? ANC more than 4 kilo per microliter? CSF WBC more than 13? Does the child have a chronic illness? Received antibiotics prior to this visit? History of unexplained hyperbilirubinemia? Age 29 to 59 days of age. Temperature more than 38 Celsius or 100.4 Fahrenheit, no signs of a focal infection, no recent immunizations, except hepatitis B brought in from home. Is the patient well-appearing? If no, conduct a full sepsis evaluation, perform HSV checklist, start vancomycin ceftriaxone acyclovir if HSV evaluation, and admit patient. If the patient is well-appearing, then perform limited sepsis evaluation, and complete the bacterial infection checklist. If there is high risk, perform full sepsis evaluation, and then HSV checklist. If there is low risk, perform HSV checklist. Is the patient low risk without an HSV evaluation? No. If high risk: start ceftriaxone, and if

undergoing HSV evaluation, start acyclovir, and admit patient. If the patient is at low risk, perform discharge readiness checklist. If not ready, admit patient, otherwise discharge patient follow up with PCP in 24 hours. There are two columns. Row 1. Well-Appearing Definition: HR less than 160. RR less than 60. No oxygen requirement. Reassuring exam. Near baseline po intake. May tolerate occasional elevated HR/RR in setting of fever if not sustained. Does not require warmer or isolette use. Clinical judgement is to be used when determining well–appearing status. There are two columns. Row 1. Sepsis Evaluation Studies: Limited Sepsis Evaluation Studies: Catheterized urinalysis and urine culture. CBC with differential. Blood Culture times 1, min 1.0 milliliters. Procalcitonin, PCT. Respiratory viral testing, RPAN, if respiratory symptoms. Chest x-ray, if respiratory symptoms. Row 2. No data: For Full Sepsis Evaluation, add: CSF bacterial culture, cell count, protein, glucose, Enterovirus PCR CSF. Enterovirus PCR from plasma during peak season, June to October or if CSF WBC more than 7. Row 3. Bacterial Infection Checklist: If any Yes then considered High Risk. If lab not obtained then disregard question. Born at less than 37 weeks gestation? History of prior hospitalization? Prolonged more than 4 days newborn nursery course? Urinalysis positive for nitrites, leukocyte esterase, or WBC more than 5 per HPF? ANC more than 4 kilo per microliter? Is the procalcitonin, PCT, elevated more than 0.5 nanograms per milliliter? Does the child have a chronic illness? Received antibiotics prior to this visit? History of unexplained hyperbilirubinemia? Row 4. Herpes Simplex Virus, HSV, Checklist: Perform HSV evaluation, see below, if 29 to 42 days old and 1 of the following: Ill-appearing; Maternal active HSV lesions at time of delivery; Vesicles on skin exam, including scalp; Hepatitis, elevated AST or ALT, if otherwise obtained; Abnormal neurologic status, seizure; CSF WBC more than 7 if otherwise obtained. Row 5. No data: HSV Evaluation: HSV

PCR whole blood, HSV PCR CSF, HSV PCR swab of conjunctivae, nasopharynx, mouth, anus and lesions, if present, COMP, comprehensive metabolic panel, up to clinician discretion to send HSV PCR CSF if more than 42 days and concern for meningitis and encephalitis. There are two columns. Row 1. Medications: Ampicillin, 50 milligrams per kilogram per dose IV IM Q6. Ceftriaxone, 100 milligrams per kilogram times 1 in ED, then 12 hours later, start 50 milligrams per kilogram per dose IV IM Q12. Acyclovir, 20 milligrams per kilogram per dose IV Q8. Vancomycin, 15 milligrams per kilogram per dose IV Q8. Cefepime, 50 milligrams per kilogram per dose IV Q8. Additional considerations: If UTI is suspected, add Ampicillin to cover for Enteroccocus. If CSF WBC more than 7, GP organisms on Gram stain or history of MRSA then add empiric Vancomycin. Consider Cefepime instead of Cefotaxime or CTX if history of prolonged hospitalization more than 72 hours. Row 2. Discharge Readiness Checklist: If any No admit the patient. Are the parents comfortable with monitoring their child at home? Do the parents have reliable means of receiving communication from the hospital ED? Can bacterial culture results be followed daily by the hospital or ED? Can the patient follow-up with their PCP in 24 hours? Are they within 30 minutes of an ED?

Back to Table

A table shows the overview, definition, pathogenesis, and testing of fever due to occult bacteremia or OB.
Overview: Before Hib, pneumococcal vaccine era this was primarily a concern in those aged 3 to 36 months with fever 39 degrees Celsius and more. In the pre-vaccine era, approximately 3 to 10 percent of well appearing children younger than 3 years old with fever without a source were found to have occult bacteremia. Now, with widespread vaccination this number has fallen to less than 1 percent. Definition: Positive blood culture with no infection and well

appearance. Pathogenesis: Enterococcus spp., N. meningitidis, nontype B H. influenza, E. coli, Moraxella catarrhalis, Salmonella spp. and S. aureus Testing: Routine testing and empirical antibiotic administration is not warranted in well appearing children 3 to 36 months with fever without a source. New studies suggest that CRP and procalcitonin may be more accurate at identifying serious bacterial infections including bacteremia than previous markers such at WBC and absolute neutrophil count.

Back to Table

A table shows the Yale Observation Scale for infants and children age 3 to 36 months.
There are four columns: Observation item, normal with 1 point score, moderate impairment with 3 points score, and severe impairment with 5 points score. Row entries are as follows. Row 1: Quality of cry; Strong or none; Whimper or sob; Weak, moans, high pitch, hardly responds. Row 2: Reaction to parents; Cries briefly, no crying, content; Cries off and on; Persistent cry with little response. Row 3: State variation; Awake, or if asleep wakens quickly; Eyes close briefly, awake or wakens with prolonged stimulation; No arousal, falls asleep. Row 4: Color; Pink; Pale extremities, acrocyanosis; Ashen, cyanotic, mottled, or pale. Row 5: Hydration; Normal skin eyes, mouth; Normal skin and eyes, mouth slightly dry; Skin doughy or tented, dry mouth, sunken eyes. Row 6: Response overtures; Alert or smiles consistently; Alert or brief smile; No smile, anxious, dull no alerting to overtures.

Back to Table

A table lists the possible cause of different features of petechial rash.
There are two columns: Feature and possible cause. Row entries

are as follows. Row 1: Ill or toxic; Meningococcemia or Rocky Mountain Spotted Fever. Row 2: Sick contacts; Meningococcemia, rubella, Epstein-Barr, enterovirus, hepatitis B, gonococcemia, rheumatic fever. Row 3: Travel or local ticks; Rocky Mountain Spotted Fever, dengue, typhus, rat bite fever. Row 4: Palpable purpura; Vasculitis and infectious. Row 5: None of above; Thrombocytopenia, such as ITP, TTP, or other platelet disorder.

Back to Table

A table shows the fever and petechiae etiology when the organism was identified and no organism was found.
Organism identified: N. meningitidis is 7 percent, of which 4 percent is with meningitis, and 3 percent is without meningitis, S. pneumoniae and H. influenzae is 1 percent, Streptococcus pyogenes pharyngitis is 10 percent, RSV infection is 6 percent, and other hemabsorbing virus is 6 percent. No organism found, clinical diagnosis: Viral syndrome is 45 percent, otitis media is 13 percent, aseptic meningitis is 3 percent, pneumonia is 3 percent, otitis media with pneumonia is 2 percent, and exudative pharyngitis, partially treated sepsis, or meningitis is 1 percent each.

Back to Table

A table shows the predictors of pediatric bacterial meningitis, and the predictive value of total score.
Data from the table, presented in the format, predictors, points, predictive value of total score, percentage, are as follows. Row 1: Bacteria on gram strain, 2, sensitivity total score 1 and higher, 99.6 to 100. Row 2: CSF protein 80 milligrams per deciliter and higher, 1, sensitivity total score 1 and higher, 99.6 to 100. Row 3: Serum WBC count 10,000 cells per millimeters cubed and higher, 1, sensitivity total score 2 and higher, 87. Row 4: Seizure at or before

presentation, 1, negative PV total score equals 0, more than 99 percent. Row 5: CSF neutrophils more than or equal to 1000 cells per millimeters cubed, 1, negative PV total score equals 0, more than 99 percent. Text under the table reads, “CSF: cerebrospinal fluid. WBC: white blood cell. Total score equals 2 points for gram stain, and 1 point for each of other listed predictors. Predictive value denotes ability to diagnose bacterial meningitis. If none of the criteria are present in a child with CSF pleocytosis, the risk of bacterial meningitis is 0.1 percent.”

Back to Table

A table shows the causes of ehrlichiosis, its diagnosis, treatment, and features in pediatric HME.
Human monocytic and granulocytic ehrlichiosis, HME and HGE: A febrile illness due to Rickettsia transmitted by Lone Star or wood tick especially in the southeast, south central, and Midwest United States; 90 percent occur from April to September. Deer and livestock are hosts. Incubation is 12 to 14 days. Diagnose: Wright stain, antibody titer, CDC requires compatible Hx plus more than or equal to 1 to 64 titer or a fourfold change between acute and convalescent titers. Treatment: See page xxx for disease treatment recommendations. Features. Fever: 100 percent. Known tick bite: 82 percent. Headache or Myalgia: 63 percent. Increased Liver or Spleen: 41 percent. Rash trunk plus extremity macule, papule, or petechiae: 66 percent. Increased LFT: 89 percent. Decreased platelets: 82 percent. Decreased WBC or lymphocytes: 69 to 80 percent. Decreased sodium: 65 percent. Anemia: 39 percent.

Back to Table

A table shows the causes of Lyme disease, its diagnosis, treatment, and features in children.

Inflammatory disease versus multiple organs due to spirochete, Borrelia burgdorferi, transmitted by ticks, deer tick. Disease can be, 1. Early local 1 to 2 weeks, ECM or erythema chronicum migrans, red macule or papule expands to large size, mean 16 centimeters in adults, resolves over a week. 2. Early disseminated 2 to 12 weeks, carditis, early arthritis, mean 2.4 large joints; knee greater than ankle; 2 to 100,000 cells per millimeters cubed, especially eosinophils, meningitis, multiple EM lesions. 3. Chronic arthritis or neuro deterioration. Diagnose by ELISA or IFA followed by more specific Western immunoblot if equivocal or positive first test. Treatment: see page xxx. Features. ECM rash especially at skin crease, mean adult size 16 centimeters: 68 percent. Flulike symptoms: 64 percent. Arthritis or arthralgia 40 percent more than 1 joint: 59 percent. Known tick bite: 49 percent. ECG changes especially first-degree AV block: 29 percent. Bell's palsy, seventh CN: 14 percent. Aseptic meningitis: 4 percent. Myelitis or neuropathy: 1 percent.

Back to Table

A table shows the causes of Rocky Mountain Spotted Fever or RSMF, its diagnosis, and features in children.
RMSF: Vasculitis due to R. rickettsia, most cases occur in the south Atlantic, southeast, and south central United States, although disease is widespread. Wood and dog tick transmit. 90 percent occur from April to September with two-thirds younger than 15 years old. Incubation is 2 to 12 days. Tests are not positive until 7 to 10 days. The Weil-Felix test is inaccurate and no longer used to diagnose. Instead immunofluorescence assay, IFA, or ELISA testing is often used. Features: Headache, Myalgias, Fever. Plus abdomen pain, diarrhea. Rash, 95 percent, starts on wrists and ankles and spreads centrally. Palm or Sole rash: 50 to 75 percent. No tick bite reported, 40 percent. Seizures or Meningismus. DIC or

Shock.

Back to Table

A table shows the causes of Southern Tick-Associated Rash Illness or STARI disease, its diagnosis, treatment, and features in children. The exact cause of STARI is unknown, although it may be due to Borrelia lonestari with the Lone Star tick serving as a vector centralized to southeast, south central United States. Peak incidence is earlier than Lyme, May to June. Symptoms are similar to Lyme disease although less severe at the time of diagnosis and more rapid clearing of symptoms after treatment. Tests for Lyme disease are usually negative, and there is no definitive diagnostic test. Treatment: Many experts recommend doxycycline, amoxicillin, or cefuroxime treatment. Features: Erythema chronicum migrans-like rash, smaller. Rash: Less pruritus, less tender than Lyme. Regional lymph nodes. Flulike symptoms occur. Arthralgias are common. Late complications are uncommon, example, arthritis, neurologic deficits.

Back to Table

A table lists the steps in the removal of ticks.
Apply gloves plus or minus inject small wheal of lidocaine plus epinephrine directly beneath tick. Applying petroleum jelly, alcohol, fingernail polish, or hot match to underside of tick. May cause regurgitation, of organisms, and should be avoided. Using blunt tweezers, grasp the tick as close as possible to the skin. Pull slowly in a firm perpendicular direction, do not squeeze or rotate tick. Cleanse area thoroughly after procedure with disinfectant. Person performing procedure should thoroughly wash hands afterward. Place tick into alcohol or flush down the toilet.

Back to Table

A table lists the AAP-AAFP acute otitis media guidelines. Certain diagnosis of AOM requires the following: Presence of a middle ear effusion, MEE, and one of the following. Moderate to severe bulging of the tympanic membrane or otorrhea not due to acute otitis externa, or mild bulging of the tympanic membrane with 48 hours or earlier otalgia, or intense erythema of the tympanic membrane. A table with three columns lists the criteria for initial antibiotics or observation in children with AOM. The column headers are age, severe signs and symptoms, superscript 1, and mid signs and symptoms, superscript 2. Row entries are as follows. Row 1: Less than 6 months; Antibiotics; Antibiotics. Row 2: 6 months to 2 years; Antibiotics; Antibiotics if bilateral, if unilateral antibiotics versus OBS, superscript 3. Row 3: More than 2 years; Antibiotics; Antibiotics versus OBS for either bilateral or unilateral disease, superscript 3. Antibiotic recommendations: First line if no antibiotics in the past 30 days and no concurrent purulent conjunctivitis, or if observation failure at 48 to 72 hours: Amoxicillin 80 to 90 milligrams per kilogram per day, or if nontype I penicillin, PCN, allergy: Cefdinir 14 milligrams per kilogram per day or divided BID, cefuroxime 30 milligrams per kilogram per day divided BID, cefpodoxime 10 milligrams per kilogram per day divided BID or if type I PCN allergy superscript 4: azithromycin, clarithromycin. If antibiotic failure at 48 to 72 hours of treatment: Augmentin 90 milligrams per kilogram per day, or if nontype I PCN allergy, ceftriaxone 50 milligrams per kilogram IM times 3 days, or if type I PCN allergy: clindamycin 10 milligrams per kilogram per dose three times per day.

Back to Table

A table lists the CDC AAP guidelines for judicious use of antibiotics

in pediatric respiratory infections.
There are two columns. Row entries are as follows. Row 1. Cold: Mucopurulent rhinitis alone is not indication for Abx. See sinusitis, which follows. Row 2. AOM and otitis media with effusion, OME: Diagnosis of AOM requires middle ear effusion and signs or symptoms of acute local or systemic illness. Uncomplicated AOM may treat with 5 to 7 days of Abx if less than 2 years old. Abx are not indicated for OME unless effusion persists 3 months or longer. Abx prophylaxis is reserved for control of recurrent AOM, defined as 3 or more distinct and well-documented episodes in 6 months or 4 or more in 12 months. Row 3. Pharyngitis: Guidelines recommend group A strep, GAS, testing with treatment decision based on results. Testing should be performed on patients with 2 or more criteria, see table that follows. Children under the age of 3 should not be routinely tested. Empiric treatment may be considered for symptomatic children with confirmed GAS exposure. Row 4. Sinusitis: Clinical diagnosis of bacterial sinusitis requires persistent or worsening upper respiratory signs and symptoms, example, rhinosinusitis or cough for more than 10 to 14 days, or more severe features, temperature 39 degrees Celsius and higher, facial swelling or pain, and purulent discharge for 3 days and longer. Radiograph indications: recurrence, suspect complication, diagnosis unclear. CT is reserved if surgery is being considered. See CDC antibiotic recommendations on page xxx.

Back to Table

A table lists the points for different clinical features for group A Streptococcal Pharyngitis.
There are two columns: Individual clinical features and individual points. The point for all of the following features is 1: Fever more than 38.3 degrees Celsius or 101 degrees Celsius, age 5 to 15 years, November to May presentation, cervical adenopathy, URI

absent, that is, cough, rhinorrhea, congestion, and pharyngitis, that is, tonsillar erythema, hypertrophy, or exudate.

Back to Table

A table lists the most common causes of pneumonia based on age. There are four columns: age, bacterial, viral, and other. Row entries are as follows. Row 1: Less than 3 weeks; Most common are Group B streptococcus, E. coli, and Listeria, and less common are S. pneumoniae, S. aureus, and Anaerobes; CMV, RSV, hMPV, HSV, and Rubella; B. pertussis, C. trachomatis, Mycobacterium hominis, Treponema pallidum, and Ureaplasma urealyticum. Row 2: 3 weeks to 3 months; S. pneumoniae, S. aureus, and H. influenzae nontypable; RSV, hMPV, Parainfluenza, Adenovirus, and Influenza; B. pertussis and C. trachomatis. Row 3: 3 months to 5 years; S. pneumoniae, S. pyogenes, and S. aureus; RSV, hMPV, Parainfluenza, Adenovirus, and Influenza; Mycoplasma pneumoniae, Chlamydia pneumoniae, and Mycobacterium tuberculosis. Row 4: More than 5 years; S. pneumoniae, S. pyogenes, and S. aureus; hMPV, Influenza, and Adenovirus; M. pneumoniae, C. pneumoniae, and M. tuberculosis.

Back to Table

A table lists the pneumonia admit criteria for different evaluation. There are two columns: evaluation and admit criteria. Row entries are as follows. Row 1: Pulse oximetry for all admissions; O2 sat less than 93 percent, some use less than 91 to 92 percent. Row 2: CXR not routine if disease mild, uncomplicated, superscript 1; RR more than 60 to 70 per minute, more than 45 to 50 child.

Back to Table

A table lists the causes of urinary tract infections, and the risk of occurrence by age group.
Organisms in neonates: E. coli 74 percent, Klebsiella 7 percent, Pseudomonas 7 percent, Proteus 4 percent. In older infants or children: E. coli is most common. Proteus and Pseudomonas are more common if hospitalized, recurrent UTI, or male. A table shows two columns: age and UTI risk if fever present. Row entries are as follows. 0 to 2 months: 7.5 percent. 2 to 24 months: 4.1 percent. 2 to 5 years: 1.7 percent.

Back to Table

A table lists the risk factors of UTI.
Females younger than 2 years old. Fever for 2 days and longer. No alternate source for fever. White or Caucasian. Temperature 39° C and higher. Prior urinary infection or anatomic abnormality. Males younger than 6 months old or younger than 12 months, uncircumcised.

Back to Table

A table lists the sensitivity and negative predictive value for different urinalysis features.
There are three columns: urinalysis feature, sensitivity, and negative predictive feature. Row entries are as follows. Row 1: Any WBC or high power field, hpf, 77 percent, 97 percent. Row 2: 5 WBC per hpf or more, 43 to 84 percent, 90 to 98 percent. Row 3: Any bacteria, 86 to 93 percent, 99 percent.

Back to Table

A table shows the management options for urinary tract infections. There are two columns. Row entries are as follows. Row 1. Admit: 2

to 3 months old and younger, obstruction, high-grade reflux, dehydration, vomiting, toxicity, nephrolithiasis, or immunocompromised. Row 2. IV antibiotics: Ceftriaxone 50 to 75 milligrams per kilogram per day IV, do not use for younger than 28 days old, or Cefotaxime or neonates 50 milligrams per kilogram per day IV every 8 hours to every 12 hours, or Gentamicin 2 to 2.5 milligrams per kilogram per day IV every 8 hours plus ampicillin 50 milligrams per kilogram per day IV every 6 hours, especially if gram-positive bacteria, or piperacillin-tazobactam IV 240 to 300 milligrams per kilogram per day, piperacillin component, divided every 6 hours to every 8 hours, max 16 grams per day. Row 3. Oral antibiotics: Cephalexin 50 to100 milligrams per kilogram per day PO divided every 6 hours to every 8 hours, max 4 grams per day, or cefixime 8 milligrams per kilogram per day PO divided every 12 hours to every 24 hours, max 400 milligrams per day, or sulfamethoxazole-trimethoprim 6 to 12 milligrams per kilogram per day, trimethoprim component, PO divided every 12 hours, max 160 milligrams TMP per dose, or amoxicillin-clavulanate 20 to 40 milligrams per kilogram per day PO divided every 8 hours, or nitrofurantoin such as Furadantin, Macrodantin, 5 to 7 milligrams per kilogram per day PO divided every 6 hours, nitrofurantoin, Macrobid-adolescents, 100 milligrams PO every 12 hours. Treat for 14 days if fever or toxic, 7 to 14 days if no fever and no toxicity; see pages xxx–xxx. Row 4. Urinary tract evaluation: No clinical response in first 48 hours: urinary tract US or CT, to exclude abscess or obstruction, plus voiding cystourethrogram, VCUG, or radionuclide cystography, RNC at earliest convenience. VCUG preferred in males to assesses urethra for posterior valves. If nontoxic or doing well, VCUG or RNC at earliest convenience. Continue antibiotics while awaiting the previously mentioned study. Radionuclide renal scans or DMSA and CT will identify acute changes from pyelonephritis or renal scarring. Their exact role in aiding

management of a child with UTI is still undefined.

Back to Table

A table lists the causes of acute viral respiratory infections. There are two columns: virus and percentage. Row entries are as follows. Row 1: Rhinovirus or Picornavirus, 9 to 52. Row 2: Respiratory syncytial virus, 7 to 60. Row 3: Human metapneumovirus, 3 to 19. Row 4: Parainfluenza, 3 to 11. Row 5: Multiple viruses, 7 to 22. Row 6: Influenza, 2 to 7. Row 7: Adenovirus, 2 to 9. Row 8: Coronavirus, 3 to 16. Row 9: Bocavirus, 2 to 19.

Back to Table

A table lists the sensitivity and specificity of different viruses. There are three columns: Virus, sensitivity in percent, and specificity in percent. Row entries are as follows. Row 1: Adenovirus, 96.4, 99.7. Row 2: Coronavirus 299E, 82.4, 100. Row 3: Coronavirus, HKU1, 100, 100. Row 4: Coronavirus NL63, 100, 99.7. Row 5: Coronavirus OC43, 100, 99.4. Row 6: Influenza A, 96.8, 100. Row 7: Influenza A H1N1, 100, 100. Row 8: Influenza A H1, 100, 100. Row 9: Influenza A H3, 100, 99.4. Row 10: Influenza B, 41, 100. Row 11: Metapneumovirus, 93.3, 100. Row 12: Parainfluenza 1, 93.3, 100. Row 13: Parainfluenza 2, 63.6, 100. Row 14: Parainfluenza 3, 100, 100. Row 15: Parainfluenza 4, 100, 100. Row 16: Rhinovirus or Enterovirus, 100, 98. Row 17: RSV A, 100, 99.7. Row 18: RSV B, 95.5, 100.

Back to Table

A table shows the seasonal variations in respiratory diseases in North America.

Data from the table are as follows. RSV: November to May. Influenza: November to March. Corona virus or SARS: December to April. Huma metapneumovirus: Year-round, slightly more common in winter. Adenovirus: Year-round, more common later winter to June. Parainfluenza: March to November. Rhinovirus: March to October.

Back to Table

A table lists the sensitivity and specificity of three antigen-based rapid diagnostic assays for influenza.
Sensitivity of rapid tests for H1N1 was only 10 to 70 percent in 2009. There are three columns: Tests, sensitivity in percent, and specificity in percent. Row entries are as follows. Row 1: Direct fluorescent antibody, 62, 98. Row 2: Indirect immunofluorescent antibody, 50 to 75, 95 to 97. Row 3: Optical immunoassay, 71, 82.

Back to Table

A table lists the sensitivity and specificity of three antigen-based rapid diagnostic assays for RSV.
There are three columns: Tests, sensitivity in percent, and specificity in percent. Row entries are as follows. Row 1: Direct or indirect fluorescent antibody, 93 to 98, 92 to 97. Row 2: Enzyme linked immunoassay, 59 to 97, 75 to 100. Row 3: Direct immunoassay, 93, 91. Row 4: Optical immunoassay, 88 to 95, 97 to 100.

Back to Table

A table lists Diagnostic Criteria of Kawasaki Disease.
Fever lasting at least 5 days without other source, and at least four of the following: 1. Bilateral bulbar, nonexudative conjunctival

injection or often spares limbus. 2. Mucous membrane changes, for example, infected pharynx, strawberry tongue, or redness, fissuring, and crusting of lips. 3. Edema or erythema of palms or soles, or desquamation in subacute phase. 4. Rash both polymorphous and truncal. 5. Cervical adenopathy, with at least one node greater than 1.5 centimeters . This is the least common feature.

Back to Table

A table lists specific inborn errors of metabolism, by biochemical features superscript 1.
There are four columns: Metabolic acidosis, serum NH3, glucose, and IEM type. Row entries are as follows. Row 1: left right arrow; left right arrow; left right arrow; Nonketotic hyperglycinemia. Row 2: left right arrow; upwards arrow; left right arrow; Citrulline normal, that is, transient hyperammonemia of newborn or hyperornithinemia, hyperammonemia, and homocitrullinuria or HHH. Urea cycle disorders: low citrulline, that is, downward arrow ornithine trans-carbamylase or downward arrow carbamyl phosphate synthetase, mild upward arrow citrulline, that is, downward arrow argininosuccinate lyase, upward arrow citrulline or citrullinemia. Row 3: upward arrow; upward arrow; downward arrow; Fatty acid oxidation: Carnitine transferase deficiencies or NK, medium or very long-chain acyl CoA dehydrogenase deficiencies or NK. Organic acidemia: Glutaric acidemia type II or K, methylmalonic acidemia or K,L, propionic acidemia or K,L, congenital lactic acidosis or K,L. Row 4: upward arrow; upward arrow; left right arrow; Organic acidemia: beta-ketothiolase deficiency or K. Row 5: upward arrow; upward arrow; upward arrow; Organic acidemias: Isovaleric acidemia or K,L, methylmalonic acidemia or K,L, propionic acidemia or K,L. Row 6: upward arrow; left right arrow; left right arrow; Organic acidemia: Isovaleric acidemia or K,L. Row 7: upward arrow; left right arrow; downward arrow; Carbohydrate metabolism:

Fructose 1,6 diphosphatase deficient or K,L. Glycogen storage type: I that is, L, III, that is, K. Amino aciduria: Maple syrup urine disease, that is, early onset, glutaric aciduria type I.

Back to Table

A table lists management.
There are two columns. Row entries are as follows. Row 1: Evaluation; Blood—Glucose, CBC, electrolytes, Ca, LFTs, bilirubin, NH3, quantitative amino acids, lactate, pyruvate, carnitine, fatty acids. Urine—Ketone bodies, reducing substances, protein, organic acids, galactose. CSF, that is, undiagnosed neonates—Glucose, protein, cell count, microscopy, lactate, amino acids. Row 2: Catabolism; Reverse catabolism with IV fluids, that is, 10 percent dextrose plus age appropriate electrolytes at 1.5 times maintenance; intralipids for severe presentations. Row 3: Precipitant; Search for or treat precipitant, for example, infection, and coexisting hypoglycemia. Row 4: Acidosis; Liberal NaHCO3 due to ongoing acid production plus dialysis. If organic acidemia, B subscript 12, 1 milligram IM or methylmalonic acidemia plus biotin 10 milligrams PO or NG, that is, multiple carboxylase deficiency, thiamine 25 to 100 milligrams PO, that is, MSUD, folic acid 1 to 5 milligrams PO, that is, methylmalonic acidemia with homocystinuria, vitamins C and K, that is, primary lactic acidosis due to electron transport defect, glycine or isovaleric acidemia, and carnitine, that is, low carnitine. Row 5: Hyperammonemia; If urea cycle defect, that is, NH3 with no acids: first, arginine HCl 6 milliliters per kilogram of 10 percent solution IV over 90 minutes, that is, citrullinemia, argininosuccinic aciduria, second, sodium benzoate and sodium phenylacetate or Ammonul for OTC or CPS deficiency. Dialysis for severe or recalcitrant cases.

Back to Table

A little lists out the Normal Bladder Volume and Normal Plasma Creatinine, PCr.
The row entries are as follows. Row 1: Bladder volume estimate; less than 1 year old: Weight kilograms, times 10 milliliters. More than 1 year old: age in years plus 2 times 30 milliliters. Row 2: Plasma creatinine estimate; Males: PCr one mg per dl equal 0.35 plus 0.025 times age in years. Females: PCr 1 mg per dl equals 0.35 plus 0.018 times age in years.

Back to Table

A table lists the Differentiation Between Causes of Renal Failure. There are four column headings, Test, Prerenal, Renal, and Postrenal. The row entries are as follows. Row 1: Urine sodium; less than 20; more than 40; more than 40. Row 2: Fractional excretion of sodium, FENa superscript 1; less than 1; more than 2; more than 2. Row 3: Renal failure index superscript 2; less than 1; more than 2; more than 2. Row 4: Urine osmolality; more than 500; less than 300; less than 400. Row 5: Urine or serum creatinine ratio; more than 40; less than 20; less than 20. Row 6: Serum BUN or creatinine ratio; more than 20; less than 10 to 20; less than 10 to 20. Row 7: Renal size by ultrasound; Normal; Normal; Normal or upwards facing arrow Hydronephrosis or obstruction. Row 8: Radionuclide renal scan; downward facing arrow; Uptake downward facing arrow excretion; Uptake OK downward facing arrow excretion; Uptake OK downward facing arrow excretion.

Back to Table

A table lists the Assessment of Coma and Altered Level of Consciousness.
The row entry is as follows, Differential diagnosis of coma and altered LOC, Mnemonic TIPS-AEIOU; Trauma or tumor Infection or Intussusception, Poisons Sepsis, seizure, or shock; Abuse or alcohol. Encephalopathy, endocrine, or electrolytes. Insulin or Hypoglycemia or inborn metabolic error. Opiates. Uremia.

Back to Table

A table lists the Normal Neonatal or Infant Reflexes Appearance or Disappearance.
The column headings are: Reflex, description, Appears, and Disappears. The row entries are as follows. Row 1: Moro—Lift head 30 degrees and let fall to neutral. A positive test equals arm extension and abduction, then arm adduction; Birth; 1 to 3 months. Row 2: Palmar grasp—Object in hand causes flexion or grasping; Birth; 4 months. Row 3: Root response—Stroking cheek causes mouth to turn in direction of stimulus; Birth; 3 to 4 months. Row 4: Tonic neck—Turn head to side while child is supine, with ipsilateral arm and leg extending and opposite arm or leg flexing. Normal infant tries to break reflex position; Birth; 5 to 6 months. Row 5: plus Babinski—Stroking lateral border of sole, to big toe. A positive reflex causes big toe dorsiflexion, and fanning of other toes; Birth; 1 to 2 years.

Back to Table

A table lists the Most common etiologies of headache in children presenting to a pediatric emergency department.
The etiologies and their percentages are as follows. Viral illness: 39;

Migraine: 18; Sinusitis: 8; Strep throat: 9; Viral meningitis: 9; Brain tumor: 2.7; Intracranial: 1.3; hemorrhage: 1.3; Postconcussive: 10.3.

Back to Table

A table lists the four Practice Parameter: Evaluation of First Nonfebrile Seizure in more than 1 Month Old.
The row entries are as follows. Row 1: Lab tests superscript 1; Order labs, CBC, glucose, electrolytes, based on clinical circumstances, for example, vomiting, diarrhea, dehydration, failure to return to baselines status. Downward facing arrow Na and downward facing arrow Ca, most common unrecognized triangle, are rare—more common if smaller than or equal to 6 months. Consider UA, NH3, blood gas, arterial or venous, lactate. Consider toxicology screen if any question of exposure. Superscript 3. Row 2: Lumbar puncture superscript 1; Perform only if suspect CNS infection or subarachnoid bleed. Row 3: EEG superscript 2; Perform on all first nonfebrile seizures, usually outpatient. Row 4: Neuroimaging superscript 1; MRI is preferred to CT for identifying etiology; CT is more available acutely and excludes life threats: bleed or mass effect; Perform emergent neuroimaging if postictal focal deficits or altered mental status does not resolve rapidly. Nonurgent MRI should be seriously considered in any child with (1) significant cognitive or motor impairment of unknown etiology, (2) abnormal exam, (3) focal seizure without secondary generalization, (4) EEG that does not represent a benign partial epilepsy of childhood or primary generalized epilepsy or (5) age more than or equal to 1 year.

Back to Table

A table lists the Most Common Etiologies of Status Epilepticus in

Children Younger Than 16 Years Old.
The list of etiologies and their percent is as follows. Fever or Infection: 36; Med Change: 20; Unknown: 9; Metabolic: 8; Congenital: 7; Anoxia: 5; Infection: 5; Trauma: 4; Stroke: 3; Ethanol or Drugs: 2.

Back to Table

A table lists the Evaluation Guidelines and Management of Status Epilepticus.
Protect airway, administer O2, start IV, cardiac monitor, pulse oximeter. Perform stat bedside glucose test and send electrolytes and drug levels. IV glucose if hypoglycemia, page 54, and pyridoxine 50 to 100 milligrams IV if neonate. Intravenous drug therapy, see sequence in table that follows. Treat fever or infection and correct sodium, calcium, or magnesium abnormalities. Evaluation guidelines, Am Acad Neurol: Obtain antiseizure drug levels for all on antiepileptics. Obtain blood cultures and LP only if clinical suspicion of bacteremia, serious infection, or meningitis. Obtain CT or MRI after stabilization if clinical indication or unknown cause. Consider a toxicology screen, metabolic panel for inborn errors if no cause is found or other clinical indicators present.

Back to Table

A table lists the Drug Therapy for Status Epilepticus, A to E Preferred Order.
There are five column headings, they are: no data, Drug, Dose and route, Maximum rate, and Special features. The row entries are as follows. Row 1: A; Lorazepam; 0.05 to 0.1 milligrams per kilogram IV; less than 0.5 to 1 milligram per minute; May repeat q5 min times 2. Or midazolam; 0.2 milligrams per kilogram nasal per buccal; Quicker onset than rectal diazepam; Quicker onset than

rectal diazepam; May repeat q5 min times 2. Or diazepam; 0.5 milligram per kilogram PR; no data; May repeat half dose one time. Row 2: B; Fosphenytoin PE superscript 1; 10 to 20 milligrams per kilogram IV; less than or equal to 3 milligram per kilogram per minute; Monitor closely. Or phenytoin; 10 to 20 milligrams per kilogram IV; less than or equal to 1 milligram per kilogram per minute; Monitor closely. Row 3: C; Phenobarbital superscript 2; 15 to 20 milligrams per kilogram IV; less than 1 milligram per kilogram per minute; Monitor closely. Row 4: D; Midazolam; 0.05 to 2 milligram per kilogram IV or IM; Bolus 0.2 mg/kg (max 10 mg) over 2 to 5 minutes, with initial infusion at 100 mcg per kilogram per hour. Titrate as needed by 50 to 100 mcg per kilogram per hour, max 400 to 2,000 mcg per kilogram per hour. Row 5: E; Pentobarbital, coma superscript 3; 5 milligram per kilogram IV load 0.5 to 3 milligram per kilogram per hour; Over 10 to 30 minutes and less than 50 milligram per minute; intubation required; vasopressors prn.

Back to Table

A table lists the Predictive Score of Shunt Failure or Shunt Obstruction.
There are two main columns: Early presenters, within 5 months of surgery, and Late presenters more than 9 months to 2 years since surgery. The Clinical features and their Points under Early presenters are as follows. Fluid tracking around shunt: 1; Headache: 1; Irritability: 1; Fever: 1; Bulging fontanelle: 2; Erythema at surgery site: 3; downward facing LOC: 3. The early shunt score, total points above and its percent of Shunt failure probability for Early presenters are as follows. 0 points: 4; 1 point: 50; 2 points: 75; more than or equal to 3 points: 100. The Clinical features and their Points under late presenters are as follows. Nausea and vomiting: 1; Loss of developmental milestones: 1;

upward facing arrow Head circumference: 1; Fluid tracking around shunt: 1; downward facing arrow LOC: 3. The late shunt score, total points above and its percent of Shunt failure probability for Early presenters are as follows. 0 points: 8; 1 point: 38; more than or equal to 2 points: 100.

Back to Table

A table lists the CSF Shunt Infections—Presenting Features in Children superscript 1.
The four column entries are as follows: Feature, V-P shunt2, V-A shunt2, and Most common organisms. The row entries are as follows. Fever; 95 percent; 100 percent; Staph epidermidis SE: 32 to 57 percent. Row 2: Shunt malfunction; 57 percent; 14 percent; Staph. aureus SA: 4 to 38 percent. Row 3: Abdominal pain; 48 percent; 0; SA plus Strep. Viridans: 4 to 15 percent. Row 4: Meningismus; 29 percent; 0; Gram negatives plus minus SE; 15 percent, 3 percent. Row 5: Headache; 14 percent; 14 percent; SE plus Enterococcus; 7 percent. Row 6: Irritability; 19 percent; 43 percent; SE plus Strep. Pyogenes 4 percent. Row 7: Nephritis; 0; 14 percent; Enterococcus or Candida; 4 percent.

Back to Table

A table lists the Differentiation of Upper Motor Neuron from Lower Motor Neuron Disease.
There are three column entries. They are Category, UMN disease, and LMN disease. The row entries are as follows. Row 1: Muscular deficit; Muscle groups; Individual muscles. Row 2: Reflexes; Increased; Decreased or Absent. Row 3: Tone; Increased; Decreased. Row 4: Fasciculations; Absent; Present. Row 5: Atrophy; Absent or Minimal; Present.

Back to Table

A table lists the Summary of Different Types of Common Infant Formulas and Uses.
There are three column headings. They are: Infant formula type, Brand Examples, and Details. Row 1: Cow milk protein; Earth's Best Organic, Enfamil Infant, Similac Advance, Similac Non-GMO; Most commonly used and most do well on this type Contains: choline, DHA, ARA May contain: prebiotics or gluco-oligosaccharides. Row 2: Partially hydrolyzed protein, Gerber Good Start, and Similac Sensitive; May be easier to digest. Row 3: Extensively hydrolyzed protein or hypoallergenic; Enfamil Nutramigen, Gerber Extensive HA, Similac Alimentum; Proteins broken down into small peptides Lactose free. Uses: infants with food protein allergies like cow milk protein, allergic proctocolitis. Row 4: Amino acid; Alfamino, Elecare, Neocate, Puramino; Proteins broken down into amino acids Uses: infants with food protein allergies like cow milk protein, allergic proctocolitis. Row 5: Soy protein; Enfamil Prosobee, Gerber Good Start Soy, Similac Isomil; Lactose-free Uses: vegetarians, metabolic disorders, e.g., galactosemia. Contains: soy protein, DHA, ARA. Row 6: Low-lactose or lactose-free; Enfamil Gentlease, Similac Sensitive; Less casein than whey Whey may be partially broken down. Row 7: Premature; Enfamil Premature, Similac Neosure, Hospital only: Enfamil Enfacare, Similac Special Care; More calories per ounce Higher levels of protein, minerals, and electrolytes.

Back to Table

A table lists the Approximate Feeding Schedule for the First Year After Birth.
There are three column headings. They are Age, Formula Fed, and Breastfed. The row entries are as follows. Row 1: Full-term new

born; 2 oz every 3 to 4 hours; On demand every 2 to 3 hours or 8 to 12 times per day. Row 2: 1 month; 3 to 4 oz every 3 to 4 hours; On demand every 2–4 hours or 7 to 8 times per day. Row 3: 2 to 4 months; 3 to 6 oz 5 to 8 times per day; On demand 5 to 8 times per day. Row 4: 4 to 6 months; 4 to 6 oz 4 to 6 times per day; 4 to 6 times per day. Row 5: 6 to 8 months; 6 to 8 oz 3 to 5 times per day; 3 to 5 times per day. Row 6: 8 to 12 months; 7 to 8 oz 3 to 4 times per day; 3 to 4 times per day. Row 7: 1 year and older; 16 to 24 oz whole milk per day; 1 to 2 times to multiple times per day, as long as mom and baby desire.

Back to Table

A flow diagram shows the Diagnosis of Ectopic Pregnancy in Clinically Stable Patients.
Qualitative beta hCG and immediate bedside ultrasound if available, immediate gynecology consult in shock and suspect ectopic. If beta hCG is positive, do sonogram. If the results of sonogram are indeterminate, do quantitative beta hCG; if Ectopic pregnancy, do Treatment or laparoscopy; and if Intrauterine pregnancy or IUP, follow expectantly 0.003 percent heterotopic, superscript 1, risk. If Quantitative beta hCG is below discriminatory zone or DZ, superscript 1, options are: 1. Serial beta hCG, 2. Laparoscopy, 3. Progesterone, 4. Culdocentesis. If unstable and no other diagnostic option. After Serial beta hCG, Repeat beta hCG in 48 hours 1. If decreasing or stable, ectopic or abortion, nonviable pregnancy, consult OB, 2. Less than 66 percent increasing beta hCG occurs in ectopics, abortions and in 15 percent of normal pregnancies, 3. Greater than 66 percent, increasing beta hCG occurs IUP and also in up to 15 percent of ectopic pregnancies. In progesterone: 1. Progesterone levels less than 5 nanogram per milliliter are approximately 95 percent predictive of abnormal pregnancy, 2. Progesterone levels greater than 25 nanogram per

milliliter indicate a 97 percent chance that pregnancy is normal, and 3. No single cutoff is 100 percent accurate. If Quantitative beta hCG is above discriminatory zone, superscript2, do Treatment or laparoscopy. Superscript are as follows: superscript 1 reads, concurrent Intrauterine pregnancy, IUP, plus ectopic; Super script 2 reads, DZ is 1,000–1,500 milli international units per milliliter for transvaginal US and 6,500 milli international units per milliliter for transabdominal Ultrasound, US.

Back to Table

A table lists Ultrasound, US Findings, superscript 1, and Quantitative beta hCG in IUP.
There are three columns: Intrauterine pregnancy, IUP, Time, and milli international units per milliliter. Under Intrauterine pregnancy: 1, Decidual reaction. 2, Gestational sac seen at 4.5 weeks with beta hCG greater than 1,000 to 1,400 via transvaginal US or 6 weeks with beta hCG greater than 6,500 via transabdominal US. 3, Yolk sac: Seen at 5.5 weeks, beta hCG greater than 7,200. 4, Fetal pole or heartbeats are seen at 5.5 to 7 weeks, beta hCG greater than 10,800 to 17,200. Under columns Time ; mIUper milliliter: Row 1: less than 1 weeks, less than 5 to 50. Row 2: 1 to 2 weeks, 40 to 300. Row 3: 2 to 3 weeks; 100 to 1,000. Row 4: 3 to 4 weeks, 500 to 6,000. Row 5: 1 to 2 months, 5,000 to 200,000. Row 6: 2 to 3 months, 10,000 to 100,000. Row 7: 2nd trimester, 3,000 to 50,000. Row 8: 3rd trimester, 1,000 to 50,000.

Back to Table

A table lists Ovarian Torsion.
Clinical features are listed: Row 1: Mean age in years of peds studies, 10 to 13. Row 2: Abdomen pain greater than or equal to sudden, 86 to 100 percent. Row 3: Mean days pain pre-ED visit, 3

to 6 days. Row 4: Vomiting, 67 to 91 percent. Row 5: Fever, late finding, 18 to 57 percent. Row 6: Abdomen tenderness, 88 to 100 percent. Row 7: Palpable ovarian mass, 10 to 64 percent. Row 8: Peritoneal signs, 23 percent. Lab or radiologic features are listed. Row 1: WBC count greater than 12,000 cells per millimeter, 32 to 51 percent. Row 2: Plain radiography mass, 26 percent. Row 3: CT ovarian mass, 95 to 100 percent. Row 4: CT enlarged fallopian tube, approximately 75 percent. Ultrasonography, see tables that follow. Text in column reads, Overview: Ovarian torsion is usually due to an enlarged ovary with or without a mass, usually benign, that alters its center of gravity causing it to twist on its axis and compress the venous drainage first, then the arterial flow later. Following venous compression, pressure rises within the ovarian capsule. Eventually, ischemia and necrosis occur. Evaluation: A beta HCG is mandatory. Diagnose by US, color Doppler best, abnormalities are usually seen on CT. Management: Surgical detorsion may salvage many ovaries even if prolonged symptoms, greater than 3 days.

Back to Table

A table lists Ultrasonographic Findings in Ovarian Torsion. There are two columns: Ultrasonographic Findings, Frequency. Row 1: Enlarged ovary or ovarian mass, 95 to 100 percent. Row 2: Absent venous flow, earlier than arterial flow obstruction, 67 to 93 percent. Row 3: Absent arterial flow persistent flow, especially if dual blood supply, 46 to 73 percent. Row 4: Twisted vascular pedicle or whirlpool sign, circular or coiled vessels, greater than 75 percent. Row 5: Ovary with ground glass appearance, 26 percent. Row 6: Free fluid within abdomen 21 percent.

Back to Table

A table lists the overview and management of five Common Gynecologic Conditions.
Overview of Vulvovaginitis: Common gynecologic problem in prepubertal girls. Most cases are nonspecific and related to normal vaginal flora. Candidal vulvovaginitis is rare in prepubertal girls. Symptoms include vaginal discharge, irritation, pain, dysuria, and redness. Diagnosis is made by history and physical exam. Management of vulvovaginitis: Reassurance, stressing importance of good perineal hygiene, use of hypoallergenic soaps, use of cotton underwear. Avoidance of irritants such as bubble baths, synthetic-fabric underwear, tight clothing. Overview of Labial adhesions: Usually asymptomatic and seen in infants. Occasionally it can lead to urinary dribbling and vulvar irritation. Not indicative of sexual abuse. Management of labial adhesions: Can resolve spontaneously. Topical estrogen cream can also be used, typically once daily applied on the midline for 4 to 6 weeks. Overview of imperforate hymen: Abnormality of the vagina leading to hematocolpos. Symptoms can range from asymptomatic amenorrhea to cyclic abdominal or pelvic pain, urinary retention, back pain. Management of imperforate hymen: Diagnosis is made on physical examination or ultrasound demonstrating hematocolpos. Treatment is surgical, hymenectomy.

Back to Table

A table lists Causes of Vaginal Bleeding in Specific Patient Populations.
Prepubertal females: Vulvovaginitis, Vaginal foreign body, Urethral prolapsed, Straddle injury or genital trauma, Precocious puberty, Dermatoses, lichen sclerosus, atopic dermatitis, Sexual abuse, Neoplasm. Postpubertal females: Anovulatory cycles, Infections, example cervicitis, Foreign body, Laceration or trauma, Sexual abuse, Polyp or fibroid or Myoma, Hematologic conditions, bleeding

disorder like VWD, platelet dysfunction, or coagulation defects; thrombocytopenia, Thyroid disorders, Ectopic pregnancy, Miscarriage, Medication side effects.

Back to Table

A table lists Sexually Transmitted Infections.
There are three columns: Infection or Condition, Recommended treatment, Special considerations. Row 1: Bacterial vaginosis, Metronidazole 500 mg PO BID for 7 days, No data. Row 2: Cervicitis Azithromycin, 1 gram PO in a single dose, Consider treatment for both gonorrhea and chlamydia given prevalence of coinfection is high. Row 3: Chlamydial infections, adolescents and pregnant patients, Azithromycin 1 gram PO in a single dose, No data. Row 4: Gonococcal infections of cervix, urethra, rectum, pharynx, Ceftriaxone 250 mg IM in a single dose PLUS Azithromycin 1 gram PO in a single dose, No data. Row 5: Genital herpes simplex—first episode Acyclovir 400 mg PO three times daily for 7 to 10 days, Alternate regimen, valacyclovir 1 gram PO twice daily for 7 to 10 days. Row 6: Genital herpes simplex—recurrent episode, Acyclovir 400 mg PO three times daily for 5 days, Alternate regimen: valacyclovir 1 gram PO once daily for 5 days. Row 7: Syphilis, Penicillin 2.4 million units IM in a single dose, Latent syphilis, neurosyphilis, and congenital syphilis are treated with different dosing of penicillin.

Back to Table

A table lists ED Ophthalmologic Exam.
There are two columns. Row 1: Chemical exposure, known or any suspicion of; stop examination, Irrigate immediately. Row 2: Obtain visual acuity, Make sure patient is wearing his or her correction; Snellen Chart, 20 feet , Each eye separately—completely occlude

but not compress each eye, record smallest line the patient can read for each eye, give credit for a line if the patient misses up to one letter Picture Chart, 2 to 4 years and moderately mentally impaired Tumbling E chart, 3 to 5 years and mute, illiterate or mildly mentally impaired, more accurate than picture chart. Row 3: External exam; Assess lids, skin, conjunctiva, cornea for obvious foreign body, lacerations, disruption; palpate periorbital area for bony stepoffs, assess for proptosis, enophthalmos. Row 4: Corneal light reflex or CLR, assesses ocular alignment; if Position of reflex is Symmetric then Ocular alignment is normal, if Position of reflex is outward displacement then Ocular alignment is esotropia, if Position of reflex is inward displacement then Ocular alignment is exotropia, if Position of reflex is downward or upward displacement then Ocular alignment is hypertropia. Row 5: Cover, uncover test, also assesses ocular alignment, more accurate than CLR , requires greater patient cooperation; Patient fixates on object 15 to 20 feet away, Cover right eye quickly with hand and observe left eye for movement, repeat quickly to other side, If eye movement is none then Ocular alignment is normal, if eye movement is outward then Ocular alignment is esotropia, if eye movement is inward then Ocular alignment is exotropia, if eye movement is downward or upward then Ocular alignment is hypertropia.

Back to Table

A table lists the red eye.
There are four columns: Signs and symptoms, Distinguishing features, Condition and pearls, Management or Treatment. Row 1: Lid swelling, Lacrimal gland swelling or Proptosis; Gritty, burning sensation of lids, Matting of eye when awaken, Redness, swelling, irregular contour to lid margin, Scaly, flaky debris to lid margins, Mild to moderate conjunctival injection, Reduced tear secretion. Chronic blepharitis, Anterior blepharitis: Common in atopy, Usually

Staphylococcus aureus, Infection of skin, cilia, accessory glands of eye; Lid margin hygiene BID, Warm moist washcloth over closed lids 5 to 10 min, Wipe away with soft cloth, Moisten cotton tip in 3 ounce water with three drops baby shampoo—scrub lids, Rinse, Brush off any dry debris, Apply bacitracin or erythromycin ointment nightly 32-week Lid margin hygiene BID, Warm moist washcloth over closed lids 5 to 10 min, Wipe away with soft cloth, Moisten cotton tip in 3 ounce water with three drops baby shampoo—scrub lids, Rinse, Brush off any dry debris, Apply bacitracin or erythromycin ointment nightly 32 week Posterior blepharitis, Common in rosacea or seborrheic dermatitis of scalp and face, Inflammation of meibomian sebaceous glands. Row 2: No data; No data; posterior blepharitis, Common in rosacea or seborrheic dermatitis of scalp and face, Inflammation of meibomian sebaceous glands; lid hygiene as above, PO tetracycline 0.5 to 1 gram per day qid or doxycycline 50 to 100 milligram PO BID. Row 3: No data; Painful, tender focal swelling to anterior eyelid margin, Pimple, develops over several days; Stye equals Hordeolum External stye, Anterior lid margin, Focal inflammation of ciliary follicles or accessory glands Internal stye, Posterior lid margin, Due to plugged meibomian glands from inflammation; arm compresses to affected eye BID, Hard-boiled egg or boiled potato cooled to touch holds heat and facilitates reheating, Topical antibiotics are useless.

Back to Table

A table lists Ocular Trauma
There are three columns: Presentation, Pearls, and Management. Row 1: Chemical exposure: to Alkaline, Household cleaners, Fertilizers, pesticides, Lye, cement cleaner, sparklers, firecracker products, and chemical exposure to acid , car battery fluid; Vision threatening, Conjunctiva may be normal in face of severe injury due to blood vessel destruction, Immediate irrigation, Do not spend time

taking history if known or suspected chemical contact, Acid burns result in Coagulation necrosis and denature surface proteins but usually do not penetrate the eye, Alkali burns worse: Cause rapid penetration through cornea and anterior chamber and then combine with cell membrane lipids causing liquefaction necrosis; Remove debris, topical anesthetic, immediately irrigate with LR for 30 min to pH 7, inferior fornix, evert lids, Inspect for corneal opacification and conjunctival swelling, visual acuity, fluorescein, do not patch, increases risk of infecting devitalized tissue, emergent referral, Acid or alkaline burn, lower visual acuity, severe conjunctival swelling, corneal clouding. Row 2: Blunt ocular trauma: Direct blow to the eye; increased risk severe injury if lower visual acuity, diplopia, severe pain. Plus LOC, saw stars, may not produce significant signs; Assess for severity of impact with assessment of ocular pain, lower visual acuity, diplopia, irregular pupil, hyphema, eye shield, do not patch, emergent ophthalmology referral.

Back to Table

A table lists Neonatal Conjunctivitis. Accompanying text reads, Onset: During first month of life, Signs: Conjunctival injection with watery or purulent discharge, Causes: Infection, irritation, or blocked tear duct.
There are five columns: Differential, Hx and PE, Dx, Txt, pearls. Row 1: Chemical conjunctivitis; Onset: Within 6 to 8 hours of instillation of topical prophylaxis at birth, presentation: Mildly red eyes and some swelling of the eyelids; Hx; No treatment, resolves spontaneously within 36 to 96 hours; Prophylaxis, erythromycin ophthalmic ointment, reduces but does not eliminate risk of gonococcal conjunctivitis, does not cover Chlamydia trachomatis. Row 2: Chlamydia trachomatis, approximately 40 percent; Onset: 5 to 14 days postpartum, possibly earlier if premature rupture of membranes, presentation: Variable, minimal to severe, conjunctival

injection, lid swelling, watery discharge becoming mucopurulent; Gold standard: NAAT, asterisk, conjunctival swab with epithelial cells from everted eyelid, is obligate intracellular organism; systemic, due to high rate of nasopharyngeal infection and pneumonia, First line: PO erythromycin ethylsuccinate 314 days, effective up to 90 percent conjunctivitis and 80 percent pneumonia; consider if: 1 month of age with conjunctivitis AND, Hx of untreated maternal Chlamydia trachomatis infection, if mother had no prenatal care OR, there was a maternal hx of Neisseria gonorrhea infection.

Back to Table

A Table lists Analysis of Joint Fluid.
There are four columns: Feature, Noninflammatory, Inflammatory, Septic, Hemorrhagic. Row 1: Clarity, Clear, Cloudy, Purulent or Turbid, Bloody. Row 2: Color, Yellow, Yellow, Yellow, Red or Brown. Row 3: WBC per milliliter, less than 200 to 2000, 200 to 100,000, greater than 50,000, less than 200, superscript 2. Row 4: PMN in percentage, less than 25 percent, greater than 75 percent, greater than 75 percent, less than 25 percent. Row 5: Glucose, superscript 1, 95 to 100 percent, 80 to 100 percent, less than 50 percent, 100 percent. Row 6: Culture, Negative, Negative, Positive greater than 50 percent, Negative. Row 7: Disease DJD, trauma, rheumatic fever, osteochondritis; Crystal, spondyloarthropathy, Lyme, Reiter’s, TB, fungi, viral, RA, superscript 3; Septic arthritis; Trauma, bleeding diathesis, neoplasm. Superscript 1 text reads Joint or Serum glucose times 100 percent. Superscript 2 text reads, pure blood, joint equals serum WBC. Superscript 3 text reads Rheumatoid arthritis.

Back to Table

A table lists Etiology of Arthritis Based on Number of Involved

Joints, superscript 1.
There are three columns and three rows. Row 1: Monoarthritis, 1 joint; Trauma, tumor, septic, gout, or pseudogout; Lyme disease, avascular necrosis, osteoarthritis, acutely. Row 2: Oligoarthritis, 2 to 3 joints; Lyme, Reiter's, rheumatic fever; Gonococcal, ankylosing spondylitis, gout, polyarticular. Row 3: Polyarthritis greater, than 3 joints; Rheumatoid, lupus, viral, rubella, hepatitis; Serum sickness, septic, neonate, immune compromised. Superscript 1 text reads, Migratory arthritis causes: Gonococcal, viral, rheumatic fever, Lyme, lupus, subacute endocarditis, mycoplasma, histoplasmosis, coccidioidomycosis, Henoch-Schönlein purpura, serum sickness especially cefaclor, sepsis, S. aureus, Streptococcus, Meningococcus.

Back to Table

A table lists Septic Arthritis.
The presenting features are as follows, superscript 1: Average age, 4 years; Ageless than 2 years, 4 to 60 percent; Median duration symptoms, 3 days; Recent URI or trauma, 53 over 31 percent; Associated osteomyelitis, 22 percent; Temperature greater than 101 degree Fahrenheit, approximately 75 percent; increase in Sedimentation rate, ESR, 60 to 90 percent; Average ESR in millimeter per hour, 36 to 56; increase in C-reactive protein, 82 to 95 percent; increase in Serum WBC, 46 to 60 percent; X-ray normal, except neonate, hip subluxation, approximately 80 percent; Abnormal Technetium scan, 70 to 90 percent; Abnormal MRI, better than US at telling septic joint versus synovitis, 88 percent. Accompanying text reads, Overview: Neonatal equals Group B strep, S. aureus, gram-negative greater than 2 months S. aureus, Strep. gram negative, Neisseria, Salmonella, especially sickle cell, Pseudomonas, metal nail puncture through rubberized sole of shoe, 90 percent in 1 joint, knee greater than hip greater than

ankle, multiple if neonate. Pseudoparalysis and irritability occur in young, and pain or decreasing ROM older. Joint usually held in position maximum distention. Increased resistance to movement. US, effusion in 85 percent septic hips, also trans. synovitis. Joint culture plus in 50 to 80 percent Management, 1: IV antibiotics, see page xxx, 2: repeat aspiration, 3: surgical drainage if a: hip, b: increasing debris, fibrin, loculation in joint space, or c: no improvement within 3 days of IV antibiotics. Superscript 1 text reads, See page xxx for algorithm discriminating between septic and transient synovitis of hip.

Back to Table

A table lists Osteomyelitis, see page xxx for vertebral osteomyelitis. Presenting features, exclude neonate are as follows: Average age, 5.9 years; Age less than 5 years, 50 percent; Complaint of pain or swelling, 65 over 54 percent; Local tender or warmth or red, one third each; Fever by hx or exam, 75 to 85 percent; increase in Sedimentation rate, ESR, 89 to 92 percent; Average ESR in millimeter per hour 42 to 61; increase in C-reactive protein, 98 percent; increase in Serum WBC, 31 to 43 percent; Normal WBC and ESR, less than 5 percent; X-ray normal, especially first 10 days, 42 percent; Abnormal Technetium scan, 82 to 95 percent; Abnormal MRI, 88 to 100 percent. Accompanying text reads, Overview, in neonate, Group B strep, S. aureus, gram-negative In neonate, most common features are pseudo paralysis , 64 percent, tenderness , 55 percent, fever, 32 percent, red 32 percent, and irritability, 36 percent. Infants may have paradoxical irritability, pain increases with holding. If older, S. aureus greater than Strep greater than gram-negative most common sites: femur greater than tibia greater than foot greater than humerus greater than pelvis. Management, 1: IV antibiotics, see page xxx, 2: Surgery may be indicated for a: abscess formation, b: bacteremia beyond 72 hours

of IV antibiotics, c: sinus tract, or d: sequestra presence.

Back to Table

A table lists Back Pain in percentage.
There are three columns: Etiology, n equals 225, Superscript 1 and 2, lesser than 12 years, greater than or equal to 12 years. Row 1: Musculoskeletal, trauma, strain; 57; 43. Row 2: Infection, viral, pneumonia, UTI, 5 percent, superscript 1; 13; 17. Row 3: Idiopathic; 12; 13. Row 4: Sickle cell disease; 14; 13. Row 5: Psychogenic; 2; 2. Row 6: Other, gallstones, pancreas, renal; 2; 2. Superscript 1 text reads, If fever, 36 percent had source, meningitis, lung, pharyngitis, PID, UTI, 32 percent virus, 18 percent sickle crisis. See the following text and pages xxx, xxx for discitis, vertebral osteomyelitis, epidural abscess. Superscript 2 text reads if fever with bilateral radicular pain, weakness, bowel or bladder dysfunction, or perineal anesthesia, or suspect spinal cord infection or lesion, MRI spine or consult neurosurgery.

Back to Table

A table lists Discitis.
Presenting features are: Age less than or equal to 2.5 years, 75 percent; Refuse or Difficult walking, 56 percent; Back or Neck pain, 100 percent greater than 3 years, 25 to 42 percent; Abdominal pain, 3 to 22 percent; Average symptom duration, 5 to 22 days; Hx fever or T greater than 100.3 degree Fahrenheit, 28 to 47 percent; Tender back, 50 percent; Lumbosacral involvement, 78 to 82 percent; Serum WBC greater than 10,500, 50 percent; Average ESR, millimeter per hour, 39 to 42; Abnormal bone scan, 72 to 90 percent; Abnormal MRI, 90 to 100 percent. Accompanying text reads, Overview, intervertebral disc infection due to hematogenous spread to vascular channels in cartilage of intervertebral disc space

that disappears later in life. One third of patients have plus cultures, blood or disc for S. aureus. Most are culture negative. X-rays are abnormal in 76 percent, Superscript 1. MRI is diagnostic procedure of choice. Management, 1: exclude more serious disease, osteomyelitis, abscess, tumor, or other peritoneal, retroperitoneal abscess. 2: Antibiotic uses debatable; if used, treat MRSA, page xxx. Superscript 1 text reads, decreased Disc space, eroded vertebral end plates.

Back to Table

A table lists Epidural Abscess, Spinal.
The presenting features are: Average age, 8 years; Average symptom duration, 8 to 9 days; Limb weakness,78 percent; Fever, 63 percent; Back pain, 54 percent; Complete paralysis, 45 percent; Partial paralysis, 33 percent; Sphincter disturbance, 38 percent; Spine tenderness,27 percent; Sensory level, 24 percent; Abnormal plain films, superscript 1, 14 to 50 percent; Cerebrospinal fluid WBC count elevated, 37 percent; elevated serum WBC, 85 percent; Abnormal myelogram, 100 percent; Abnormal MRI, 92 to 100 percent. Accompanying text reads, Overview, Abscess in spinal epidural space usually involves posterior aspect of epidural space, 86 percent, especially lumbar region extending to 7 vertebral levels. S. aureus is cause in 79 percent, Strep. In 8 percent, followed by gram-negatives or mixed flora. Occasionally, Mycobacterium tuberculosis is cause. Source is hematogenous in one half, seeded by skin or soft tissue site. One fourth had spine trauma precipitant. Management, 1: IV antibiotics see osteomyelitis treatment on page xxx. Ensure that MRSA is covered, and 2: neurosurgical consult with surgical drainage. Superscript 1 text reads, most commonly loss of intervertebral disc height.

Back to Table

A table lists Vertebral Osteomyelitis.
Median age, 6 to 8 years; Age less than or equal to 2.5 years, 14 percent; Average symptom duration, 33 days; History fever, 54 to 79 percent; Back or Neck pain, all ages, 64 percent; Prior infection, lung, skin, 29 percent; Back trauma, 21 percent; Limp, 14 percent; Abdominal, shoulder, rib pain, or incontinence, 7 percent each; Hip or flank pain, 8 percent; Temperature greater than 102 degree Fahrenheit, 79 percent; Para spinal mass, 11 percent; Average WBC, cells per millimeter cubed, 12600; WBC greater than 11,000 cells per millimeter cubed,64 percent; Average ESR, millimeter per hour,46; Abnormal X-ray, 46 percent; Abnormal bone scan, 85 to 95 percent; Abnormal MRI, 96 t0 100 percent. Accompanying text reads, Etiology, S. aureus greater than S. epidermidis gram-negatives, Bartonella. Infection occurs when organisms settle in low-flow vasculature near subchondral plate. Patients are generally older and more ill-appearing than those with discitis. Recent trauma is noted in 14 percent. Management, diagnose by MRI, although technetium scanning may be more useful in very young with nonlocalized pain. IV antibiotics, see osteomyelitis, page xxx. Surgery may be indicated for a: abscess formation, b: bacteremia or systemic illness beyond 48 to 72 hours on IV antibiotics, c: sinus tract, d: sequestra presence, e: progressive neurologic deficit, f: progressive vertebral body collapse or kyphosis.

Back to Table

A table lists upper extremity injuries management, If closed, no neurovascular injury, no rotational deformity.
There are two columns. Row 1: Shoulder clavicle. Row 2: Scapula fracture, fx Requires high trauma to break, consider chest CT; 75 percent have other serious injuries with mortality up to 14 percent, Surgery if body fracture displaced greater than 10 millimeter, neck plus clavicle fx, displaced coracoid fx plus distal clavicle or AC joint

injury, acromial fx plus subacromial narrowing, glenoid neck fx plus greater than 10 millimeter or greater than or equal to 40 degrees, displacement, glenoid rim plus shoulder sublux or instability, or glenoid fossa displaced greater than 3 to 5 millimeters, Splinting, Sling or shoulder immobilizer. Row 3: Clavicle fracture; Middle third, Nonoperative. Medial third, Usually a Salter Harris 1 or 2 injury and mimics a sternoclavicular dislocation. If post-displacement, exclude mediastinal injury. Reduce under general anesthesia. Distal third, immobilize nondisplaced as per middle third. Grossly displaced, types four to six, require surgery, especially greater than 13 years or if significant tenting of skin, splinting, sling arm. A figure of 8 is rarely used.

Back to Table

A table lists Classification of Pediatric Pelvic Fractures, superscript 1.

There are two types of classification, Torode and Zieg classification, superscript 2 and Tile and Pennal classification. Under Torode and Zieg classification the following are listed. Type 1 Avulsion fx; Type 2 Iliac wing fracture; 3a Separated iliac apophysis; 2b Fracture bony iliac wing; Type 3 Simple ring fractures; 3a Pubis fx, disrupted symphysis Posterior structures stable; 3b Acetabular fx, no ring fx B; Type 4 Fx with unstable segment Ring disruption fracture; 4 a Bilateral sup or inferior rami; 4 b Anterior rami or symphysis plus posterior fx, example, sacrum); 4 c Fx, unstable piece between anterior ring pelvis or acetabulum. Under Tile and Pennal classification the following are listed. Type A Stable fractures; A1 Avulsion fractures; A2 Nondisplaced wing or ring fx; A3 Transverse fracture of sacrum or coccyx; Type B Partially unstable fx; B1 Open book injury; B2 Lateral compress, triradiate; B3 Bilateral type B injuries; Type C Unstable pelvic ring; C1 Unilateral fractures; C1-1 Ilium fracture; C1-2 Dislocation plus or minus fx SI joint C1-3 Sacral

fracture C2 Bilat fx, 1 type or 1 type C, C3 Bilateral type C fractures. There are six columns: Torode class, Mortality, GU injury, other FX, superscript3, Neuro. Injury, Abd surgery. Row 1: 1, 0 percent, 6 percent, 39 percent, 61 percent, 11 percent. Row 2: 3, 3 percent, 26 percent, 49 percent, 57 percent, 13 percent. Row 3: 4, 13 percent, 38 percent, 56 percent, 56 percent, 40 percent. Superscript 1 text reads, once triradiate cartilage closed, adult classification, tile and treatment is used. Superscript 2 text reads, class does not include acetabular FX. Superscript 3 text reads, 3Fx, other fractures, nonpelvic.

Back to Table

A table lists Avulsion Fractures of Pelvis or Proximal Femur, superscript 1.
There are two columns: Location, relative frequency, Mechanism. Row 1: Ischial tuberosity, 38 to 54; Forceful hamstring contraction, jumping. Row 2: Ant sup. iliac spine, 19 to 32 percent; Forceful sartorius contraction, kicking or sprint. Row 3: Ant inf. iliac spine, 18 to 22 percent; Forceful rectus femoris contraction, kicking. Row 4: Lesser trochanter, 9 percent; forceful psoas contraction, sprint, jump, kick, skate. Row 5: Iliac crest, 1 to 3 percent; Contract abdomen or obliques, kicking twisting rotate. Row 6: Symphysis pubis, 0 to 3 percent, contraction leg adductors, swim, kick, jump, run. Superscript 1 text reds, Management is Rest, no weight bear for greater than or equal to 3 to 7 days, then gradual weight with crutches, then limited exercise for 2 to 4 weeks. Surgery if displaced greater than 2 centimeters, chronic pain plus excess callus, especially ischial.

Back to Table

A table lists High-Yield Criteria for Knee, Ankle, and Pelvic

Radiographs in the ED.
There are two columns. Row 1: Pelvic criteria, superscript 1; Painful or tender or abraded or contused pelvis, GCS less than 15 or distracting injury. Row 2: Knee criteria, Superscript 2; 1: Unable to flex 90 degree or 2: unable to bear weight, 4 steps, in the ED. Row 3: Ankle criteria, superscript 3; 1: Unable to bear weight immediately after injury or 2: unable to take 4 steps in the ED or 3: tender along inferior or posterior edge of malleolus. Superscript 1 text reads, Pelvic criteria were 99 to 100 percent, sensitive. Superscript 2 text reads, Knee criteria were 92 to 100 percent sensitive. Superscript 3: Ankle criteria were 100 percent sensitive.

Back to Table

A table lists Acetabulum or Femur.
There are two columns. Row 1: Acetabulum; Type 1: Small fragments plus or minus hip dislocate, 2: Linear FX plus or minus pelvic FX not displaced; 3: Linear FX, hip unstable, 4: Central FX dislocation. Nondisplaced or minimally displaced or stable, less than or equal to 1 millimeters: Bed rest, nonweight-bearing. Traction or surgery if unstable or displaced greater than 1 millimeter. Row 2: Hip fracture Delbet classification; Type 1, Transepiphyseal plus or minus acetabular dislocation. Type 2, Transcervical, femoral neck. Type 3, Cervicotrochanteric, base femoral neck. Type 4, Intertrochanteric. Management consists of reduction if needed, and spica cast or surgery depending on patient age and specific injury.

Back to Table

A table lists Knee.
There are two columns. Row 1: Patella and patellar sleeve; Patella, If nondisplaced, intact retinaculum, immobilization. Surgery

indicated if greater than 4 millimeter articular displacement, articular step off greater than 3 millimeters or comminution. Sleeve FX, Avulsion distal pole patella with sleeve or articular cartilage, periosteum, and retinaculum, especially 8 to 12 years. Often missed on X-ray. Need MRI to diagnose. Treat surgically. Splinting, Long leg splint with knee nearly fully extended. Row 2: Tibial tuberosity, Ogden classification; Type 1, distal to junction of ossification of prox tibia and tuberosity. Type 2, Junction of ossification of prox tibia and tuberosity. Type 3, Extend to joint, associated with displaced anterior fragment plus discontinuation joint surface. Surgery is indicated for all except type 1 with minimal displacement.

Back to Table

A table lists Tibia or Fibula or Ankle or Foot.
There are two columns. Row 1: Proximal tibial physis, opliteal artery injury in 3 to 7 percent. Compartment syndrome also occurs. Nonoperative if non- or minimally displaced. If reduced, general anesthesia. Splint, long leg splint with knee in full extension. Row 2: Tibia and fibula shaft fracture, associated, compartment syndrome of lower extremity. proximal metaphyseal or distal tibia fractures can cause anterior tibial artery injury. Prox tibia fx, If nondisplaced, long leg splint or cast with knee nearly full extension plus varus mold. If displaced, admit plus closed reduction in OR. Diaphyseal, displaced, closed reduction. Surgery: unstable, shortening uncorrected by closed treatment, displaced fx in skeletally mature. Splinting, long leg splint with knee bent 30 to 40 percent. Row 3: Toddler’s fracture, history minor trauma, in child, less than 5 years, average age 27 months. nondisplaced oblique or spiral distal tibia FX may require oblique X-ray to ID. Splinting, long leg splint with knee bent 30 to 40 degree, Jones wrap.

Back to Table

A table lists Differential of Painful Hip.
There are five columns: Features, Toxic synovitis, Legg-Calvé-Perthes, Septic arthritis, Slipped capital femoral epiphysis. Row 1: Age in years; 1.5 to 12; 4 to 9; less than 2, but any age 8 to 16. Row 2: Sex, M to F; 3 to 2; 5 to1; 1 to 1; 2 to 1. Row 3: history; Prior URI; minimally painful; Fever, plus or minus prior URI; Obesity in 88 percent. Row 4: Physical Exam; decreasing hip abduction and rotation, limited hip abduction; hip often held flexed, abducted; Trendelenburg gait, hip ER with flexion. Row 5: X-rays; enlarged medial joint space; subchondral Lucency femur; increasing joint space, femur head is laterally subluxed; line fem. neck crosses less than 10 percent epiphysis. Row 6: Ultrasound; effusion, approximately 90 percent; No effusion; Effusion; No effusion. Row 7: WBC or ESR; Normal; Normal; Elevated; Normal.

Back to Table

A table lists differentiating Septic Arthritis from Transient Synovitis of Hip.
There are two columns: Clinical features, Probability of septic arthritis. Clinical features list the following. History fever greater than 101.3 degree Fahrenheit, 38.5 degree Celsius, no weight-bearing, ESR greater than or equal to 40 millimeter per hour, Superscript 1. Serum WBC greater than 12,000 cells per millimeter cubed. Probability of septic arthritis lists the following. No listed features: 0.2 percent, any one feature: 3 percent, any two features: 40 percent, any three features: 93.1 percent, all four features: 99.6 percent. Superscript 1 text reads, sedimentation rate.

Back to Table

A table lists Etiology of Limp in Children lesser than 14 years old presenting to a pediatric ED, Superscript 1.
There are two columns: Location of Pain, Final Diagnoses. Location of Pain lists the following: Hip 34 percent; No pain 21 percent; Knee 19 percent; Leg, not hip or knee 18 percent; not localized 7 percent; Back 2 percent. Final diagnoses lists the following: Toxic synovitis 40 percent; Unknown 29 percent; Strain or overuse 18 percent; Reactive arthritis or HSP 3 percent; Legg-Calve-Perthes 2 percent; Osteomyelitis 2 percent; Cellulitis or adenitis 2 percent; Toddler's fracture 1 percent; Other fx, Kohler's 2 percent; Malignancy 1 percent; SCFE less than 1 percent; Osgood Schlatter less than 1 percent. Superscript 1 text reads, prospective, no recent trauma.

Back to Table

A table shows disorders that alter end tidal carbon dioxide concentrations superscript 1.
There are two columns. The data from the table are as follows. Increasing ETCO2: Equipment or Mechanical Faulty exhalation valve, tourniquet release, reperfusion of an ischemic limb, transient seizure, contamination of sensor or optical bench increased baseline and ETCO2; Cardiovascular Return of spontaneous circulation, increased cardiac output; Pulmonary Hypoventilation, respiratory depression, obstructive disease, rebreathing, increases baseline ETCO2; Metabolic Hyperthermia, including malignant, NaHCO3, onset within 1 minute, lasts less than 2 minutes, shivering. Decreasing ETCO2: Equipment/Mechanical Circuit leak, partial airway obstruction, ventilator disconnection; Cardiovascular Cardiac arrest, shock, decreased cardiac output, high-dose epinephrine administration; Pulmonary Hyperventilation, bronchospasm and upper airway obstruction can decrease steepness of respiratory upstroke: decrease slope of waveform,

mucous plugging, massive pulmonary embolism; Metabolic Hypothermia, ETCO2 less than or equal to 31 is associated with serum bicarbonate less than or equal to 15 milliequivalent per liter, 76 percentage sensitive, 96 percentage specific in children with gastroenteritis.

Back to Table

A table shows reference values, PEFR1 for spirometry.
There are eleven columns. Age, 6 years male, 6 years female, 8 years male, 8 years female, 10 years male, 10 years female, 12 years male, 12 years female, 14 years male, 14 years female. Row entries are as follows. Row 1: 44; 99; 149; 119; 168; 139; 186; 159; 205; 178; 224. Row 2: 48; 146; 179; 166; 197; 186; 216; 206; 235; 226; 254. Row 3: 52; 194; 208; 214; 227; 234; 246; 254; 265; 274; 283. Row 4: 56; 241; 235; 261; 256; 281; 275; 301; 295; 321; 314. Row 5: 60; 289; 268; 309; 287; 329; 305; 349; 324; 369; 343. Row 6: 64; 336; 297; 356; 316; 376; 335; 396; 354; 416; 373. Row 7: 68; 384; 327; 404;346; 424; 365; 444; 384; 464; 403. Row 8: 72; 431; 357; 451; 376; 471; 395; 491; 414; 511; 432.

Back to Table

A table shows severity of acutes asthma exacerbation superscript 1. There are four columns. Row entries are as follows. Row 1: Mild; Features: SOB with activity; Initial PEFR or FEV1: Greater than or equal to 70 percentage of predicted or personal best; Course: Care at home, quick relief with inhaled SABA. Row 2: Moderate; Features: SOB limits usual activity; Initial PEFR or FEV1: 40 to 69 percentage of predicted or personal best; Course: Office or ED visit usual, relief with frequent inhaled SABA with some symptoms for 1 to 2 days after treatment started, oral steroids often needed. Row 3:

Severe; Features: SOB with rest or with talking; Initial PEFR or FEV1: Less than 40 percentage of predicted or personal best; Course: ED visit usual, likely hospital admit, partial relief with frequent inhaled SABA with some symptoms for greater than 3 days after treatment is started; oral steroids in all, other adjuncts may be used. Row 4: Life threatening; Features: Cannot speak Diaphoresis; Initial PEFR or FEV1: Less than 25 percentage of predicted or personal best; Course: Hospitalization in all cases, some require ICU admission, minimal to no relief with frequent inhaled SABA, IV steroids, adjuncts are used.

Back to Table

A table shows pediatric asthma severity score, PASS for use percentage 2 years old superscript 1.
There are four columns. Finding, 0, 1, and 2. Row entries are as follows. Row 1: Respiratory rate; Normal rate; Tachypnea; no data. Row 2: Wheezing; None or mild; Moderate; Severe or absent. Row 3: Work of breathing superscript 2; None or mild; Moderate; Severe. Row 4: Prolonged expiration; Normal or mildly prolonged; Moderate prolonged; Severely prolonged.

Back to Table

A table shows risk factors for asthma-related death.
The data from the table are as follows. Prior severe episode, ICU admit, intubation, chest tube. Greater than or equal to 2 admissions, or greater than 3 ED visits in past year. Use greater than 2 canisters of short-acting beta-agonist per month. Difficulty perceiving airway obstruction or the severity of worsening asthma. Low socioeconomic status, inner-city residence. Illicit drug use, major psychiatric, psychosocial problems. Comorbidity: cardiovascular or chronic lung disease.

Back to Table

A flow chart shows the guidelines for ED Management of Asthma. A text box reads, History, examination, O2 saturation, peak flow or PEFR or FEV1. Three arrows branching from it point to three boxes horizontally placed below. Box 1 reads, FEV1 or PEFR is more than or equal to 40 percent: beta 2 agonist by MDI or neb. Times 3 doses 1st h. Oxygen to keep sat. More than or equal to 90 percent. Oral steroids if no immediate response. Box 2 reads, FEV1 or PEFR less than 40 percent: High dose beta 2 agonist plus ipratropium neb. Q 20 min or continue times 1 h. Oxygen to keep sat. More than or equal to 90 percent. Oral steroids. Box 3 reads, Impending arrest: Intubation plus ventilate with 100 percent oxygen. Beta 2 agonist plus anticholinergic neb. IV steroids. Two lines from box 1, and 2 merge into a downward facing arrow which points to a box which reads, Repeat exam, PEFR, oxygen saturation as needed. A downward arrow from box 3 points to another box reading, Admit to ICU. Lines from both these boxes branch into two downward facing arrows and point to two different boxes. Box 1 reads, Moderate exacerbation: PEFR 40 to 69 percent of predicted best. Moderate symptoms. Inhaled beta 2 agonists q 60 min. Oral or increased inhaled steroids. Treat 1 to 3 h, if improvement, make admit decision in less than 4 h. Box 2 reads, Severe exacerbation: PEFR less than 40 percent of predicted best. Severe rest symptoms, high risk. No improvement after initial treatment. Inhaled beta 2 agonists q h or continuous plus inhaled anticholinergics. Oxygen and systemic steroids. From these two boxes, three arrows branch off further and point to three text boxes. Box 1 reads, Good Response: PEFR more than or equal to 70 percent, sustain response 60 min. Normal exam. Box 2 reads, Incomplete response: PEFR more than or equal to 40 percent, less than 70 percent. Mild to moderate symptoms. Box 3 reads, Poor response: PEFR less than 40percent. p carbon dioxide

more than or equal to 42 millimeter Hg. Severe symptoms. An arrow from box 1 points to a box below it. It reads as follows, Discharge Home: Continue inhaled beta2 agonists plus oral steroid. Patient education regarding medicines, review plan, follow-up. An arrow from box 2 above too points to the box 1 here, and box 2 below it which reads, Admit to hospital: Inhaled beta2 agonist and anticholinergic. Oral or IV steroid. Oxygen to keep sat. More than or equal to 90 percent. Follow PEFR, HR, oxygen sat. An arrow from box 3 above points to box 3 below it. It reads as follows, Admit to ICU: Inhaled beta 2 agonist q h or continuous. IV steroids, plus or minus Mag. Oxygen. Possible intubation.

Back to Table

A table shows parenteral agents for treating acute asthma. There are four columns. Agent, Dose (max dose), Frequency, and Comments. Row entries are as follows. Row 1: Epinephrine 1:1,000; 0.01 milligrams per kilogram IM or SC; q 20 minutes multiplied by 3; Nonselective alpha, beta-agonist. Row 2: Magnesium sulfate; 25 to 50 milligrams per kilogram IV (Max 2 grams); No data; Administer over 15 min. Row 3: Methylprednisolone; 1 to 2 milligrams per kilogram IV (Max 125 milligrams); No data; No data. Row 4: Terbutaline, 1 milligrams per milliliter; 0.01 milligrams per kilogram IM or SC; q 20 minutes multiplied by 3; More b selective than epinephrine. There are two columns. Row 1: Agent: Terbutaline; Dose (max dose): 2 to 10 millicentigram per kilogram IV load 1 0.1 to 0.4 millicentigram per kilogram per minute IV. Row 2: Agent: Ketamine; Dose (max dose): 0.2 milligrams per kilogram bolus followed by 0.5 milligrams per kilogram per hour.

Back to Table

A table shows inhaled medications used for acute asthma exacerbations superscript 1,2.
There are three columns. Agent, Dose1, and Comments. Row entries are as follows. Row 1: Albuterol nebulizer solution 20 milliliter vials, 0.5 percentage OR 3 milliliter vials, 0.021 percentage, 0.042 percentage, or 0.083 percentage; 2.5 milligrams (minute) or 5 milligrams, 3 milliliter NS q 20 minutes for mod-severe initial with Ipratropium then alone continuous or q1–4 h; beta-agonist, more selective b2 than isoetharine and metaproterenol. Row 2: Albuterol HFA MDI (Ventolin HFA); 90 millicentigram per puff, 200 per can; Use spacer 1 mask, less than 4 years; 4 to 8 puffs q 4 to 6 h prn. Row 3: Ipratropium (Atrovent); Neb 250 to 500 milligrams multiplied by 3 or 2 to 3 puffs of 17 milligrams per puff via MDI; Anticholinergic, longer onset than most beta-agonists. Row 4: DuoNeb albuterol plus ipratropium; Mixed together for 3 doses given every 20 minutes; Moderate or severe asthma. Row 5: Continuous albuterol; 0.5 milligrams per kilograms per hour Max 15 milligrams per hour; Moderate or severe asthma. Row 6: Heliox helium, oxygen; 80:20 or 70:30, Heliox:O2 mixture; Decreased Airway resistance, increased bronchodilator delivery, increased carbon dioxide elimination.

Back to Table

A table shows oral medications for acute asthma exacerbations. There are four columns. Agent, Preparation, Dose, and Comment. Row entries are as follows. Row 1: Dexamethasone, Decadron; Elixir: 0.5 milligrams per 5 milliliter Solution: 1 milligrams per milliliter; 0.6 milligrams per kilogram multiplied by 1 dose Max 16 milligrams; Single dose equivalent to 5 days prednisolone. Row 2: Prednisolone Pediapred 5 by 5 Prelone and Orapred 15 milligrams per 5 milliliter; Solution: 5 and 15 milligrams per 5 milliliter Tabs: 5 milligrams; 2 milligrams per kilogram initial then 1 to 2 milligrams

per kilogram per day; Steroid, if treat 3 to 7 days, No taper needed. Row 3: Prednisone; Solution: 5 milligrams per 5 milliliter. Tabs: 1, 2.5, 5, 10, 20, 50 milligrams; 2 milligrams per kilogram initial then 1 to 2 milligrams per kilogram per day; Steroid, if treat 3 to 7 days, No taper needed.

Back to Table

A table shows bronchiolitis respiratory distress assessment instrument, RDAI.
There are six columns. Row entries are as follows. Row 1: Wheezing, Expiratory; 0: None; 1: End; 2: 1 by 2 Lung fields; 3: Three fourth Lung fields; 4: All fields. Row 2: Wheezing, Inspiratory; 0: None; 1: Part; 2: Throughout; 3: No data; 4: No data. Row 3: Wheezing, Location; None; Segmental; Diffuse. Row 4: Retractions, Supraclavicular; None; Mild; Moderate; Marked; No data. Row 5: Retractions, Intercostal; None; Mild; Moderate; Marked; No data. Row 6: Retractions, Subcostal; None; Mild; Moderate; Marked; No data.

Back to Table

A table shows American Academy of Pediatrics Management Guidelines for Bronchiolitis.
There are two columns. The data from the table are as follows. Diagnosis and risk assessment: Diagnosis and severity assessment is based on history and exam. Routine labs, X-rays are not recommended. Routine testing for viruses, RSV is rarely useful clinically. High risk: Less than 12 weeks, prematurity, heart or lung disease, or immunocompromised. Respiratory care: Nasal suctioning. Oxygen is indicated if O2 saturation (sat) falls persistently below 90 percentage, to keep greater than or equal to 90 percentage. Keep well hydrated with oral feeds or IV fluids.

Bronchodilators are not routinely recommended. Nebulized epinephrine is not routinely recommended. Nebulized hypertonic saline is not routinely recommended in ED. Steroids are not routinely recommended. Antibiotics are used only if coexisting bacterial infection. Chest physiotherapy is not routinely recommended. Heliox is not recommended by AAP. It may improve work of breathing and gas exchange while preventing intubation if respiratory distress. Isolation: Respiratory, Contact isolation. Alcohol-based hand cleansing is preferred, although antimicrobials soaps are OK to prevent nosocomial spread of RSV.

Back to Table

A table shows antibiotic treatment greater than 3 months of age. There are four columns. Setting, Type of pneumonia, Pathogen, and Antibiotic. Row entries are as follows. Row 1: Outpatient Immunized; Uncomplicated pneumonia; S. pneumonia Amoxicillin; PCN allergic: Clindamycin. Row 2: Outpatient Unimmunized; Uncomplicated pneumonia; S. pneumonia plus H. flu type B; Augmentin 30 milligram per kilogram dose BID into 7 days PCN Allergic: Levofloxacin 6 months to 5 years: 10 milligrams per kilogram BID, max 375 milligrams per dose greater than 5 years: 10 milligrams per kilogram QD, max 750 milligrams. Row 3: Outpatient Unimmunized; Atypical features greater than 5 years old; Mycoplasma, C. pneumoniae; Azithromycin 10 milligrams per kilograms day 1, 5 milligrams per kilograms days 2 to 5 Levofloxacin will cover atypical. Row 4: Inpatient Immunized; Uncomplicated, S. pneumonia; Ampicillin IV; PCN allergy: Clindamycin IV. Row 5: Inpatient Underimmunized; Uncomplicated; S. pneumonia 1 H. flu type B; Ceftriaxone PCN, Cef allergy: Levofloxacin. Row 6: Inpatient; Complicated or severe (large effusion, abscess, empyema or ICU); Strep and Staph Anaerobes if abscess; Ceftriaxone 1 Vancomycin PCN/Cef allergy Levofloxacin 1

Vancomycin. The data from the table shows Discharge criteria: Able to take PO. Pulse ox greater than 90 percentage in room air. Baseline mentation. Improvement of vital signs. Social environment able to give PO medications and have close follow-up.

Back to Table

A table shows hospital-acquired pneumonia.
There are two columns. The data from the table are as follows. S. aureus, Enterobacteriaceae, Pseudomonas aeruginosa, and anaerobes; Aminoglycoside (gentamicin OR amikacin) PLUS. Piperacillin-tazobactam 300 milligrams per kilogram per day in four divided doses (max 16 grams per day), OR, Meropenem 60 milligrams per kilogram per day in three divided doses (max 3 grams per day), OR, Ceftazidime 125 to 150 milligrams per kilogram per day in three divided doses (max 6 grams per day), OR, Cefepime 150 milligrams per kilogram per day in three divided doses (max 4 grams per day), OR, Clindamycin 30 to 40 milligrams per kilogram per day in three or four divided doses (max 2.7 grams per day). MRSA; Vancomycin, do not use with Piperacillin-tazobactam, asterisk.

Back to Table

A table shows diseases and complications associated with cystic fibrosis.
There are two columns. Organ and Manifestation and management. Row entries are as follows. GI; Cholelithiasis: Up to 5 percentage have stones, 5 percentage have cholestasis, biliary cirrhosis rare. Ursodeoxycholate slows progression of liver lesions. Distal intestinal obstruction syndrome (DIOS): Later in childhood, distal small bowel obstruction, pain, decreased stooling, plus or minus diet per med noncompliance. If incomplete, plus or minus

Miralax, GoLYTELY, lactulose. Meconium ileus: 15 percentage, obstruct distal small bowel with meconium in first 48 hours of life. Hyperosmolar enemas 50 percentage relief, others need surgery. Meconium plug syndrome: A more benign blockage of the colon. Rectal prolapse: May be presenting symptom (especially less than 3 years). Pancreatic insufficiency: Leading to malabsorption occurs in 90 percentage by age 1 year. Leads to failure to thrive and later diabetes. Enzyme replacement tends to adequate fat absorption in up to 80 percentage.

Back to Table

A table shows most common etiology of grunting in children presenting to a pediatric ED.
There are two columns. The data from the table are as follows. Cardiorespiratory: 57 percentage; Upper or lower respiratory tract infection: 28 percentage; Reactive airway disease: 20 percentage; Aspiration foreign body or liquid: 4 percentage; Myocarditis, CHF, congenital heart: 4; Sickle cell acute chest syndrome: 2 percentage. Nonrespiratory infection: 25 percentage; Bacteremia, sepsis: 12 percentage; Fever, viral infection: 6 percentage; Meningitis, pyelonephritis, 4 percentage each: 4 percentage. Surgical abdomen, intussusception, obstruction ileus: 8 percentage. Sickle crisis, VP shunt malfunction, corneal abrasion, skull fx, hemolytic anemia: 2 percentage each.

Back to Table

A table shows etiology of hemoptysis for children admitted to hospital.
The data from the table are as follows: Cystic fibrosis: 65 percentage; Congenital heart disease: 15 percentage; Pneumonia: 6; Neoplasm: 3 percentage; Pulmonary HTN, bleed, embolism: 2

percentage; Tuberculosis: 1 percentage; Nasopharyngeal: 1 percentage; Sepsis: 1 percentage; Vasculitides: 1 percentage; Other: 5 percentage.

Back to Table

A table shows stridorous upper airway diseases in children.
There are five columns. Feature, Croup, Tracheitis superscript 4, Epiglottitis superscript 4, and Retropharyngeal abscess superscript 4. Row entries are as follows. Row 1: Age (y); 0.3 to 3.0; 5 to 10; 2 to 8; Median 3.5. Row 2: Prodrome; d; h–d; Min–h; d (prior URI). Row 3: Fever; Low grade; Usual; Usual; Usual. Row 4: X-ray superscript 1; Steeple sign superscript 1; Exudate; Ratios superscript 2; Soft tissue swelling superscript 3. Row 5: Etiology; Viral; S. aureus; H. influenzae; Strep, Staph, anaerobe. Row 6: Cough; Yes; Yes; No; Uncommon. Row 7: Drool; No; No; Yes; Yes. Row 8: Toxic; Usually; no; Yes; Yes; Yes.

Back to Table

A table shows croup score.
There are five columns. Feature, 0, 1, 2, and 3. Row entries are as follows. Row 1: Color; Normal; Dusky; Cyanotic; Cyanotic on O2. Row 2: Air movement; Normal; Mild decreased; Moderate decreased; Marked decreased. Row 3: Retractions; None; Mild; Moderate; Severe. Row 4: Mentation; Normal; Restless; Lethargic; Obtunded. Row 5: Stridor; None; Mild; Moderate; Severe, Obstructed. There are three columns. Total score, Severity, and Treatment. Row entries are as follows. Row 1: 0 to 4; Mild; Home care. Row 2: 5 to 6; Mild or moderate; Consider steroids, admit if less than 6 months, unreliable family. Row 3: 7 to 8; Moderate; Racemic epinephrine, consider steroids, admit most. Row 4: 9 to 14; Severe; Racemic epinephrine, steroids, ICU admission. Row 5:

15; Life threat; Racemic epinephrine, steroids, intubation.

Back to Table

A table shows contraindications to noninvasive mechanical ventilation.
The data from the table are as follows: Contraindications: Respiratory arrest, cardiovascular instability, altered mentation, uncooperative, high aspiration risk, viscous or copious secretions, recent face or airway surgery, recent upper GI-esophageal surgery, upper GI-tract bleeding, facial trauma, burns, extreme obesity, fixed nasopharyngeal abnormalities limiting use of equipment.

Back to Table

A table shows noninvasive positive pressure ventilation, NPPV modes, parameters.
The data from the table are as follows. Bilevel positive airway pressure, BiPAP; (1) Start inspiratory positive airway pressure, IPAP at 8 centimeter H2O. Then, increase to 10 to 16 centimeter H2O, available range 2 to 25 centimeter H2O. (2) The expiratory positive airway pressure, EPAP is usually set at 5 to 8 centimeter H2O, available range 2 to 20 centimeter H2O. This provides positive end expiratory pressure increasing functional residual capacity and maintaining airway patency at the end of expiration. (3) A backup rate may or may not be provided. (4) Nebulized medications can be delivered via BiPAP. (5) Improvement may be heralded by decreased respiratory rate, increased O2 saturation, decreased accessory muscle use, reduction of airway occlusion if upper airway obstruction, and improved lung volumes on chest radiography. Continuous positive airway pressure, CPAP: CPAP delivers constant level of pressure support to the airways during inspiration and expiration. A mask with nasal prongs, adapters or a

face mask delivers continuous pressure ranging from 4 to 10 centimeter H2O. Nebulized treatments are not routinely administered via CPAP.

Back to Table

A table shows noninvasive positive pressure ventilation, NPPV modes, parameters.
There are two columns. The data from the table are as follows. Nasal intermittent positive pressure ventilation, NIPPV; NIPPV provides periodic increases in positive pressure above a baseline CPAP pressure. NIPPV is delivered via nasal prongs or a tight nasal mask connected to a ventilator or a bilevel nasal CPAP device. If a ventilator is used, the periodic positive pressure can be administered synchronously with an infant's respiratory effort. A low, 5 centimeter H2O and a high, 8 centimeter H2O CPAP level can be set. Heated high flow nasal cannula, HFNC; Heated humidified gas, for example, approximately 100 percentage O2 can be delivered without irritating or drying nasal mucosa. 5 liters per minute to 40 liters per minute. Weaning parameters for all modes; Clinically stable for 4 to 6 hours. Respiratory rate and heart rate normalize. Compensated pH greater than 7.35, SaO2 greater than or equal to 92 percentage on less than or equal to 2 to 3 liters O2.

Back to Table

A table lists a questionnaire Pediatric Suicide Risk Tool questionnaire.
The table lists Ask Suicide Screening Questions or ASQ. 1. In the past few weeks, have you wished you were dead? Yes or No. 2. In the past few weeks, have you felt that you or your family would be better off if you were dead? Yes or No. 3. In the past week, have you been having thoughts about killing yourself? Yes or No. 4. Have

you ever tried to kill yourself? Yes or No. 5. If yes, how? When? If the patient answers Yes to any of the above, ask the following acuity question: 5. Are you having thoughts of killing yourself right now? Yes or No. If yes, please describe

Back to Table

A table lists the Comparison of Radiation Doses from Medical Imaging Tests and Background Radiation.
The table has three column headings: Imaging, Radiation dose or mSv super script 1, and Time to accumulate comparable natural background dose. Row entries for computed tomography are as follows. Row 1: Multiphase abdomen and pelvis; 31.0; 10 years. Row 2: Abdomen and pelvis; 10.0; 3 years. Row 3: Chest or pulmonary embolism; 10.0; 3 years. Row 4: Chest; 7.0; 2 years. Row 5: Head; 2.0; 8 months. Row 6: Sinuses; 0.6; 2 months. Row entries for Fluoroscopy are as follows. Row 1: Coronary angiography; 5 to 15; 20 months to 5 years. Row 2: Barium swallow; 1.5; 6 months. Row entries for Nuclear medicine are as follows. Row 1: Cardiac perfusion, sestamibi; 12.5; 4 years. Row 2: Bone scan; 4.2; 1 year 4 months. Row 3: Lung ventilation or perfusion; 2.0; 8 months. Row entries for Radiography are as follows. Row 1: Abdomen; 1.2; 5 months. Row 2: Lumbar spine; 0.7; 3 months. Row 3: Chest; 0.1; 10 days. Row 4: Extremity; 0.001; less than 1 day. Row entries for other are as follows. Row 1: Mammography; 0.7; 3 months. Row 2: Bone densitometry, DEXA2; 0.001; less than 1 day.

Back to Table

A table lists a comparison of radiation doses from medical imaging tests and background radiation.
The table has three column headings: Examination, radiation dose

or mSv superscript 1 and time to accumulate comparable natural background dose. Row entries for computed tomography are as follows. Row: 1: Sinuses, 0.6, 2 months. Row 2: Head, 2.0, 8 months. Row 3: Chest, 7.0, 2 years. Row 4: Chest or pulmonary embolism, 10.0, 3 years, Row 5: Abdomen and pelvis, 10.0, 3 years. Row 6: Multiphase abdomen and pelvis, 31.0, 10 years. Row entries for Radiography are as follows: Row 7: Extremity, 0.00, less than 1 day. Row 8: Chest, 0.1, 10 days. Row 8: Lumbar spine, 0.7, 3 months. Row 9: Abdomen, 1.2,5 months. Row 10: Mammography, 0.7, 3 months. Row 11: Bone densitometry or DEXA 2, 0.001, 1 day. Row entries for Nuclear medicine are as follows: Row 12: Lung ventilation or perfusion, 2.0, 8 months. Row 13: Bone scan, 4.2, 1 year and 4 months. Row 14: Cardiac perfusion or sestamibi, 12.5, 4 years. Row entries for Fluoroscopy are as follows: Row 15: Barium swallows 1.5, 6 months. Row 16: Coronary angiography, 5 to 15, 20 months to 5 years.

Back to Table

A table lists common causes of abdominal pain by age.
The table has six column headings: Age, less than 3 months, more than or equal to 3 months to 1 year, 1 to 5 years, 5 to 12 years, more than 12 years. Row 1: Common and more benign, Colic and GERD and milk protein allergy, GERD and constipation, UTI and constipation, UTI and constipation and FGID and gas, UTI and Constipation and FGID and gas and ruptured ovarian cyst. Row 2: Urgent, acute Gastroenteritis, acute Gastroenteritis and HSP and Pneumonia and Meckel diverticulum, acute Gastroenteritis and IBD and Pneumonia, acute Gastroenteritis and IBD and Pneumonia and Hepatitis and Pancreatitis and Nephrolithiasis and PID. Row 3: Emergent, trauma and NEC and Omphalitis and adhesions and testicular torsion, Trauma and midgut volvulus and incarcerated hernia and pyloric stenosis and intussusception, Trauma and

Appendicitis, Trauma and Appendicitis and testicular or ovarian torsion and DKA, Trauma and Appendicitis and Testicular or ovarian torsion and Ectopic pregnancy and DKA.

Back to Table

A table lists causes of bilious vomiting in infants and children.
A table has three column headings: Age, Cause, and Percentage of cases. Row 1: 0 to 4 weeks, Surgical disorders caused by midgut volvulus, hernia, bowel atresia, meconium ileus or plug, Hirschsprung's, 20 to 51 percent. Nonsurgical: Mostly idiopathic or unknown cause, 49 to 80 percent. Row 2: 1 to 12 months, Surgical disorders are 14 percent of which intussusceptions is 7 percent and bowel obstruction or hernia is 7 percent, Nonsurgical disorders are 86 percent of which Gastroenteritis is 64 percent, Bronchiolitis is 18 percent, and Urinary infection is 4 percent. Row 3: Less than 12 months, Surgical disorders are 14 percent of which Appendicitis is 5 percent, small bowel obstruction is 2 percent, Pancreatitis (not all surgical) or cholecystitis is 2 percent, intussusceptions is 1 percent, and ventricular shunt failure is 1 percent. Nonsurgical disorders are 89 percent of which Gastroenteritis or cyclic vomiting is 74 percent; respiratory infection, pharyngitis, otitis, and asthma are 11 percent; and other disorders including pelvic infection, DKA, HSP, and pregnancy are 4 percent.

Back to Table

A table lists frequency of historical features at different ages.
The table has three column headings: 0 to 2 years which is rare, 2 to 5 years which is less than 5 percent of all cases and 6 to 12 years. Row 1: Vomiting 85-90 percent, abdominal pain 89 to 100 percent, pain 98 percent. Row 2 : Pain 35 to 77 percent, vomiting 66 to 100 percent where unlike older children and adults, vomiting

may precede pain, pain with movement 41 to 75 percent. Row 3: Fever 40 to 60 percent, pain with movement 68 to 95 percent. Row 4: Diarrhea 18 to 46 percent, vomiting before pain is less than or equal to 18 percent. Row 5 : Irritability 35 to 40 percent. Row 6: Cough or rhinitis 40 percent, anorexia 47 to 75 percent. Row 7: Grunting 8 to 23 percent, diarrhea 9 to 16 percent. Row 8 : Hip pain or stiffness 3 to 23 percent , fever 80 to 87 percent and anorexia 53 to 60 percent, constipation 5 to 28 percent and dysuria 4 to 20 percent.

Back to Table

A table lists Appendicitis Diagnosis and Management.
The table has two rows: Diagnosis and Management. Entries for diagnosis is a follows: 1. Score as per Table 30-3; 2. WBC count and CRP, poor utility, especially less than 24 hours of symptoms; 3. Serial WBC count useless; 4. US is 60 to 90 percent sensitive where diameter is greater than 6 mm, target sign, wall is greater than 2 mm, some perform pre-CT and CT only if normal US ; 5. CTis greater than or equal to 95 percent sensitive, especially if focused RLQ exam with 3 to 5 millimeter cuts or reconstruction, using IV plus or minus colonic contrast. Entries for management are as follows: 1. Fluid resuscitation; 2 IV antibiotics if suspect perforation on page xxx; 3. Surgical consultation; 4. Limited studies found that select children with symptoms less than 24 hours or with more than 5 days presumed perforation treated nonoperatively with IV antibiotics may have superior or equivalent outcome to those treated operatively.

Back to Table

A table lists out the toxins that affect vital signs and physical examination.

Hypotension: ACE inhibitors, α and β antagonists, Anticholinergics, Arsenic acutely, Ca+2 channel block, Clonidine, Cyanide, Antidepressants, Disulfiram, Ethanol, methanol, Iron, isopropanol, Mercury, GHB, Nitrates, Nitroprusside, Opioids, Organophosphate, Phenothiazines, Sedatives, Theophylline. Hypertension: Amphetamines, Anticholinergics, Cocaine, Lead, MAO inhibitors, Phencyclidine, Sympathomimetics. Tachycardia: Amphetamines, Anticholinergics, Arsenic acutely, Antidepressants, Digitalis, Disulfiram, Ethylene glycol, iron, Organophosphates, Sympathomimetics PCP, phenothiazines, Theophylline. Bradycardia: Antidysrhythmics, α agonists, β antagonists, Ca+2 channel blockers, Digitalis, opioids, GHB Organophosphates. Tachypnea: Ethylene glycol, Methanol, Nicotine, Organophosphate, Salicylates, Sympathomimetics cocaine, Theophylline. Bradypnea: Barbiturates, Botulism, Clonidine, Ethanol, Isopropanol, Opioids, Organophosphate, Sedatives. Hyperthermia: Amphetamines, Anticholinergics, Arsenic (acute), Cocaine, Antidepressants, LSD, Phencyclidine, Phenothiazines, Salicylates, Sedative-hypnotics, Theophylline, Thyroxine. Hypothermia: Carbon monoxide, Ethanol, Hypoglycemic agents, Opioids, Phenothiazines, Sedative-hypnotics. Mydriasis, pupillary dilation: Anticholinergics, Antihistamines, Antidepressants, Anoxia—any cause, Amphetamines, Camphor, Cocaine, Cyanide, Drug withdrawal, Sympathomimetics, Select narcotics- meperidine, pentazocine, Lomotil, propoxyphene. Miosis (pupillary constriction): Anticholinesterases, Insecticides, Bromide, Central α2 agonists, Clonidine, guanefacine, Guanabenz, imidazoline, Coma—any sedative, Nicotine, Opioids, Phencyclidine, Pilocarpine, Physostigmine, Yohimbine.

Back to Table

A table lists the drugs and toxins that cause seizures.

Amphetamines, Anticholinergics, Antidepressants, β blockers, Bupropion, Carbon monoxide, Cyanide Cocaine, Camphor, Diphenhydramine GHB, Isoniazid Lead, Lidocaine, Lindane, Lithium, Nicotine, Organophosphates, PCP, Propoxyphene, Quinine, SSRIs, Withdrawal- ethanol, sedative, Theophylline, Tramadol, Venlafaxine.

Back to Table

A table lists the drugs and toxins that cause hypoglycemia. 6-Mercaptopurine or 6-MP, Ackee fruit or unripe fruit Jamaican Ackee tree S. Florida or Caribbean, Alcohols or ethanol, methanol, isopropanol, ethylene glycol, Angiotensin-converting enzyme or ACE inhibitors, β blockers, Bishydroxycoumarin or rat poison, Bitter melon gourds, Chlorpromazine, Climbing ivory gourd, Clofibrate, Didanosine, Disodium ethylenediaminetetraacetic acid or EDTA, Disopyramide, Fluoxetine, Fenfluramine, Fenugreek herb, Ginseng plant-American, Asian, Siberian, Haloperidol, Hypoglycemic agents or sulfonylureas, biguanides, α glucosidase inhibitor, thiazolidinediones, benzoic acid derivatives, Insecticides or carbamates or organophosphates, Insulin or exogenous, Isoniazid, Lithium, Mamejava plant, Methotrexate, Monoamine oxidase or MAO inhibitors, Nonsteroidal anti-inflammatory agents, P-aminobenzoic acid, Pentamidine, Phenylbutazone, Phenytoin, Pomegranate tree, Probenecid, Quinine, Ritodrine, Salicylates, Sertraline, Steroids or anabolic: stanozolol, Sulfonamides, Thiazide diuretics, Thioglycolate, Thyroid hormone, Tremetol, Tricyclic antidepressants or TCA, Trimethoprim.

Back to Table

A table lists the Poisoning or Toxidromes syndrome and Manifestations.

There are three column headings. They are Syndrome, Toxin, and Manifestations. The row entries are as follows. Row 1: Anticholinergic; Natural: Belladonna alkaloids, atropine, homatropine, Amanita muscuria. Synthetics: Cyclopentolate, dicyclomine, tropicamide, antihistamines, phenothiazines, dextromethorphan, TCA; Peripheral antimuscarinic: Dry skin, thirst, blurred vision, mydriasis, upward facing arrow pulse, upward facing arrow BP, red rash, upward facing arrow temperature, abdominal distention, urine retention. Central symptoms: Delirium, ataxia, cardiovascular collapse, seizures. Row 2: Acetylcholinesterase inhibition; Insecticides or organophosphates, carbamates. Nerve gas agents, see page xx; Muscarinic effects or SLUDGE: Salivation, lacrimation, urination, defecation, GI upset, emesis. Also downward facing arrow or upward facing arrow pulse and BP, miosis. Nicotinic effects: upward facing arrow pulse, muscle fasciculations, weakness, paralysis, downward facing arrow respirations, sympathetic stimulation. Central effects: Anxiety, ataxia, seizure, coma, downward facing arrow respiration, cardiac collapse. Row 3: Cholinergic; Acetylcholine, betel nut, bethanechol, clitocybe, methacholine, pilocarpine; See muscarinic and nicotinic effects mentioned previously. Row 4: Hemoglobinopathy; Carbon monoxide, methemoglobin; Headache, nausea, vomiting, dizziness, coma, seizures, cyanosis, cutaneous bullae, “chocolate” blood with methemoglobinemia. Row 5: Narcotic; Morphine, dextromethorphan, heroin, fentanyl, meperidine, propoxyphene, codeine, diphenoxylate, Dilaudid; CNS depression, miosis, except meperidine, downward facing arrow respirations, downward facing arrow BP, seizures, with propoxyphene and meperidine. Row 6: Sodium channel blockade; β-blockers, not all, Benadryl, calcium channel blockers, carbamazepine, citalopram, class I antiarrhythmic, cocaine, cyclic antidepressives, lamotrigine, loxapine, orphenadrine, phenothiazines, thioridazine, tetrodotoxin or

TTX SALT syndrome: Shock, Altered mental status, Long QRS, wide complex, Terminal R in aVR. Other ECG features: wide QRS with bradycardia, wide complex tachycardia, ventricular or supraventricular. Row 7: Sympathomimetic; Aminophylline, amphetamines, cocaine, ephedrine, caffeine, methylphenidate; CNS excitation, seizures, upward facing arrow pulse, upward facing arrow BP, downward facing arrow BP with caffeine, hyperpyrexia, psychosis, sweating. Row 8: Withdrawal syndrome; Alcohol, barbiturates, benzodiazepines, cocaine, narcotics; Diarrhea, mydriasis, piloerection, upward facing arrow BP, upward facing arrow pulse, insomnia, lacrimation, cramps, yawning, hallucinations.

Back to Table

A table lists the Poisoning toxins, Antidotes, and Treatments. There are three column entries. They are, Toxin, Antidote, and Other considerations. The row entries are as follows. Row 1: Acetaminophen; N-acetyl cysteine, see page xxx for dose; Very effective if used within 8 hours, use Rumack-Matthew nomogram to guide management. Row 2: β blockers; Glucagon 50 to 150 mcg per kilogram IV, SC, or IM may repeat Glucagon may help reverse downward facing arrow pulse and downward facing arrow BP. Row 3: Ca+2 channel blockers; CaCl2 45 to 90 milligrams per kilogram slow IV, glucagon—see β blocker dose; Glucagon may help reverse downward facing arrow pulse and downward facing arrow BP. Row 4: Cyanide; Cyanide Kit and Cyanokit; See pages xx, xx for detail. Row 5: Digoxin; Digoxin Fab fragments; See page xxx for dose. Row 6: Ethylene glycol; Fomepizole or Antizol 15 milligrams per kilogram IV plus 10 milligrams per kilogram IV q 12 hours times 4 doses; Ethanol if Antizol not available; ethanol dose page xxx, dialysis. Row 7: Hydrofluoric acid; IV, arterial, or SC or topical calcium gluconate; Acute or delayed deep tissue burn, systemic

acidosis, dysrhythmias secondary to hypocalcemia, hypokalemia, and hypomagnesemia. Row 8: Isoniazid; Pyridoxine—70 to 75 milligrams per kilogram IV up to 5 grams; Reverses seizures. Row 9: Methanol; Antizol, dialysis, ethanol; See pages xxx, xxx for detail. Row 10: Methemoglobinemia; Methylene blue, 0.2 milliliters per kilogram of 1 percent solution IV over 5 minutes; Consider exchange transfusion if severe methemoglobinemia. Row 11: Opiates; Naloxone 0.01 to 0.10 milligrams per kilogram up to 2 milligrams IV; Codeine, diphenoxylate, fentanyl, propoxyphene may require higher doses. Row 12: Organophosphates; Atropine 0.05 milligram per kilogram IV may double until effective plus pralidoxime, 2-PAM; Exceptionally high atropine doses may be necessary; see page xxx. Row 13: Salicylates; Dialysis Sodium bicarbonate 1 mEq per kilogram IV; Goal of alkaline diuresis is urine pH 7.50 to 7.55, see pages xxx, xxx. Row 14: Sodium channel block; Sodium bicarbonate 1 mEq per kilogram IV; Goal of narrowing QRS complex and reversing arrhythmias. Row 15: TCA; Sodium bicarbonate 1 mEq per kilogram IV; Goal is serum pH 7.50 to 7.55 to alter protein binding, see page xxx.

Back to Table

A table lists the Radio-opaque ingestions, Mnemonic CHIPES. Chloral hydrate and chlorinated hydrocarbons. Heavy metals- arsenic, Pb, mercury, health food- bone meal, vitamins. Iodides, iron. Potassium, psychotropics, for example, phenothiazines, antidepressants. Enteric-coated tabs, KCl, salicylates. Solvents- chloroform, CCl_4.

Back to Table

A table lists the Drugs cleared by hemodialysis and by hemoperfusion.

Drugs cleared by hemodialysis: Salicylates, Ethylene glycol, Methanol, Bromide, Ethanol, Theophylline, Depakote, Isopropyl alcohol, Chloral hydrate, Lithium, Iron, Isoniazid, Barbiturates.
Drugs cleared by hemoperfusion: Barbiturates, for example, phenobarbital, Theophylline, Phenytoin, Possibly digoxin.

Back to Table

A table lists the General Approach to the Poisoned Child.
Treat airway, breathing, and BP. Insert IV and apply cardiac monitor. Apply pulse oximeter and administer O subscript 2. Dextrose 5 to 10 milliliters per kilogram of D subscript 10W in neonate, 2 to 4 milliliters per kilogram D subscript 25W less than or equal to 2 years, 1 to 2 milliliters per kilogram D subscript 50 W greater than 2 years. Naloxone 0.01 to 0.10 milligram per kilogram can be given as a therapeutic trial especially if opioid ingestion is suspected. Benzodiazepines, or Ativan 0.05 to 0.10 milligram per kilogram IV.

Back to Table

A table lists the Contraindications, and Drugs cleared by multidose charcoal.
Contraindications: Caustics- acids, alkalis. Ileus, bowel obstruction. Risk of aspiration, if AMS. Drugs bound poorly by charcoal or arsenic, bromide, K+, toxic alcohols, heavy metals- iron, iodide, lithium, pesticides, solvents. Drugs cleared by multidose charcoal: Carbamazepine, chlorpropamide, dapsone, diazepam, digoxin, nadolol, nonsteroidals, oleander, phenobarbital, phenytoin, propoxyphene, salicylates, theophylline, and TCA.

Back to Table

A table lists the Cathartics.
Cathartics theoretically help by upward facing arrow fecal elimination of charcoal-bound toxins, and preventing concretions. Monitor electrolytes closely with their use. Cathartic choices: Sorbitol 35 percent —1 gram per kilogram PO or NG. Magnesium citrate 4 milliliters per kilogram PO or NG. Na+ or MgSO4—250 milligrams per kilogram PO or NG.

Back to Table

A table lists the Whole Bowel Irrigation.
Administration: Place NG tube. Administer polyethylene glycol, GoLYTELY at 25 to 40 milliliters per kilogram hour. Stop when objects recovered or when effluent is clear. Indications: Iron, zinc, sustained release meds. Ingested crack vials or drug packets. Contraindications: CNS or respiratory depression. Ileus, bowel obstruction, perforation.

Back to Table

A table lists the Acetaminophen Phases.
There are three columns. They are, Phase, Time after ingestion, and Signs and symptoms. The row entries are as follows. Row 1: 1; 30 minutes to 24 hours; Asymptomatic, or minor GI irritant effects. Row 2: 2; 24 to 72 hours; Relatively asymptomatic, GI symptoms resolve, possible mild elevation of LFTs or renal failure. Row 3: 3; 72 to 96 hours; Hepatic necrosis with potential jaundice, hepatic encephalopathy, coagulopathy, and renal failure, sepsis. Row 4: 4; 4 days to 2 weeks resolution of symptoms or death.

Back to Table

A table lists the management.

Decontamination; Charcoal is indicated only if toxic coingestants are present. Some upward facing arrow oral Mucomyst dose by 20 percent if charcoal given. N-acetyl cysteine, NAC Mucomyst, Acetadote—IV formulation; Assess toxicity based on nomogram. If drug level will return in less than 8 hours post-ingestion, treatment can be delayed until the level is known. NAC prevents 100 percent of toxicity if administered less than 8 hours from ingestion. If level will return more than 8 hours and more than or equl to 150 milligrams per kilogram ingested, administer first dose of Mucomyst. NAC is useful less than or equal to 24 hours after ingestion, possibly up to 72 hours. PO dose: 140 milligrams per kilogram PO, then 70 milligrams per kilogram q 4 h times 17 doses. Shorter course, 20 to 36 hours, may be effective if normal liver function tests and undetectable serum acetaminophen level, less than 10 mcg per milliliter, at 20 to 36 hours. Contact poison center for short protocol specifics. Source: Ann Emerg Med. 2007;50:272. IV dose—150 milligrams per kilogram IV, in D subscript 5W, over 15 minutes, then 50 milligrams per kilogram, in D subscript 5W, over 4 hours, then 100 milligrams per kilogram, in D subscript 5W, over 16 hours. Up to 18 percent develop anaphylactoid reaction, especially if asthmatic or if they have had a prior NAC reaction. If this happens, discontinue and manage symptoms, for example, antihistamines, epinephrine, inhaled beta agonists, IV fluids. If symptoms stop and were mild, consider restarting NAC. Otherwise, do not restart. Be aware that NAC can cause anaphylaxis.

Back to Table

A table lists the list of beta blockers, and treatment of beta blocker toxicity.
The two column headings are: System, and Clinical features. The row entries are as follows. Row 1: CNS; Lethargy, slurring,

confusion, coma, seizures, downward facing arrow respirations. Row 2: Cardiac; downward facing arrow HR, downward facing arrow BP, AV block, 1st, 2nd, or 3rd, sinus arrest, asystole. Row 3: GI; Nausea, vomiting, ileus, obstruction, bowel ischemia or infarction. Row 4: Metabolic; Hyperglycemia, especially verapamil, lactic acidosis. Treatment of β blocker toxicity: Two column headings are, Option, and Recommendations. The row entries are as follows. Row 1: Gastrointestinal decontamination; Avoid ipecac. Aspiration and asystole are reported. Charcoal— Repeat doses, see page xxx. Row 2: Glucagon; Indications: downward facing arrow HR or BP. Dose: 50 to 150 mcg per kilogram plus 50 mcg per kilogram per hour IV. Row 3: Glucose and insulin; Insulin—1 unit per kilogram bolus, then 0.5 units per kilogram per hour. Glucose—0.5 to 1 gram per kilogram gram bolus, then 0.5 gram per hour. Monitor q 30 to 60 minutes glucose per K+ until all infusions have been off for more than or equal to 6 hours. Row 4: Atropine; No HR response is suggestive of beta blocker toxicity. Administer 0.02 milligram per kilogram IV prn, maximum of 0.5 to 1 milligram. Row 5: Fluid or Vasopressors: If downward facing arrow BP does not respond to NS, administer alpha plus beta agonists, epinephrine or norepinephrine, or pure beta agonist, dobutamine. Row 6: Other options; Consider NaHCO3 1 to 2 mEq per kilogram IV to reverse sodium channel blockade, SALT syndrome, if wide QRS, low BP, minus plus acidosis. Use pacemaker if no response to above. Consider dialysis if atenolol, nadolol, or acebutolol overdose. Inamrinone—Consult pharmacist, special dosing or monitoring.

Back to Table

A table lists the Calcium Channel Blockers.
The two column headings are, System, and Clinical features. The row entries are as follows. Row 1: CNS; Lethargy, slurring, confusion, coma, seizures, downward facing arrow respirations.

Row 2: Cardiac; downward facing arrow HR, downward facing arrow BP, AV block, 1st, 2nd, or 3rd, sinus arrest, asystole. Row 3: GI; Nausea, vomiting ileus, obstruction, bowel ischemia or infarction. Row 4: Metabolic; Hyperglycemia, especially verapamil, lactic acidosis. The two column headings are, Option, and Recommendations. The row entries are as follows. Row 1: Gastrointestinal decontamination; Charcoal. Avoid ipecac. Whole-bowel irrigation if sustained-release preparation. Row 2: Calcium; Usually ineffective at improving cardiac conduction defects. Primary indication is to reverse hypotension. Administer Ca+2 gluconate 60 to 100 milligrams per kilogram IV over 5 minutes, repeat prn. Alternatively, CaCl2 20 milligrams per kilogram IV over more than or equal to 5 minutes. Row 3: Glucagon; Indications: downward facing arrow HR or BP. Dose: 50 to 150 mcg per kilogram IV bolus plus 50 mcg per kilogram per hour IV. Row 4: Glucose and insulin; Insulin—1 unit per kilogram bolus, then 0.5 units per kilogram per hour. Glucose—0.5 to 1 gram per kilogram bolus, then 0.5 gram per hour. Monitor q 30 to 60 minutes glucose per K+ until all infusions have been off for more than or equal to 6 hours. Row 5: Atropine; Administer 0.02 milligram per kilogram IV if symptomatic downward facing arrow HR, repeat 3 times. Row 6: Fluids or Pressors; downward facing arrow BP occurs from peripheral vasodilation. Give NS, then vasoconstrictor: norepinephrine, Neo-Synephrine, upward facing arrow dose dopamine. Row 7: Other options; Consider NaHCO3 1 to 2 mEq per kilogram IV to reverse sodium channel blockade, SALT syndrome, if wide QRS, low BP, plus minus acidosis. Pacemaker if no response to calcium, glucagon, atropine.

Back to Table

A table lists the Carbon Monoxide Elimination.
The two column entries are, FiO subscript 2, and Carbon monoxide

half-life. The row entries are as follows. Row 1: Room air; 4 to 6 hours. Row 2: 100 percent rebreather; 1 to 1.5 hours. Row 3: 3 ATM hyperbaric O subscript 2; 15 to 30 minutes.

Back to Table

A table lists the Clinical Features of Carbon Monoxide Poisoning. Clinical features are as follows. Row entries are as follows. Row 1: Carboxyhemoglobin level; Typical symptoms at given level of Carbon monoxide toxicity. Row 2: 0 to 10 percent; Usually none, plus minus downward facing arrow exercise tolerance, upward facing arrow angina, and upward facing arrow claudication. Row 3: 10 to 20 percent; Frontal headache, dyspnea with exertion. Row 4: 20 to 30 percent; Throbbing headache, dyspnea with exertion, downward facing arrow concentration. Row 5: 30 to 40 percent; Severe headache, vomiting, visual changes. Row 6: 40 to 50 percent; Confusion, syncope on exertion, myocardial ischemia. Row 7: 50 to 60 percent; Collapse, seizures. Row 8: more than 60 to 70 percent; Coma and death. Row 9: Variable; Cherry red skin, visual field defect, homonymous hemianopsia, papilledema, retinal bleed, hearing changes, pulmonary edema. GI upset with vomiting, especially common less than 8 years old. Assessment of Carbon monoxide intoxication has following row entries. Row 1: Carboxyhemoglobin levels; Levels are unreliable and may be low in significant intoxication. Row 2: Anion gap; Cyanide and lactic acidosis may contribute to anion gap. Row 3: Saturation gap; Calculated—directly measured arterial O2 saturation. This gap occurs with cyanide, methemoglobin, and sulfhemoglobin. Row 4: ECG; May show changes consistent with myocardial ischemia. Row 5: Cardiac enzymes; May be elevated from direct myocardial damage. Treatment of Carbon monoxide toxicity has two column entries. They are, Criteria for admission, and Criteria for hyperbaric oxygen. The row entry is as follows. All with carboxyhemoglobin

more than 15 to 20 percent Pregnancy and carboxyhemoglobin more than 10 percent. Acidosis, ECG changes, myocardial ischemia, abnormal neurologic exam or history of unconsciousness. Symptoms after 100 percent O2 times 3 hours; Cyanide toxicity, coma, unconscious more than 20 minutes, abnormal neurological exam, ischemic changes on ECG, dysrhythmias, or neurologic symptoms after 100 percent O2 times 3 hours, also consider if pregnant with carboxyhemoglobin level more than 15 percent, or at carboxyhemoglobin level more than 20 percent.

Back to Table

A table lists the Clonidine Clinical features, and Treatment. Row entries for clinical features are as follows. Row 1: General; Up to 76 percent of children manifest symptoms by 1 hour and 100 percent by 4 hours, unless sustained release pill. Symptoms usually last less than 24 hours. Caution: Ingestion of a clonidine patch may cause prolonged symptoms; therefore, admit for observation and consider whole bowel irrigation if this type of ingestion occurs. Row 2: CNS; Lethargy, coma, recurrent apnea, miosis, hypotonia. Row 3: Cardiac; Sinus bradycardia, hypertension, transient, later hypotension. Row 4: Other; Hypothermia and pallor. The row entries under treatment are as follows. Row 1: Monitor; Cardiac monitor and pulse oximeter and observe closely for apnea. Apnea often responds to tactile stimulation. Row 2: Decontamination; Charcoal—only consider if less than 1 hours from ingestion. Avoid ipecac. Row 3: Atropine; Indication: bradycardia. Dose: 0.02 milligram per kilogram IV. Row 4: Antihypertensives; Hypertension is usually transient. If needed, use short-acting titratable agent, for example, nitroprusside. Row 5: Fluids or Pressors; Treat hypotension with fluids and dopamine prn. Row 6: Naloxone; 0.02 milligram per kilogram IV may reverse CNS but not cardiac or BP effects. Up to 10 milligrams may be required.

Caution: Naloxone may also precipitate hypertension.

Back to Table

A table lists the Cocaine Pharmacokinetics.
Cocaine is the HCl salt of the alkaloid extract of the Erythroxylum coca plant. It can be absorbed across all mucous membranes. It is a local anesthetic, ester-type, that blocks the reuptake of norepinephrine, dopamine, and serotonin. The three column headings are: Route, Peak effect, and Duration. The row entries are as follows. Row 1: Nasal; 30 minutes; 1 to 3 hours. Row 2: GI; 90 minutes; 3 hours. Row 3: IV or Inhaled; 1 to 2 minutes; less than or equal to 30 minutes.

Back to Table

A table lists the Clinical Features of Cocaine Toxicity.
The row entries are as follows. Row 1: General; Agitation, hyperthermia, sweat, rhabdomyolysis, GI perf or ischemia. Row 2: Cardiac; A direct myocardial depressant prolongs QT with sympathetic hyperactivity, myocardial ischemia, often with atypical clinical features and ECG findings—acutely or during withdrawal, upward facing arrow BP, upward facing arrow HR, LVH, arrhythmias, upward facing arrow platelet aggregation, accelerated atherosclerosis. Row 3: CNS; Seizures, CNS infarct or bleed, CNS abscess, vasculitis, dystonia. Row 4: Lung; Pneumothorax or Mediastinum, hemorrhage, pneumonitis, ARDS. Row 5: Psychiatric; Paranoia, psychosis. Management has following row entries. Row 1: General; Apply cardiac monitor, oxygen, pulse oximeter and observe for arrhythmia, seizures, and hyperthermia. Benzodiazepines are drug of choice for agitation, while haloperidol is also effective, without upward facing arrow cocaine seizure threshold. Row 2: Hyperthermia and Rhabdomyolysis;

Benzodiazepines to reduce agitation and muscle activity; cool with mist and fan; continuous rectal probe temperature; check serum CK or CO2; administer IV fluids and bicarbonate to prevent renal failure, page xx. Row 3: GI decontaminate; Body stuffers—Charcoal and monitor for perf. or ischemia. Body packer—X-ray and whole bowel irrigation; if rupture, consider laparotomy to remove cocaine. Row 4: Cardiovascular, arrhythmias, and hypertension; Administer benzodiazepines for upward facing arrow BP, upward facing arrow HR. Treat according to standard ALS protocols: Use nitroprusside or phentolamine if severe HTN. Use caution with labetalol: beta greater than alpha block plus minus upward facing arrow seizures. In the past, experts recommended avoiding beta blockade due to unopposed alpha effects. Limited studies suggest there may be a beneficial, protective effect of beta blockade. Currently, clear recommendations cannot be given regarding their use or avoidance. Wide-complex tachycardia due to quinidine like effect. Give NaHCO3 1 mEq per kilogram IV and cardiovert. Row 5: Cardiovascular chest pain; Administer benzodiazepines, aspirin, and IV NTG if MI. Phentolamine IV may reverse coronary vasoconstriction. Row 6: Neurologic; Treat status epilepticus with benzodiazepines. Barbiturates are second line while phenytoin is not useful. Exclude coexisting disease, CT, glucose, electrolytes, R/O infection.

Back to Table

A table lists the Digoxin Clinical Features—Acute Toxicity, and chronic toxicity.
The row entries under Clinical features–acute toxicity are as follows. Row 1: Digoxin level; Usually markedly elevated, obtain greater than 6 hours after ingestion. Row 2: GI and CNS; Nausea, vomiting, diarrhea, headache, confusion, coma. Row 3: Cardiac; Paroxysmal atrial tachycardia, AV blocks, bradyarrhythmias. Row 4: Metabolic;

Hyperkalemia from inhibition of the Na+ or K+ ATP pump. The row entries under Clinical features–chronic toxicity are as follows. Row 1: Digoxin level; May be normal. Row 2: History; URI symptoms, on diuretics, renal insufficiency, yellow-green halos. Row 3: Cardiac; Ventricular arrhythmias, PVCs are more common than with acute toxicity. Row 4: Metabolic; Potassium low or normal, magnesium is often low. Following are entries under Treatment of digoxin toxicity: Multidose charcoal. Atropine 0.02 milligram per kilograms for downward facing arrow HR. Ventricular arrhythmia: lidocaine 1 milligram per kilograms IV plus minus MgSO subscript 4 25 milligrams per kilograms slow IV. Treat upward facing arrow K+: page xx; avoid calcium. Avoid cardioversion if possible, predisposes to ventricular fibrillation. Digoxin Fab fragments Digibind. Indications for Digibind: Ventricular arrhythmias. Bradyarrhythmias unresponsive to therapy. Ingestion of more than 0.1 milligram per kilogram. Digoxin level greater than 5 nanograms per milliliter. Consider if K+ greater than 5.5 mEq per L. Total body load digoxin —TBLD estimates: First assess total body load of digoxin, TBLD equals digoxin level, ng per milliliter times weight in kilogram divided by 100. Acute ingestion—the total milligrams ingested if digoxin capsules or elixir is ingested. Acute ingestion—the total milligrams ingested multiplied by 0.8 if another form of digoxin is ingested. Or estimate Digibind dose based on serum levels.

Back to Table

A table lists the Dosing Digibind.
Dose, number of vials equals serum digoxin concentration in nanogram per milliliter times weight in kilogram per 100. If ingested quantity unknown, consider empiric administration of 2 to 10 vials. One 38 milligrams Digibind vial can bind 0.5 milligram of digoxin if amount ingested known. Dilute Digibind to 10 milligrams per milliliter and administer IV over 30 minutes. Consider using 0.22-

micron filter for infusion. Serum digoxin levels are useless after Digibind, as lab assay measures bound plus unbound digoxin. These misleading levels may be exceptionally high, as Digibind draws digoxin back into the serum. Once bound, digoxin-Fab complex is renally excreted.

Back to Table

A table lists the Ethylene Glycol, and clinical features.
A table has two columns. They are, Timing, and Clinical features. The row entries are as follows. Row 1: 1 to 12 hours; Early: Inebriation, ataxia, slurring without ethanol on breath. Later: Coma, seizures, and death. Row 2: 12–24 hours; Cardiac: Deterioration occurs during this phase. Early: Tachycardia, hypertension, tachypnea. Later: Congestive heart failure, ARDS, and cardiovascular collapse. Myositis occasionally occurs during this phase. Row 3: 24–72 hours; Nephrotoxicity with calcium oxalate crystal precipitation leading to flank pain, renal failure, and hypocalcemia. The next two column headings are, Diagnosis, and Treatment. Diagnosis Anion gap acidosis. Osmol gap, measured—calculated osmol greater than 10 mOsm per L, page xx. Hypocalcemia, ECG— upward facing arrow QT interval. Calcium oxalate crystals in urine, urine may fluoresce with UV light—e.g., Wood's lamp. Upward facing arrow BUN and creatinine. Serum ethylene glycol level greater than 20 mg per dl is toxic. Serious toxicity has been reported in the absence of an elevated anion gap and crystalluria. Treatment: Charcoal ineffective. NaHCO3 1 mEq per kg IV—keep pH ~7.40. Ca+2 gluconate 10 percent, 100 milligram per kilogram IV if low calcium. Pyridoxine and thiamine IV. Fomepizole superscript 2, Antizol—15 milligrams per kilogram IV, plus 10 milligrams per kilogram q 12 h times 4 doses, then upward facing arrow to 15 milligrams per kilogram IV q 12 h until level less than 20 mg per dl. Ethanol if Antizol unavailable. Dialysis if (1)

oliguria or anuria, (2) severe acidosis, or (3) level more than 50 mg per dl more than 20 mg per dl if fomepizole not used.

Back to Table

A table lists the Flunitrazepam—Rohypnol “Roofies.”
The row entries are as follows. Row 1: Onset or Duration; Maximal absorption is 0.5 to 1.5 hours with T1 by 2 of nearly 12 hours. Row 2: Major clinical effects; CNS—Sedation, incoordination, hallucinations. Paradoxical excitement, especially with alcohol use. Downward facing arrow DTRs, mid to small pupils. CV-Pulm—Respiratory depression, hypotension, aspiration. Row 3: Management; NOT routinely detected in urine benzodiazepine screen. Charcoal if less than 1 hour from ingestion. Protect airway and apply cardiac monitor, pulse oximeter. Flumazenil, see dose, page xx. may reverse CNS effects. Admit if lethargic or unstable after 2 to 4 hours of observation.

Back to Table

A table lists the Gamma Hydroxybutyric Acid, Features, and Details. The two column headings are Features, and Details. Row entries are as follows. Row 1: Onset or Duration; Onset of symptoms is equals 15 minutes, with spontaneous resolution from 2 to greater than 48 hours, depending on dose and coingestant. Row 2: Major clinical effects; CNS: Acts with ethanol to produce CNS or respiratory depression. At upward facing arrow levels patients are unresponsive to noxious stimuli and lose pharyngeal reflexes. Seizures, clonic arm or leg or face movements, vomit, amnesia, downward facing arrow DTRs, vertigo, nystagmus, and ataxia occur. CV-Pulm: downward facing arrow HR, irregular or downward facing arrow respirations, downward facing arrow BP. Row 3: Management; Protect airway and apply cardiac monitor, pulse

oximeter. Treat symptomatically, for example, atropine for persistent downward facing arrow HR. Exclude coingestant or other diagnosis, for example, CNS trauma. Admit if symptoms do not resolve after 6 hours of observation.

Back to Table

A table lists the Iron formulation and details.
The three column headings are, Iron formulations, Elemental iron, and Mechanisms of iron toxicity. The row entries are as follows. Row 1: Ferrous gluconate; 12 percent; Direct GI mucosal damage with hemorrhagic gastritis, bleeding. Row 2: Ferrous sulfate; 20 percent; Hepatic necrosis. Row 3: Ferrous fumarate; 33 percent; Mitochondrial damage. Row 4: Ferrous phosphate; 37 percent; Venodilation and hypotension. Row 5: Ferrous or ferric pyrophosphate; 12 percent; Third-spacing of fluids. Row 6: Ferrocholinate; 12 percent; Thrombin inhibition-coagulopathy.

Back to Table

A table lists the Clinical Features—Staging of Iron Poisoning.
The three column headings are, Stage, Time post ingestion, and Findings. The row entries are as follows. Row 1: I; 1 to 6 hours; Local toxicity: GI bleeding, perforation, diarrhea, and shock due to direct corrosion and vasodilation. Row 2: II; 2 to 12 hours; Relative stability and resolution: Stage I symptoms resolve. Row 3: III; 12 to 36 hours; Metabolic disruption: Metabolic acidosis, circulatory collapse, neurologic deterioration, hepatic failure, renal failure, coagulation defects, and third-spacing of fluids. Row 4: IV; 2 to 4 days; Liver failure: Hepatic necrosis. Row 5: V; 2 to 6 weeks Late sequelae: GI tract scarring.

Back to Table

A table lists the Clinical Features—Suggestive of Iron Toxicity. Vomiting and diarrhea, especially less than than or equal to 6 hours; Hypotension. Mental status changes; Coagulopathy, acidosis. A table shows the estimate of quantity elemental iron ingested and toxicity potential. The two column headings are, elemental Iron, table 31.27, and toxicity. Row entries are as follows. Row 1: less than 20 milligrams per kilogram; none. Row 2: 20 to 60 milligrams per kilogram; mild to moderate. Row 3: more than 60 milligrams per kilogram; severe.

Back to Table

A table lists the Serum Iron and TIBC levels.
Obtain serum iron and total iron-binding capacity, TIBC at least 4 hours post-ingestion. Absorption may be delayed for slow-release forms, if so obtain second level at 8 hours. Iron levels greater than or equal to 350 mcg per dl, normal 50 to 150 are serious, as the TIBC, 350 to 500 mcg per dl, is exceeded. High iron falsely lowers TIBC level, rendering test unreliable. The two column headings are, Serum iron in mcg per dl, and Toxicity. The row entries are as follows. Row 1: less than 100; none. Row 2: 100 to 300; mild. Row 3: 300 to 500; moderate. Row 4: 500 to 1000; Severe. Row 5: more than 1000; possibly lethal.

Back to Table

A table lists the Adjunctive Diagnostic Tests.
The row entries are as follows. Row 1: WBC count; greater than 15,000 cells per millimeter superscript 3 is associated with a serum iron greater than 300 mcg per dl. Row 2: Glucose; more than 150 grams per dl is associated with a serum iron more than 300 mcg dl. Row 3: KUB; Radio-opaque tablets on plain films indicate potential for further absorption per toxicity; 50 percent with iron more than

300 mcg per dl equals negative X-ray.

Back to Table

A table lists the Treatment of Iron Poisoning.
The row entries are as follows. Row 1: Fluid or Blood; Use NS plus minus blood prn. Consult surgeon if suspect perforation. Row 2: Decontaminate; Charcoal is ineffective. Row 3: Whole bowel irrigation; Administer polyethylene glycol, GoLYTELY; page xxx. This option is especially useful if X-ray shows tablets beyond pylorus. Row 4: Deferoxamine; Do not rely on deferoxamine challenge to make decisions. 15 milligrams per kilogram per hour IV infusion. Do not wait for iron levels to return if the patient is symptomatic. Deferoxamine given IV or IM causes downward facing arrow BP, which is usually the limiting factor in infusion rate. Seizures can occur following deferoxamine. If improving, discontinue deferoxamine when urine clears and iron level less than 100 mcg per dl. Row 5 : Dialysis; If renal failure prevents excretion of ferrioxamine. Row 6: Indications for chelation with deferoxamine; Multisystem toxicity, for example, vomiting, diarrhea, GI bleeding, downward facing arrow BP, acidosis, altered mental status, coagulopathy. Tablets seen on plain abdominal radiograph. Serum iron more than 350 mcg per dl or serum iron more than TIBC, TIBC can be unreliable when serum iron levels are high.

Back to Table

A table lists the Methanol Toxicity.
The two entries are, Clinical features, Treatment, and Diagnostic studies. Clinical features: 0 to 12 hours; Inebriation, drowsiness. Asymptomatic period. 12 to 36 hours. Vomiting, hyperventilation. Abdominal pain, pancreatitis. Visual blurring, blindness with mydriasis and papilledema. CNS depression. Treatment: $NaHCO_3$

1 mEq per kilogram IV—keep pH more than 7.35. Folate. Consult poison center. Fomepizole, Antizol—see ethylene glycol dosing, page xxx. Ethanol, 10 percent in D subscript 5W, if no Antizol— (1) IV loading dose 10 milliliters per kilogram over 1 to 2 hours, (2) then 1.6 milliliters per kilogram per hour (3) Ethanol goal: equals 100 to 150 mg per dl. Dialyze if (1) visual symptoms, (2) CNS depression, (3) level more than 50 milligrams per dl, (4) severe metabolic acidosis, or (5) history of ingestion of greater than 30 milliliters. Stop dialysis and ethanol when methanol levels fall to less than 20 milligrams per dl. Diagnostic studies: Osmol gap superscript 1 may occur before anion gap acidosis, see page xx. Anion gap and lactic acidosis. Hemoconcentration, hyperglycemia. Methanol levels greater than 20 milligrams per dl are toxic. (1) CNS symptoms occur greater than 20 milligrams per dl. (2) Visual symptoms occur greater than 50 milligrams per dl.

Back to Table

A table lists the Clinical Features of Insecticide Toxicity.
The row entries are as follows. Row 1: Onset of symptoms; Usually begin less than 24 hours after exposure. Lipid-soluble organophosphates, for example, fenthion, may take days to produce symptoms with persistence for weeks to months and periodic relapses. Row 2: CNS; Cholinergic excess: delirium, confusion, seizures, respiratory depression. Carbamates have less central effects. Row 3: Muscarinic; SLUDGE: Salivation, Lacrimation, Urination, Defecation, GI upset, Emesis; miosis, bronchoconstriction, bradycardia. Row 4: Nicotinic; Fasciculations, muscle weakness, sympathetic ganglia stimulation, hypertension, tachycardia, pallor, rarely mydriasis.

Back to Table

A table lists the Diagnostic Studies in Insecticide Poisoning.
The row entries are as follows. Row 1: Labs; upward facing arrow Glucose, upward facing arrow K+, upward facing arrow WBC, upward facing arrow amylase, glycosuria, proteinuria. Row 2: ECG; Early—upward facing arrow in sympathetic tone, tachycardia. Later—Extreme parasympathetic tone, sinus bradycardia, AV block, and upward facing arrow QT. Row 3: Serum, pseudo, RBC, plasma, Cholinesterase; Serum levels are more sensitive but less specific than RBC. Plasma levels return to normal before RBC levels. Mild cases: Levels are less than 50 percent of normal. Severe cases: Levels are less than 10 percent of normal.

Back to Table

A table lists the Treatment for Insecticide Poisoning.
The row entries are as follows. Row 1: General; First take off all clothing that may contain the toxin. Wash toxin off patient if dermal exposure. Support airway, breathing, and blood pressure. Respiratory depression is the most common cause of death. Medical personnel should gown and glove if dermal exposure. Administer charcoal if oral ingestion. Row 2: Atropine Extremely large doses often needed; Competitively blocks acetylcholine, ACh at muscarinic, not nicotinic, receptors. Atropine may reverse CNS effects. Dose: more than or equal to 0.05 milligram per kilogram q 5 minutes. Mix 50 milligrams in 500 milliliters NS and titrate. Goal: Titrate to mild anticholinergic signs, dry mouth, secretions and not to pupil size or heart rate. Treatment failure most often due to not using enough atropine. Row 3: Pralidoxime, 2-PAM; PAM has endogenous anticholinergic effects, while reversing nicotinic and central effects. It does not reverse carbamate toxicity. Dose: 20 to 50 milligrams per kilogram IV over 15 minutes. May repeat in 1 to 2 hours, then may repeat q 10 to 12 hours. Onset of effect is 10 to 40 minutes after administration. Row 4: Atrovent; Ipratropium bromide

0.5 milligram neb. q 4 to 6 hours may dry secretions.

Back to Table

A table lists the Salicylate Toxicity—Levels.
The three column entries are, Ingestion, Severity, and Signs and symptoms. The row entries are as follows. Row 1: less than 150 milligrams per kilogram; Mild; Vomiting, tinnitus, and hyperpnea. Row 2: 150 to 300 milligrams per kilogram; Moderate; Vomiting, hyperpnea, diaphoresis, and tinnitus. Row 3: more than 300 milligrams per kilogram; Severe; Acidosis altered mental status, seizures, and shock.

Back to Table

The table lists the Clinical Features of Salicylate Toxicity.
The row entries are as follows. Row 1: Direct; Irritation of GI tract with reports of perforation. Row 2: Metabolic; Early: Respiratory alkalosis from respiratory center stimulation. Later: Anion gap acidosis—uncoupled oxidative phosphorylation. Hypokalemia, upward facing arrow or downward facing arrow glucose, ketonuria, and either upward facing arrow or downward facing arrow Na plus. Row 3: CNS; Early: Tinnitus, deafness, agitation, hyperactivity. Later: Confusion, coma, seizure, CNS edema, especially less than 4 years old. Row 4 : GI; Vomiting, gastritis, pylorospasm, upward facing arrow liver enzymes, perforation. Row 5: Pulmonary; Noncardiac pulmonary edema, especially with chronic toxicity.

Back to Table

A table lists the Indicators of Salicylate Toxicity.
The row entries are as follows. Row 1: Clinical; See Table 31 to 38 for features associated with toxicity. Row 2: Ingestion; Ingestion of

more than or equal to 150 milligrams per kilogram is associated with toxicity. Row 3: Ferric chloride; Mix 2 drops FeCl subscript 3 plus 1 milliliter urine. Purple equals salicylate ingestion. Row 4: Phenistix; Dipstick test for urine. Brown indicates salicylate or phenothiazine ingestion, not toxicity. Adding 1 drop 20N H subscript 2SO subscript 4 bleaches out color for phenothiazines but not salicylates. Row 5: Salicylate levels; A level greater than 30 milligrams per dl drawn more than or equal to 6 hours. 6: ingestion is toxic. Clinical picture more important than levels, especially if chronic component to OD. Do not wait for 6 hours to treat ill patients. Follow serial levels, q 2 to 3 hours until downward trend established. In patients with a low pH, CNS penetration increases and toxicity can occur at lower levels. Done nomogram is unreliable indicator of toxicity. Row 6: Nontoxic ingestion; If each of the following are present, acute toxicity is unlikely (1) less than 150 milligrams per kilogram ingested, (2) absent clinical features, (3) level less than 30 milligrams per dl obtained more than or equal to 6 hours after ingestion, unless enteric-coated preparation, viscous preparation, or chronic ingestion.

Back to Table

A table lists the Treatment of Salicylate Poisoning.
The row entries are as follows. Row 1: General; Treat dehydration, electrolyte abnormalities. CSF hypoglycemia occurs with normal serum glucose—add D subscript 5W or D subscript 10W to all fluids. Row 2: Decontaminate; Multidose charcoal. Whole bowel irrigation, if enteric coated. Row 3: Alkalinization; Add 100 mEq NaHCO subscript 3 to 1 L D subscript 5W 1 per 2NS, plus minus 20 to 40 mEq perL K+ if no renal failure. Goal—urine pH greater than 7.5. Row 4: Hemodialysis; Indications: Renal failure, noncardiogenic pulmonary edema, congestive heart failure, persistent CNS disturbances, deterioration of vital signs, unable to

correct acid–base or electrolyte imbalance, salicylate level more than 100 milligrams per dl, acutely.

Back to Table

A table lists the Chronic Salicylate Toxicity.
The row entries are as follows. Row 1: Presentation; Patients are older, on chronic salicylates. Neuro changes and noncardiogenic pulmonary edema are more common. Many are treated for infectious or neuro disease prior to correct dx. Row 2: Toxicity; Salicylate levels are often normal to therapeutic. Row 3: Treatment; Supportive measures and urinary alkalinization are recommended. Dialyze if acidosis, confusion, or pulmonary edema.

Back to Table

The table lists the Selective Serotonin Reuptake Inhibitors and Non-tricyclic Antidepressants.
Selective serotonin reuptake inhibitors, SSRIs: OD is relatively benign. Most common symptoms: upward facing arrow HR, tremor, vomiting, and drowsy. ECG: upward facing arrow HR, nonspecific ST-T changes. Seizures, cardiotoxicity, wide QRS or QTc, can occur at high levels, especially fluoxetine. Downward facing arrow HR is seen with fluvoxamine at high or low doses. Treatment: (1) exclude coingestants, (2) observe for 6 hours, (3) Charcoal 1 gram per kilogram, less than 1 hour post-ingest., (4) NaHCO subscript 3 IV if wide QRS tachycardia, (5) observe for potentially lethal serotonin syndrome. SSRIs: Citalopram, or Celexa, Escitalopram, or Lexapro, Fluoxetine, or Prozac, Fluvoxamine, or Luvox, Paroxetine, or Paxil, and Sertraline, or Zoloft. Monoamine oxidase inhibitors-isocarboxazid, Marplan, phenelzine, Nardil, selegiline, Eldepryl, tranylcypromine, Parnate. OD may have onset up 12 hours later. Excess alpha plus beta adrenergic symptoms: Headache, tremor,

upward facing arrow BP, upward facing arrow DTR rigidity, chest pain, upward facing arrow temp. Later downward facing arrow BP, downward facing arrow HR, seizures. Treatment: (1) Nipride or phentolamine for upward facing arrow BP, No beta blockers, (2) NS plus Norepi. for downward facing arrow BP, (3) charcoal, (4) benzodiazepines, (5) treat hyperthermia, see malignant hyperthermia/rhabdomyolysis page xx. Serotonin, norepinephrine reuptake inhibitors—Venlafaxine, Effexor, duloxetine Cymbalta—OD causes upward facing arrow HR and downward facing arrow level of consciousness, brief and limited seizures, mild hypotension. Treat with supportive care. Norepinephrine and dopamine reuptake inhibitor—Bupropion, Wellbutrin. OD causes lethargy, 41 percent, tremors 24 percent, and seizures 21 percent. Mean seizure onset is 3.7 hours. Treat with benzodiazepines, phenytoin. One case prolonged QRS per QTc. Noradrenergic and serotoninergic antidepressants—Mirtazapine, Remeron, inhibits presynaptic alpha 2 receptors increasing serotonin and norepinephrine transmission. Serotonin-2 and -3 receptors are blocked diminishing anxiety and GI side effects. OD is rare—with sedation and drowsiness requiring rare intubation. No cardiac conduction effects or seizures have been noted to date. Serotonin-2 receptor antagonists—Nefazodone, Serzone, trazodone, Desyrel, esp. trazodone, cause sedation, light-headedness, GI upset, headaches. Trazodone has been associated with nonsustained ventricular tachycardia and other dysrhythmias. Treatment for OD of either agent is supportive.

Back to Table

A table lists the Serotonin Syndrome.
The three column headings are, Mild, Moderate, and Severe. The row entries are as follows. Row 1: CNS; Confused, restless; Agitated, sleepy; Coma, seizures. Row 2: Autonomic; Temp., T less than 38 degree Celsius, mydriasis, diarrhea, upward facing arrow

HR temperature less than 39.5 degree Celsius, BP low or high, mydriasis temperature more than 39.5 degree Celsius, dyspnea, diaphoresis, upward facing arrow HR. Row 3: Neuromuscular Clonus, ataxia, akathisia, upward facing arrow DTRs Myoclonus, clonus, ataxia Muscle rigidity, rhabdomyolysis. Causes: Coingestion SSRIs, TCA, MAOI, meperidine, codeine, dextromethorphan Treatment: Stop drug, manage complications hyperthermiaper rhabdomyolysis, administer benzodiazepines. Some experts recommend cyproheptadine. Table 31.44 A table lists the Sulfonylureas Treatment or Disposition. Treatment: If hypoglycemia, IV glucose, age less than 1 month: 10 milliliter per kilogram D10W, 1 to 24 months: 4 milliliter per kilogram D25W; more than 2 years: 2 milliliter per kilogram of D50W. Drip: D10 to 20W or D10 to 20NS. If no IV, glucagon 0.02 to 0.03 milliliter per kilogram SC, if less than 20 kilogram or 1 mg if more than 20 kilogram. If recurrent: octreotide, 2 mcg per kilogram IV per SC q 6 to 12 h, OR if unavailable, diazoxide, 1 to 3 milligram per kilogram, IV over 30 minutes q 4 h. Charcoal does not absorb all sulfonylureas and may be aspirated. Consider risks or benefits of whole bowel irrigation if XL prep. Disposition: Admit for 24 hours if first-generation OD, symptomatic, or XL ingestions since delayed onset 16 to 24 hours after ingestion can occur. If second or third generation, gliclazide, glimepiride, glipizide, glyburide, asymptomatic, normal glucose and unintentional OD, some experts observe greater than or equal to 8 to 12 hours post-ingestion, then discharge.

Back to Table

A table lists the Sympathomimetics, Amphetamines and Derivatives.
Effects of amphetamines are (1) sympathomimetic—alpha and beta adrenergic—mydriasis, upward facing arrow HR, upward facing arrow BP, upward facing arrow temp., arrhythmias, MI,

rhabdomyolysis, psychosis, CNS bleed, upward facing arrow sweat, seizures; (2) dopaminergic—restlessness, anorexia, hyperactive, movement disorders, paranoia; (3) serotonergic—mood, impulse control, serotonin syndrome. Ice or Crank, crystal methamphetamine, is one of most commonly synthesized illicit drugs. Onset is minutes, lasts 2 to 24 hours. MDMA, Ecstasy—popular at “raves” and consumed orally. Low dose—euphoria, mild sympathomimetic symptoms last equals 4 to 6 hours. Potent serotonin releaser, no impulse control. High dose—effects, 1 to 3, above. Treatment: (1) supportive care, cardiopulmonary and neuro monitoring; (2) benzodiazepines for agitation; (3) labetalol or Nipride or phentolamine –for upward facing arrow BP; (4) if downward facing arrow BP, dopamine or norepinephrine; (5) consider charcoal; (6) treat complications.

Back to Table

A table lists the Tricyclic Antidepressants, TCA.
Clinical features are due to alpha adrenergic block, downward facing arrow BP, anticholinergic effects, altered mentation, seizures, upward facing arrow HR, mydriasis, inhabitation of norepinephrine uptake, upward facing arrow catecholamines, Na+ channel block, quinidine-like cardiac depression. ECG findings in TCA overdose Sinus tachycardia. Upward facing arrow QRS greater than 100 ms1, Upward facing arrowPR interval, Upward facing arrow QT interval, BBB2, esp. right BBB. Right axis deviation of the terminal 40 ms of the QRS greater than 120 degree, prominent terminal R in AVR—see figure. AV conduction blocks, all degrees. Ventricular fibrillation or tachycardia. Treatment of TCA toxicity: Row 1: General; Apply cardiac monitor, obtain ECG. QRS width, QT interval. Row 2: Decontaminate; Administer charcoal 1 gram per kilogram PO or NG q 2 to 4 h. Ensure patent airway and gag reflex prior to decontamination. Avoid ipecac, as patients may have rapid mental

status decline or develop seizures. Row 3: NaHCO subscript 3. Indications: (1) acidosis, (2) QRS width more than 100 ms, (3) ventricular arrhythmias, or (4) hypotension. Alkalinization enhances TCA protein binding and reverses Na+ channel blockade and toxic cardiac manifestations. Dose: 1 to 2 mEq per kilogram IV. May repeat or initiate drip. Goal: Arterial pH of 7.50 to 7.55 or normal QRS. NaHCOsubscript 3 is ineffective for CNS manifestations, e.g., seizures. Row 4: Fluids or Pressors; Administer 10 to 20 milliliter per kilogram NS for hypotension. Repeat 1 to 2 times. If fluids are ineffective administer phenylephrine or norepinephrine, not dopamine, due to prominent alpha effects. Row 5: Antiseizure medications; Use lorazepam followed by phenobarbital. Phenytoin may be ineffective in TCA-induced seizures. Row 6: Disposition May transfer to psychiatric facility if all of following are present: No major evidence of toxicity during 6 hours ED observation. Active bowel sounds. Greater than 2 charcoal doses are given, not all experts recommend this. There is no evidence of toxic coingestant. w 6: MgSO4; 25 milligram per kilogram administered slow IV, over 15 minutes, may be useful for downward facing arrow BP, and arrhythmias. Row 7: Disposition May transfer to psychiatric facility if all of following are present: No major evidence of toxicity during 6 hours ED observation. Active bowel sounds. Greater than or equal to 2 charcoal doses are given, not all experts recommend this. There is no evidence of toxic coingestant.

Back to Table

A flow diagram shows the Guidelines for Field Triage of Injured Patients.
There are five steps. Expansions for terms are: GCS is Glasgow Coma Scale, SBP is systolic blood pressure, RR is respiratory rate. Step 1: Are any of following present?: GCS lesser than 14, SBP lesser than 90 millimeter Mercury, while 70 plus age times 2

numerically estimates hypotension in children, the expert panel used higher cutoff, lesser than 90 millimeter Mercury, to ensure appropriate over triage of children, or RR lesser than 10 or greater than 29 breath per minute, lesser than 20 if less than 1 year old, If yes, take to Highest-Level Trauma Center and if no go to step 2. Step 2: Are any of following present?: Penetration to head, neck, torso, extremity proximal to elbow, or knee, amputation proximal to wrist or ankle, flail chest, 2 or more proximal long bone fractures, mangled or crushed or de gloved extremity, pelvic fracture, open or depressed skull fracture or paralysis, If yes, take to Highest-Level Trauma Center and if no, go to step 3. Step 3: Are any of following present?: Fall greater than 10 feet or greater than 2 to 3 times child's height, high-risk auto crash (intrusion greater than 12 inches occupant side, or greater than 18 inches any side), ejection, death in same passenger compartment, high-risk car telemetry data, auto versus pedestrian or bicyclist with one of following: thrown, run over, greater than 20 miles per hour impact; or motorcycle crash greater than 20 miles per hour, or EMS provider judgment. If yes, take to Closest Appropriate Trauma Center, Which Need Not Be the Highest-Level Trauma Center and if no, go to step 4. Step 4: Children especially those lesser than 5 year old, are triaged preferentially to closest pediatric-capable trauma center. Check if Patients with bleeding disorder, for example, blood thinner with burns, time-sensitive injury, and fracture that is open or neurovascular compromise, on dialysis, or pregnancy greater than 20 weeks. If yes or no go to step 5. Step 5: Contact medical control and consider transport to a trauma center or specific resource hospital, for example, isolated burns without trauma to burn center, if significant trauma, still transport to resource hospital. If no, follow local transport protocols.

Back to Table

A table lists Pediatric Trauma Score, superscript 1.
There are four columns Patient Features, Score plus 2, Score plus 1, Score minus 1. Row 1: Size in kilogram; greater than 20; 10 to 20; lesser than 10. Row 2: Airway, Normal, Maintainable, Nonmaintainable. Row 3: Systolic BP in millimeter Mercury, greater than 90, 50 to 90, less than 50. Row 4: Mental status, Awake, Obtunded, Comatose. Row 5: Open wound, None, Minor, Major. Row 6: Extremity fractures, None, Closed, Open or multiple. Super script 1 text reads, A total score of lesser than or equal to 8 suggests possible serious injury, lesser than 1 predicts mortality rate of greater than 98 percent, 4 equals 50 percent mortality, greater than 8 predicts less than 1 percent mortality.

Back to Table

A table lists Pediatric Glasgow Coma Scale, superscript 1.
There are three columns: Eye opening, best motor, best verbal. Row 1: 0 to 1 year, 4 Spontaneous, 3 To shout, 2 To pain, 1 No response; 0 to 1 year, 6 Spontaneous movement, 5 Localizes pain, 4 Flexion withdrawal, 3 Flexion or Decorticate, 2 Extension or Decerebrate, 1 No response; 0 to 2 years, 5 Normal cry, smile, coo, 4 Cries, 3 Inappropriate cry, scream, 2 Grunts, 1 No response. Row 2: greater than 1 year, 4 Spontaneous, 3 To verbal, 2 To pain, 1 No response; greater than 1 year, 6 Obeys, 5 Localizes pain, 4 Flexion withdrawal, 3 Flexion or Decorticate, 2 Extension or Decerebrate, 1 No response, 2 to 5 years, 5 Appropriate words, 4 Inappropriate words, 3 Cries or screams, 2 Grunts, 1 No response, greater than 5 years, 5 Oriented, 4 Disoriented but converses, 3 Inappropriate words, 2 Incomprehensible, 1 No response. Superscript 1 text reads, total score indicates that injury is mild, 13 to 15, moderate, 9 to 12, or severe, less than or equal to 8.

Back to Table

A table lists Revised Trauma Score or RTS, superscript 1. There are four columns: RTS—add each category, GCS, Systolic BP in millimeter Mercury, Respiratory Rate. Row 1: 4, 13 to 15, greater than 89, 10 to 29. Row 2: 3, 9 to 12, 76 to 89, greater than 29. Row 3: 2, 6 to 8, 50 to 75, 6 to 9. Row 4: 1, 4 to 5, 1 to 49, 1 to 5. Row 5: 0, 3, 0, 0. Superscript 1 text reads, RTSC is modified for children. RR greater than 29 is normal (4) if aged 0 to 3 years, RTS lesser than 12 indicates possibility of significant trauma, RTS less than 7 equals 79 percent, probability of emergent surgery.

Back to Table

A table lists Initial Approach to Pediatric Trauma. Primary survey, 0 to 5 minutes. There are two columns: Assessment, Action. Row 1: Airway—Assess air movement, while immobilizing cervical spine; Endotracheal intubate if 1 unable to ventilate, 2 altered mentation or aspiration risk, 3 need for hyperventilation in head injury, 4 flail chest, 5 severe shock. See pages xx–xx for ETT size and rapid sequence technique. Row 2: Breathing—Assess ventilation effectiveness and oxygenation, apply pulse oximeter, plus or minus end-tidal CO2 monitor, O2, perform needle thoracostomy for tension pneumothorax, occlusive dressing for sucking chest wound, and ETT if needed. Row 3: Circulation—Assess strength, rate, quality of peripheral pulses, while stopping external bleed; attach cardiac monitor, apply pressure to external bleed.. Insert two large peripheral venous lines, and draw blood for type and cross-match, and basic labs. Row 4: See pages x, x for a complete list of normal vitals by length, weight, and age. See pages x, xx for central venous catheter sizes, and IO technique; there are three columns: Age, IV catheter size, Intraosseous size. Row 1: 0 to 1 years, 20 to 22 gauge, 17F. Row 2: greater than 1 to 6 years, 18 to 20 gauge, 15F. Row 3: 8 to 12 years, 16 to 20 gauge, no data. Row 4: greater than 15 years, 14 to 18 gauge, no data. Row

5: Disability—Assess pupils and alertness or AVPU; Assess pupils plus Pediatric GCS, page xxx, Alert, responds to Voice, Pain, Unresponsive, AVPU. Row 6: Exposure; completely undress patient, begin radiant warming. Resuscitation simultaneously performed during primary survey. Row 7: Airway or Breathing; Reassess, see previous. Row 8: Circulation; Note: Do not spend greater than 2 to 3 minutes attempting peripheral IV. If hypotensive, obtain IO or central venous access. Administer NS 20 milliliters per kilogram IV for hypotension or shock. Reassess, and repeat NS 20 milliliters per kilogram IV if needed. Administer O negative whole blood or packed RBCs 10 to 20 milliliters per kilogram.

Back to Table

A table lists Abdomen CT Criteria if Significant Pediatric Blunt Torso Trauma.
The predictor panel, superscript1, lists the following: Low systolic BP, Abdomen tender, Femur fracture, ALT greater than 125 unit per liter, AST greater than 200 units per liter, Hematocrit less than 30 percent, UA with greater than 5 RBC per HPF, seat belt sign. Predictive values of predictor panel, 95 percent confidence interval are as follows. Sensitivity: 95 percent, 90 to 98 percent, superlative text 2. Specificity: 49 percent, 34 to 40 percent. Negative predictive value: 98 percent, 96 to 99 percent. Positive predictive value: 20 percent, 17 to 23 percent. Superscript 1 text reads: Listed panel plus GCS less than 14 equals author’s prior cited indicators for abdominal CT. Superscript 2 text read, for surgical intervention was 100 percent, 1 nontherapeutic laparotomy performed.

Back to Table

A table lists Predictors of Abdominal, GU Injury, and Death Based on Pelvic Fracture Class.

There are six columns: Torode class, superlative text 1, Mortality, GU injury, other FX, superscript 2, Neuro. Injury, Abd surgery. Row 1: II, 0 percent, 6 percent, 39 percent, 61 percent, 11 percent. Row 2: III, 3 percent, 26 percent, 49 percent, 57 percent, 13 percent. Row 3: IV, 13 percent, 38 percent, 56 percent, 56 percent, 40 percent. Super script 1 text reads, See page xxx for Torode and Zieg Class. Superscript 2 text reads, Others found that multiple pelvic fx sites, 80 percent associated injury, plus RTS less than 11, see page xxx, predicted abdominal or GU injuries. If only single fracture site and RTS of 11 or 12, only 0.5 percent had intra-abdominal injury.

Back to Table

A table shows Management of Blunt Abdominal and Flank Trauma. 10 percent of trauma related deaths, Spleen greater than liver, Main complications: bleeding; solid organ or vascular injury; peritonitis—hollow viscus perforation, Validity of single pediatric FAST exam controversial—negative FAST cannot rule out intra-abdominal injury, plus FAST equals immediate abdominal CT if stable, Hemodynamically unstable patient needs OR.

Back to Table

A table lists High Yield Criteria for Cranial Computed Tomography in Children less than 2 Years Old After Trauma.
There are two columns: Predictors, Predictive values. Predictors: Altered mental status, superscript 2, Scalp hematoma, superscript 2, Loss of consciousness greater than or equal to 5 seconds, Severe mechanism, superscript 3, Palpable fracture, Not acting normal per parents. Predictive values, superscript, 4, 5, Sensitivity: 100 percent, 86 to 100 percent. Specificity: 54 percent, 52 to 56 percent. Negative predictive value: 100 percent, 99.7 to 100

percent. Positive predictive value: 2 percent, 1 to 2 percent. Superscript 1 text reads, Study inclusion criteria—Head trauma within prior 24 hours with GCS 14–15, page xxx. Exclusion criteria —Penetrating trauma, known brain tumor, preexisting neurological disorder, prior CT pretransfer, ventricular shunt, bleeding disorder, or GCS lesser than 14. Super script 2 text reads, Altered mental status—GCS lesser than 15, agitation, sleepy, slow response, repetitive questioning. Scalp hematoma—Frontal hematoma allowed. Superscript 3 text reads, Severe mechanism—Ejection from vehicle, death of another passenger, rollover, pedestrian or bicyclist without helmet struck by motor vehicle, fall greater than 3 feet, head struck by high-impact object. Superscript 4 text reads, Predictive value in detecting clinically important traumatic brain injury, ciTBI if any one of predictors present with, 95 percent confidence intervals. superscript 5 text reads, ciTBI detected by criteria—Death from TBI, intubation greater than 24 hours for TBI, hospital admit greater than or equal to 2 nights for abnormal CT.

Back to Table

Two flow diagram shows PECARN Head Injury Criteria for Imaging. Diagram A shows: Check if GCS equals 14 or other signs of altered mental status or palpable skull fracture. If yes, CT recommended, 13.9 percent of population, 4.4 percent risk of citbi. If no, check if Occipital or parietal or temporal scalp haematoma, or history of LOC greater than or equal to 5 seconds, or severe mechanism of injury, or not acting normally per parent. If no, CT not recommended, 53.2 percent of population lesser than 0.02 percent risk of citbi. If yes, observation versus CT on the basis of other clinical features including: physician experience, multiple versus isolated integral findings, worsening symptoms or signs after emergency department observation, age less than three months, parental preference. 32.9 percent of population, 0.9 risk of citbi.

Diagram B shows: Check if GCS equals 14 or other signs of altered mental status or basilar skull fracture. If yes, CT recommended, 14.0 percent of population, 4.3 percent risk of citbi. If no, check if history of LOC, or history of vomiting, or severe mechanism of injury, or severe headache. If no, CT not recommended, 57.2 percent of population lesser than 0.05 percent risk of citbi. If yes, observation versus CT on the basis of other clinical features including: physician experience, multiple versus isolated integral findings, worsening symptoms or signs after emergency department observation, parental preference. 28.8 percent of population, 0.8 risk of citbi.

Back to Table

A flow diagram shows Brain Trauma Foundation Guidelines for Severe Head Injury, GCS less than or equal to 8.
If Glasgow Coma Scale-less than or equal to 8 then, Treat following: decrease in O2, - decrease in BP, decrease in temperature, infection, overdose, high or low glucose, bleeding, electrolyte disorders, arrhythmias, and cardiac dysfunction. Then Perform Surgery if indicated, then if ICP is still elevated, Insert ICP, superscript 1, monitor, Maintain adequate CPP, superscript 2, Provide analgesia or sedation Elevate head of bed 30 degree. Check if ICP is still elevated. Yes, consider repeat CT or Drain CSF if ventriculostomy present. No, consider withdrawing ICP treatment. Check if ICP is still elevated. Yes, consider repeat CT or Neomuscular blockade. Check if ICP is still elevated. Yes, consider repeat CT or Mannitol prn, may repeat if serum osm-less than or equal to 320 msom Hypertonic 3 percent saline, may continue if serum osm greater than or equal to 360 mosm. Check if ICP is still elevated. Yes, consider repeat CT or Mild hyperventilation, pCO2 30 to 35 millimeter Mercury, then consider 2nd-tier therapy options if no surgical lesion seen: 1: if working ventriculostomy and open

cisterns on current CT—consider lumbar drain; 2: if unilateral, bilateral swelling on CT, consider unilateral, bilateral decompressive craniectomy plus duraplasty; 3: if active EEG and no contraindications to barbiturates, consider high-dose barbiturates; 4: if evidence of hyperemia but not ischemia, consider hyperventilation to a pCO2 less than 30 millimeter Mercury and consider monitoring cerebral blood flow, jugular venous O2 saturation, and arterial-venous difference in O2 content; 5: if cerebral ischemia and no contraindications to hypothermia, consider moderate hypothermia, 32 to 34 degree Celsius. Superscript 1 text reads, ICP equals intracranial pressure. Begin treatment at greater than or equal to 20 millimeter Mercury. Superscript 2 text reads, CPP equals cerebral perfusion pressure, mean arterial pressure minus ICP, for trauma brain injury goal is 40 to 65 millimeters Mercury.

Back to Table

A flow chart shows the Return to Play or RTP Guidelines for Sports Concussions.
There are five numbered text boxes, and arrows from each of it point towards the next box in the order of numbering. The text on the boxes is as follows, Box 1: Symptom-limited activity. Daily activities that do not provoke symptoms. Goal: Gradual reintroduction of work/school activities. Box 2: Light aerobic exercise. Walking or stationary cycling at slow to medium pace. No resistance training. Goal: Increase HR. Box 3: Sport-specific exercise. Running or skating drills. No head impact activities. Goal: Add movement. Box 4: Non-contact training drills. Harder training drills or passing drills. May start progressive resistance training. Goal: Exercise, coordination, and increased thinking. Box 4: Full contact practice. Following medical clearance, participate in normal training activities. Goal: Restore confidence and assess functional

skills by coaching staff. Box 5: Return to sport. Normal game play.

Back to Table

A table lists NEXUS Criteria for Cervical Spine Imaging in Pediatric Blunt Trauma.
There are two column headings: NEXUS criteria and Operator characteristics or 95 percent confidence interval. For the nexus criteria: Midline tenderness, impaired consciousness, poor history Neurologic deficit, Distracting or Painful injury, and Intoxication, the operator characteristics are as follows. Row 1: Sensitivity superscript 1: 100 percent, 89 to 100 percent. Row 2: Specificity: 20 percent, 19 to 21 percent, Row 3: Negative predictive value: 100 percent, 99 to 100 percent. Row 4: Positive predictive value 1percent, 1 to 2 percent.

Back to Table

A table lists NEXUS Criteria for Cervical Spine Imaging in Pediatric Blunt Trauma, superscript 1.
There are two columns NEXUS criteria, and Operator characteristics at 95 percent confidence interval. A NEXUS criterion lists: Midline tenderness, impaired consciousness, poor history, Neurologic deficit, Distracting or Painful injury, Intoxication. Operator characteristics at 95 percent confidence interval list the following data: Sensitivity, superscript 1:100 percent, 89 to 100 percent. Specificity: 20 percent, 19 to 21 percent. Negative predictive value: 100 percent, 99 to 100 percent, Positive predictive value: 1 percent, 1 to 2 percent. Superscript 1 text reads, CT preferred if high risk, NEXUS C-spine, prospective study included 3,065 children lesser than 18 years old, 88 less than 2 years, 817 equals 2 to 8 years, and 2,160 equals 8 to 17 years. Other retrospective studies found that NEXUS criteria were only 43 to 94

percent sensitive in detecting significant pediatric C-spine injury with 100 percent sensitivity if greater 8 years old. NEXUS may not apply if less than or equal 2 to 8 years old, or if underlying congenital to acquired spine instability.

Back to Table

A table lists Cervical Spine Anatomy in Children less than 8 Years Old.
Normal lordosis to cervical spine is absent in 14 percent of children. Normal posterior angulation of odontoid seen in up to 4 percent of children. Majority of injuries occur at C1 to C2 less than or equal to 8 years old and lower cervical spine greater than 8 years. Os odontoideum, Congenital anomaly where odontoid does not fuse with C2, Superscript 1. Ossiculum terminale, A secondary center of ossification for odontoid tip, appears by age 3, in 26 percent of children, and fuses with odontoid by 12, may never fuse. Prevertebral space at C3 is less than or equal to one third to two third of C3 vertebral body width or less than or equal to 5 to 7 millimeter squared. Pre vertebral space at C5 is less than or equal to five fourth of C5 or C6, vertebral body width or less than or equal to 14 millimeter squared. Predental space up to 5 millimeters less than or equal to 8 years, up to 3 millimeters greater than 8 years. Pseudo-Jeffersonian fx-C1 lateral masses grow faster than C2 so C1 overlaps C2, usually less than 6 millimeters. Present in 90 percent age 1 to 2, 18 percent aged 7 years. Pseudo-subluxation of C2 by C3 or C3 by C4 in 40 percent, normal variant where anterior aspect of C2 spinolaminar line is less than or equal to 2 millimeters anterior or posterior to posterior cervical line; see page xxx. Superscript 1 text reads, Spine injury with minor trauma occurs. Superscript 2 text reads, these norms can be unreliable in children.

Back to Table

A table lists Development of Cervical Spine.
There are two columns: Age, Feature. Row 1: less than 6 months; C1 ring invisible and all synchondroses are open, vertebrate are normally wedged anteriorly, and there is often no lordosis to the uninjured spine. Row 2: 1 year; Body of C1 becomes visible radiographically. Row 3: 3 years; Posteriorly located spinous process synchondroses fuse. Dens become ossified, visible radiographically. Row 4: 3 to 6 years; Neurocentral, body and C2 odontoid synchondroses fuse. Summit ossification center appears at the apex, top of the odontoid. Anterior wedging of the vertebral bodies resolve now is not normal if seen. Row 5: 8 years; Pseudosubluxation and predental widening resolve, lordosis is normal now. Row 6: 12 to 14 years; Secondary ossification centers appear at spinous process tips, mistaken for fractures, summit ossification center of odontoid fuses, if it does not, os odontoideum occurs, superior or inferior epiphyseal rings appear on the body. Row 7: 25 years; Secondary ossification centers at tips of spinous processes fuse, superior or inferior epiphyseal rings fuse to the vertebral body.

Back to Table

A table lists Spinal Cord Injury Syndromes, superscript 1.
There are five syndromes with features listed. 1: Anterior cord syndrome; Flexion or vertical compression injury to anterior cord or spinal artery, Complete motor paralysis, Hyperalgesia with preserved touch and proprioception, position sense, Loss of pain and temperature sense, Most likely cord injury to require surgery. 2: Complete cord injury; Flaccid below injury level, Absent deep tendon reflexes, decreased sympathetic, warm skin, low BP, and slow HR, sensation may be preserved, priapism may be present, if lasts greater than 24 hours, will be complete. 3: Central cord syndrome; Hyperextension injury, motor weakness in hands greater

than arms, legs are unaffected or less affected, variable bladder or sensory deficit, prognosis is generally good and most do not require surgery. 4: Brown-Séquard syndrome; Hemisection of cord, Ipsilateral weakness, Ipsilateral loss of proprioception, Contralateral loss of pain and temperature sensation. 5: Posterior cord syndrome; Pain, tingling of neck and hands, one third have upper extremity weakness, mild form of central cord syndrome. Super script 1 text reads, diffuse flexion withdrawal can occur in children with paralyzed limbs if stimulated.

Back to Table

A flow diagram shows Management of the Penetrating Neck Injury. CXR, stop bleed, chest tube prn, intubation prn, surgery consult if through platysma. Then, check if, Severe or pulsatile bleed, shock, pulse deficit, expanding hematoma, air bubbling from wound, or deteriorating neurological status? If yes, do Surgical Exploration. If no, Helical CT angiography if wound penetrates platysma, observation alone appropriate if no platysma penetration. If negative, do observation, if Negative Possible airway, or GI tract injury Vascular, do Endoscopy or esophogram, and if positive for Vascular injury do Surgery or if inconclusive for vascular injury do Diagnostic angiography. If positive for endoscopy or esophogram do surgery and if negative for endoscopy do observation.

Back to Table

A table shows Evaluation of Suspected Urethral Trauma and lists Retrograde urethrogram indications and Retrograde urethrogram technique.
Retrograde urethrogram indications are as follows: Penile, perineal, vaginal, or scrotal trauma, blood at urethral meatus or Cannot void, extravasation of blood or urine to scrotum, perineum, abdominal

wall, or penile shaft, abnormal prostate examination, significant pelvic fracture, inability to easily pass Foley catheter. Retrograde urethrogram technique are as follows: Obtain preinjection KUB film, place Cooke adapter or Christmas tree adapter on end of 30 to 60 milliliter syringe, may substitute Foley, inject 0.2 milliliter per kilogram of contrast dye over 60 seconds, take X-ray during last 10 seconds.

Back to Table

A table shows Evaluation of Suspected Bladder Trauma and lists Cystogram indications and Cystogram technique.
Cystogram indications are as follows: Penetrating injury to low abdomen or pelvis, blunt lower abdominal-perineal trauma with significant microscopic hematuria, greater than 20 RBC per HPF, gross blood, blood at meatus, significant pelvic fracture, unable to void or minimal urine after Foley. Cystogram technique are as follows: After urethrogram, empty bladder, instil contrast into bladder until 5 milliliters per kilogram or discomfort or bladder is full, see formula below for normal bladder volumes, superscript 1. Obtain oblique, and AP films of bladder, empty bladder then repeat films. Superscript 1 text reads, Bladder volume if , less than 1 year equals weight in kilogram times 10 milliliter; if greater than or equal to 1 year equals (age in years plus 2) times 30 milliliters.

Back to Table

A table lists Estimated Urethral Catheter Size in French or Fr, based on Age.
Data in the format age in years, size are as follows: 1 day, 5; 3 months, 8; 1, 8 to 10; 3, 10; 6, 10; 8, 10 to 12; 10, 12; 12, 12 to 14; teen, 16 plus.

Back to Table

A table lists Independent Predictors of Intrathoracic Injury If Significant Pediatric Blunt Torso Trauma.
There are two columns: Predictors, Predictive values, superscript 1, 95 percent confidence interval. The predictors are low BP or high respiratory rate. Chest wall tender, Abraded or Contused, specificity, low Breath sounds, or rales or rhonchi, Femur fracture, GCS less than 15. The predictive values are as follows. Sensitivity: 98 percent, 91 to 100 percent, superscript 2. Specificity: 37 percent, 34 to 40 percent. Negative predictive value: 99 percent, 98 to 100 percent. Positive predictive value: 12 percent, 10 to 15 percent. Superscript 1 text reads, predictive value if any one of the identified predictors is present. Superscript 2 text reads, 100 percent sensitive in predicting abnormality requiring therapy in this single study.

Back to Table

A table lists Rib Fracture Etiology in Infants less than 1 Year. Abuse: 82 percent. Fragile bones, superscript 1: 8 percent. Nonintentional: 8 percent. Birth Trauma: 3 percent. Superscript 1 text reads, includes osteogenesis imperfecta, rickets, prematurity.

Back to Table

A table lists clinical features of common conditions associated with scrotal pain in children and adolescents.
The table has four column headings: historical features, cute epididymitis, testicular torsion, and torsion of appendage. The row entries based on history are as follows, Row 1: Duration of pain; more than 24 hours; less than 12 hours; more than 12 hours. Row 2: Dysuria or Pyuria; Common; Rare. Row 3: Nausea or Vomiting;

Uncommon; Common; Uncommon. Row 4: Onset of pain; Gradual; Acute or Sudden. Row 5: Peak incidence; less than 2 years old and post pubertal; Perinatal and puberty; Prepubertal. Row 6: Previous episode; Unusual; Typical; Unusual. Row 7: Trauma; Unusual; Occasional; Unusual. Row entries for imaging are as follows, Row 1: Blood flow on color Doppler ultrasound; Normal or increased; Decreased; Normal or increased. Row entries for Physical examination are as follows, Row 1: Cremasteric reflex; usually present; Usual absent; Usually present. Row 2: Scrotal edema or erythema; Common more than 12 hours. Row 3: Suggestive findings; none; High-riding testicle in horizontal plane; Palpable nodule “blue-dot”. Row 4: Tenderness; Epididymis, then diffuse; Testis, then diffuse; Appendage, then testis.

Back to Table

There are fourteen column entries. They are: Medication, Strength in milligram per 5 milliliter, milligram or kilogram per dose, frequency, Age; Weight-2 months; 5, 4 months; 6.5, 6 months; 8, 9 months; 9, 12 months; 10, 15 months; 11, 2 years; 13, 3 years; 15, 5 years; 19, milliliter per dose for each of the age and weight. The row entries are as follows. Row 1: acetaminophen; 160; 15; q 6 h; 2.3; 3; 3.8; 4.2; 4.7; 5.2; 6.1; 7; 8.9. Row 2: ibuprofen; 100; 10; q 6 h; no data; no data; 4; 4.5; 5; 5.5; 6.5; 7.5; 9.5. Row 3: amoxicillin; 125; 25; bid; 5; 6.5; 8; 9; 10; 11; 13; 15; 19. Row 4: amoxicillin; 250; 25; bid; 2.5; 3.3; 4; 4.5; 5; 5.5; 6.5; 7.5; 9.5. Row 5: amoxicillin; 400; 45 superscript 1; bid; 2.8; 3.7; 4.5; 5.1; 5.6; 6.2; 7.3; 8.4; 10.7. Row 6: amoxicillin or clavulanic acid; 200 or 28.5; 20 amox; bid; 2.5; 3.3; 4; 4.5; 5; 5.5; 6.5; 7.5; 9.5. Row 7: azithromycin superscript 3, 4; 100; 5; daily; 1.3 superscript 2; 1.6 superscript 2; 2; 2.3; 2.5; 2.8; 3.3; 3.8; 4.8. Row 8: azithromycin superscript 3,4; 200; 5; daily; 0.6 superscript 2; 0.8 superscript 2; 1; 1.1; 1.3; 1.4; 1.6; 1.9; 2.4. Row 9: cefaclor superscript 3; 125;

20; bid; 4; 5.2; 6.4; 7.2; 8; 8.8; 10.4; 12; 15.2. Row 10: cefaclor superscript 3; 250; 20; bid; 2; 2.6; 3.2; 3.6; 4; 4.4; 5.2; 6; 7.6. Row 11: cefadroxil; no data; 15; bid; 3; 3.9; 4.8; 5.4; 6; 6.6; 7.8; 9; 11.4. Row 12: cefadroxil; 250; 15; bid; 1.5; 2; 2.4; 2.7; 3; 3.3; 3.9; 4.5; 5.7. Row 13: cefdinir; 125; 14; daily; 2.8 superscript 2; 3.6 superscript 2; 4.5; 5; 5.6; 6.2; 7.3; 8.4; 10.6. Row 14: cefixime superscript 4; 100; 8; daily; 2; 2.6; 3.2; 3.6; 4; 4.4; 5.2; 6; 7.6. Row 15: cefprozil; 125; 15; bid; 3 superscript 2; 3.9 superscript 2; 4.8; 5.4; 6; 6.6; 7.8; 9; 11.4. Row 16: cefprozil; 250; 15; bid; 1.5 superscript 2; 2 superscript 2; 2.4; 2.7; 3; 3.3; 3.9; 4.5; 5.7. Row 17: cephalexin; 125; 12.5; qid; 2.5; 3.3; 4; 4.5; 5; 5.5; 6.5; 7.5; 9.5. Row 18: cephalexin; 250; 12.5; qid; 1.3; 1.6; 2; 2.3; 2.5; 2.8; 3.3; 3.8; 4.8. Row 19: clindamycin; 75; 10; tid; 3.3; 4.3; 5.3; 6; 6.7; 7.3; 8.7; 10; 12.7. Row 20: clindamycin; 75; 10; tid; 3.3; 4.3; 5.3; 6; 6.7; 7.3; 8.7; 10; 12.7. Row 21: penicillin V superscript 5; 250; 250 milligrams per dose; bid or tid; no data; 5; 5; 5; 5; 5; 5; 5; 5. Row 22: SMX or TMP, Bactrim; 200 milligrams SMX: 40 milligrams TMP per 5 milliliter; 5 TMP; bid; 3.1; 4.1; 5; 5.6; 6.3; 6.9; 8.1; 9.4; 11.9. Row 23: diphenhydramine; 12.5; 1.25; q 6 h; 2.5; 3.3; 4; 4.5; 5; 5.5; 6.5; 7.5; 9.5. Row 24: cetirizine; 5; 2.5 milligrams per dose daily; no data; no data; 2.5; 2.5; 2.5; 2.5; 2.5; 2.5; 2.5. Row 25: prednisolone; 15; 1; daily; 1.7; 2.2; 2.7; 3; 3.3; 3.7; 4.3; 5; 6.3. Row 26: prednisone; 5; 1; daily; 5; 6.5; 8; 9; 10; 11; 13; 15; 19.

Back to Table

A table lists the Critical Drugs and IV Infusions.
The row entries are as follows. Row 1: adenosine; 0.1 milligram per kilogram IV rapid push, max dose 6 milligrams, second dose 0.2 milligram per kg IV rapid push, max dose 12 milligrams. Row 2: amiodarone; 5 milligram per kilogram IV bolus if pulseless VT or VF, max dose 300 milligram. Administer over 20 to 60 min if perfusing rhythm. May repeat to daily max of 15 milligrams per

kilogram. Row 3: atropine; 0.02 milligram per kilogram IV, max dose 0.5 milligram superscript 2. Row 4: diazepam; 0.1 to 0.3 milligram per kilogram IV, max dose 10 milligrams. 0.5 milligram per kg PR 2 to 5 years old; 0.3 milligram per kilogram PR 6 to 11 years old; 0.2 milligram per kilogram, more than or equal to 12 years old. Max PR dose 20 milligrams. Row 5: dobutamine; 0.5 to 20 mcg per kilogram per min IV infusion. Titrate to desired effect. Row 6: dopamine; 2 to 20 mcg per kilogram per min IV infusion. Titrate to desired effect. Row 6: enalaprilat; 0.005 to 0.01 milligram per kilogram IV, max dose 1.25 milligram. Row 7: epinephrine; Pulseless arrest: 0.01 milligram per kilogram IV q 3 to 5 min, max single dose 1 milligram. Infusion: 0.1 to 1 mcg per kilogram per min. Anaphylaxis: 0.01 milligram per kilogram IM every 15 min PRN, max single dose. 0.3 mg. Row 8: esmolol; 100 to 500 mcg per kilogram IV bolus, optional, followed by infusion of 25 to 100 mcg per kilogram per min. Titrate infusion by 25 to 50 mcg per kilogram per min q 5 to 10 min up to 500 mcg per kilogram per min. Row 9: fosphenytoin; 15 to 20 milligrams PE per kilogram IV, preferred or IM. Max infusion rate for loading dose: 150 mg PE per min. Row 10: isoproterenol; 0.05 to 1 mcg per kilogram per min IV infusion. Titrate to desired effect. Row 11: labetalol; 0.2 to 1 milligrams per kilogram IV bolus, max 40 milligram. Infusion: 0.25 to 3 milligrams per kilogram per hour, initiate infusion at low end of dosing range and titrate slowly. Row 12: levetiracetam; 20 to 60 milligrams per kilogram IV bolus, max 3,000 to 4,500 milligrams per dose. Row 13: lidocaine: 1 milligram per kilogram IV; infusion: 20 to 50 mcg per kilogram per min. Row 14: orazepam; 0.05 to 0.1 milligram per kilogram IV, max single dose 4 milligrams. Row 15: midazolam; 0.05 to 0.2 milligram per kilogram IV per IM, max 10 milligrams; 0.2 milligram per kilogram intranasal, max 10 milligrams. Infusion: 0.03 to 0.12 milligram per kilogram per hour. Titrate to desired effect. Row 16: milrinone; 50 mcg per kilogram IV

over 10 to 60 minutes, optional, followed by infusion of 0.25 to 0.75 mcg per kilogram per min IV infusion. Row 17: nicardipine; 0.5 to 5 mcg per kilogram per min IV infusion. Row 18: nitroprusside; 0.3 to 10 mcg per kilogram per min IV infusion. Row 19: norepinephrine; 0.05 to 2 mcg per kilogram per min IV infusion. Row 20: pentobarbital; 1 to 2 milligrams per kilogram IV bolus, followed by infusion of 0.5 to 1 milligram per kilogram per hour superscript 3. Titrate slowly to desired effect. Row 21: phenobarbital; 15 to 20 milligrams per kilogram IV, max dose 1,000 milligrams. Max infusion rate for loading dose: 1 milligram per kilogram per min, not to exceed 30 milligrams per min. Row 22: phenylephrine; 5 to 20 mcg per kilogram IV q 10 per 15 min. Infusion: 0.1 to 2 mcg per kilogram per min. Row 23: procainamide; 10 to 15 milligrams per kilogram, max 1,500 milligrams, IV over 30 to 60 min. Infusion: 20 to 80 mcg per kilogram per min. Stop for hypotension or QRS widens by 50 percent of original width. Row 24: prostaglandin E1, alprostadil; 0.05 to 0.1 mcg per kilogram per min IV infusion initially. Once therapeutic response is achieved, decrease rate to lowest effective dose. Usual dosing range: 0.01 to 0.4 mcg per kilogram per min.

Back to Table

There are two columns: Scenario and management considerations. Row entries are as follows. Row 1: HR greater than 220 beats per minute; Cardioversion or synchronized at 0.5 to 1 Joules per kilograms if shock, extreme dyspnea, or otherwise unstable. Adenosine or amiodarone, that is, see pages xx, xxx. Row 2: Congestive Heart Failure; Lasix 1 milligrams per kilogram IV, plus or minus dobutamine or dopamine. See pages xx, xx, xxx. See unresponsive hypoxia, which follows. Row 3: Cyanosis-unresponsive, that is, pO2 is less than 50 after 100 percent O2 administration X 10 minute; No congestive heart failure present:

“Tet spell”: knee-chest position, saline IV, that is, if no congestive heart failure), NaHCO3, phenylephrine, and prostaglandin E1 or see page xxx. Congestive heart failure present: for example, transposition of great arteries; treat congestive heart failure that is, see previous, and prostaglandin E1. Row 4: Acute stridor, that is, intubate if needed; Consider laryngomalacia, tracheomalacia, or brainstem lesion, that is, bilateral vocal cord paralysis. Row 5: Bilious vomiting; IV fluids, NG tube, plus or minus IV antibiotics. Surgical consult, that is, plus or minus upper GI series after consult. See page xxx and midgut volvulus, page xxx. Row 6: Lethargy with recurring hypoglycemia, or acidosis, high ammonia; IV fluids, replace glucose. Management differs with metabolic error. See pages xxx, xxx, metabolic errors. Row 7: Hypoglycemia, low sodium, high potassium, plus or minus ambiguous genitalia; IV fluids, treat hypoglycemia. Hydrocortisone 25 milligrams IV, that is, draw extra blood. See page xx, adrenal crisis. Row 8: Inconsistent story, that is, trauma or altered sensorium; CT head, that is, abdomen or pelvis, skeletal survey. Manage trauma, pages xxx–xxx. Report to police, child protective services. Row 9: Other cases; Consider sepsis and administer fluids, antibiotics, vasopressors, and blood as needed.

Back to Figure

The diagram flows as follows. If there is substantial risk for HIV acquisition and if it is more than or equal to 73 hours since exposure, then nPEP not recommended. If it is less than or equal to 72 hours since exposure and source patient is known to be HIV positive, the nPEP recommended. If it is less than or equal to 72 hours since exposure and source patient is of unknown HIV status, then evaluation is determined case by case.

Back to Figure

The various motor levels and motor functions are as follows. C4: Spontaneous breathing. C5: Shoulder shrug. C6: Elbow flexion. C7: Elbow extension. C8 or T1: Finger flexion. T1 to T12: Intercostal and abdominal muscles. L1 or L2: Hip flexion. L3: Hip adduction. L4: Hip abduction. L5: Great toe dorsiflexion. S1 or S2: Foot plantar flexion. S2 to S4: Rectal tone.

Back to Figure

Type 1: Straight across, S. The lower section of the bone and the upper section move away from each other. Type 2: Above, A. The lower section of the bone is completely cut off from the upper section. In addition to this, a diagonal fracture from the side of the upper section forms a bone fragment, labeled Thurston-Holland fragment. Type 3: Lower, L. The lower section of the bone is completely cut off from the upper section. In addition to this, a crack divides the lower section into two halves. Type 4: Through, T. The lower section of the bone is completely cut off from the upper section. In addition to this, a crack is across the upper and lower section. Type 5: Erasure of growth plate, E. The lower section of the bone is completely cut off from the upper section. These two sections push against each other. Type 6: Reaction periosteal, R. A fragment of the bone from the region connecting both upper and lower sections falls off.

Back to Figure

Is it delirium? Acute onset/fluctuating course plus inattention plus disorganized thinking or altered level of consciousness. Is it substance intoxication or withdrawal? Is the patient developmentally delayed or autistics? Note A S D/D D are at higher risk for delirium and medical or psych symptoms. Does the patient have a clear psychiatric diagnosis? Obtain collateral to clarify diagnosis and

reason for agitation, use behavioral de-escalation strategies. Unknown etiology for agitation? Obtain collateral, continue behavioral de-escalation strategies, continually reevaluate for above and other causes of agitation. The management step for each stage is as follows. Is it delirium? Acute onset/fluctuating course plus inattention plus disorganized thinking or altered level of consciousness. The medical workup is as follows. Address underlying medical etiology. Assess pain. Avoid benzodiazepines and anticholinergics which may worsen delirium. If still severely agitated, needs medication. PO: quetiapine or risperidone or clonidine. IM: olanzapine or chlorpromazine. IV: haloperidol or lorazepam (P O/I M/I V/N G T) if there are seizure concerns or catatonia. Is it substance intoxication or withdrawal? History, Utox, physical exam. Unknown substance Lorazepam (P O/I M/I V), with haloperidol if severely agitated or hallucinating. E t O H/B z d withdrawal or stimulant intoxication Lorazepam (P O/I M/I V/N G T), add haloperidol if severely agitated or hallucinating. Opiate withdrawal: Clonidine and/or opiate replacement (methadone, suboxone) per hospital protocol. Add symptomatic meds (ibuprofen, maalox, loperamide, ondansetron, dicyclomine) as needed. P C P intoxication: Lorazepam (P O/I M/I V/N G T) E t O H/B z d intoxication. Haloperidol (I V/I M/P O) or chlorpromazine (P O/I M) Utox negative? Suspect synthetic cannabinoids or cathinones; lorazepam plus or minus haloperidol (P O/I M/I V) or chlorpromazine (P O/I M). Is the patient developmentally delayed or autistics? Note A S D/D D are at higher risk for delirium and medical or psych symptoms. Attempt behavioral interventions. Assess pain, hunger, other physical needs. Consider visual communication tools. Utilize sensory tools. Ask what usually soothes child. Ask about prior medication responses, positive or negative, especially to benzodiazepines and diphenhydramine. If still severely agitated, needs medication. Consider extra dose of

patient's regular standing medication. Avoid benzodiazepines due to risk of disinhibition. Avoid IM route. Clonidine (P O) or diphenhydramine (P O/I M) or antipsychotic (risperidone P O, chlorpromazine P O/I M or olanzapine (P O/I M/O D T). Does the patient have a clear psychiatric diagnosis? Obtain collateral to clarify diagnosis and reason for agitation, use behavioral de-escalation strategies. Yes. Agitated catatonia Lorazepam (P O/I M/I V/N G T). A D H D Clonidine (P O) or diphenhydramine (P O/ I M) or risperidone (P O) if concerned about hypotension. Anxiety, trauma, or P T S D Lorazepam (P O/I M/I V) or clonidine (P O) if less than 12 years old or concerned about disinhibition. O D D or C D, Chlorpromazine (P O/I M) or lorazepam (P O/I M) or olanzapine (P O/I M) or risperidone (P O). Mania or psychosis. Note: Extremely rare under age 12. If on standing antipsychotic, give extra dose P O: Risperidone or quetiapine I M: Chlorpromazine or haloperidol plus or minus lorazepam, add diphenhydramine for E P S concern, or olanzapine. Unknown etiology for agitation? Obtain collateral, continue behavioral de-escalation strategies, continually reevaluate for above and other causes of agitation. Yes. Unknown etiology, mild agitation example, verbal aggression. Utilize behavioral and environmental strategies to deescalate. Unknown etiology, moderate agitation example, aggression against objects or property destruction. Diphenhydramine (P O/I M) or lorazepam (P O/I M) or olanzapine (P O/I M). Unknown etiology, severe agitation example, aggression to self or others. Chlorpromazine (P O/I M) or haloperidol + lorazepam (P O/I M) or olanzapine (P O/I M).

Back to Figure

There are nine column entries. They are, Grade, Dead,6, 5, 4, 3, 2, 1, and Rescue. The row entries are as follows. Row 1: Intervention; None; Start CPR, ABC sequence After return of spontaneous ventilation, follow intervention for grade 4; Start artificial ventilation

Respiratory arrest is usually reversed after a few imposed breaths After return of spontaneous ventilation, follow intervention for grade 4; Administer highflow oxygen by face mask or orotracheal tube and mechanical ventilation Monitor breathing because respiratory arrest can still occur Start crystalloid infusion and evaluate for use of vasopressors; Administer high-flow oxygen by face mask or orotracheal tube and mechanical ventilation; Low-flow oxygen; Advanced medical attention and oxygen should not be required; None. Row 2: Further management; forensic evaluation; column 6 to 3, Intensive care unit; Emergency Department; If no coexisting conditions, evaluate further or release from the accident site; blank. Row 3: Survival; 0 percent; 7 to 12 percent; 56 to 69 percent; 78 to 82 percent; 95 to 96 percent; 99 percent; blank; blank.

Back to Figure

Accompanying text reads, A: Atlantal dens interval, Predental space, less than 5millimeter if less than 8 years, greater than 8 years less than 3millimeter. B: Posterior cervical line, spino-laminar line of C2 should be within 2 millimeters anterior or posterior to line. C: Prevertebral space - 7 millimeters in front of C2or less than one-third width of C2 vertebral body. D: Limit of overriding of vertebral bodies is2.5 millimeter. E: Retrotracheal space should be less than 14 millimeter front of C6 or less than five fourth of width of C5 in front of C5, # are inexact. F: Prevertebral fat stripe–should not bulge out. X divided Y equals Power’s ratio Normal value is 0.7 to 1.0 Values less than 0.7 suggests anterior subluxation atlantooccipital, AA, joint. Also, a line from the anterior margin of the foramen magnum to the tip of the odontoid should be less than 10 to 12 millimeters. If greater, atlanto-occipital dislocation may be present. Wackenheim line, a line drawn along posterior clivus usually intersects tip of odontoid tangentially. If displaced, suspectatlanto occipital joint laxity. Maybe unreliable in young

children.

Back to Figure

There are four columns: Medication, Dose, Maximum, Dose Interval. In penicillin-resistant strains or before susceptibility results. Row entries are as follows. Row 1: Ciprofloxacin; 30 milligram per kilogram per day; 500 milligram per dose, divided every 12 hours. Row 2: less than 45 kilogram, Doxycycline ; 4.4 milligram per kilogram per day; 100 milligram per dose; divided every 12 hours. Row 3: more than 45 kilogram, Doxycycline; 100 milligram per dose; No data; divided every 12 hours. Row 4: Clindamycin; 30 milligram per kilogram per day; 900 mg per dose; divided every 8 hours. Row 5: Levofloxacin, less than 50 kilogram; 16 milligram per kilogram per day; 250 milligram per dose; divided every 12 hours. Row 6: more than 50 kilogram, Levofloxacin; 500 milligram per day; No data; every 24 hours. In penicillin-susceptible strains: Row 7: Amoxicillin; 75 milligram per kilogram per day; 1,000 milligram per day; Divided every 8 hours. Row 8: Pen VK; 50 to 75 milligram per kilogram per day; No data; divided every 6 to 8 hours.

Back to Unnumbered Table

There are five columns: Medication, Dose, Maximum dose, Interval, Route. Bactericidal agent, one of the following: Row 1: Ciprofloxacin, 30 milligram per kilogram per day; 400 milligram per dose; divided every 8 hours; IV. Row 2: Meropenem; 60 milligram per kilogram per day; 2,000 milligram per dose; divided every 8 hours; IV. Row 3: less than 50 kilograms, Levofloxacin, 20 milligram per kilogram per day; 250 milligram per dose; divided every 12 hours; IV. Row 4: more than 50 kilograms, Levofloxacin; 500 milligram per day; No data; every 24 hours; IV. Row 5: Imipenem or Cilastatin; 100 milligram per kilogram per day; 1,000 milligram per

dose; divided every 6 hours; IV. Row 6: Vancomycin; 60 milligram per kilogram per day; No data; divided every 8 hours; IV. Or for penicillin-susceptible strains: Row 7: Ampicillin; 200 milligram per kilogram per day; 3,000 milligram per dose; divided every 6 hours; IV. Row 8: Penicillin G; 400,000 units per kilogram per day; 4 micro unit per dose; divided every 4 hours; IV. PLUS one of the following protein synthesis inhibitors: Row 9: Clindamycin 40 milligram per kilogram per day; 900 milligram per dose; divided every 8 hours; IV. Row 10: Linezolid; 30 milligram per kilogram per day; 600 milligram per dose; divided every 8 hours for less than 12 years and divided every 12 hours for more than 12 years; IV. Row 3: Rifampin; 20 milligram per kilogram per day; 300 milligram per dose; divided every 12 hours; IV.

Back to Unnumbered Table

A table lists Daily Potassium Iodide or K I Dose for Radiation Exposure.
There are three columns: Population, Predicted thyroid exposure or rad; Daily K I dose. Row 1: Adults above 40 years; greater than 500; 130 milligram. Row 2: Adults above 18 to 40 years; greater or equal to 10; 130 milligram. Row 3: Pregnancy or lactating; greater or equal to 5; 130 milligram. Row 4: above 12 to 18 years, if greater than or equal to 70 kilogram, treat as adult; Greater than or equal to 5; 65 milligram. Row 5: above 3 to 12 years; greater than or equal to 5; 65 milligram. Row 6: above 1 month to 3 years, dilute in milk, formula, water; greater than or equal to 5; 32 milligram; Row 7: less than 1 month; greater than or equal to 5; 16 milligram.

Back to Unnumbered Table

There are four columns: Rash, Characteristics, Distribution, Course or Treatment. Row 1: Erythema toxicum; Erythematous papules

and sterile pustules surrounded by erythematous halo; over entire body surface area, palms and soles spared, occurs in first few days of life; Self-limited. Row 2: Transient neonatal pustular melanosis; Flaccid and superficial pustules, which disrupt easily, on a nonerythematous base, progress to hyperpigmented macules; Lesions may be present at birth, involves all areas including palms, soles, and genitalia; No treatment needed. Row 3: Infantile acropustulosis; Intensely pruritic, discrete erythematous papules that become vesiculopustular within 24 hours and subsequently crust; Dense lesions over palms and soles and sides of feet, waxes between 7 to 14 days and wanes between 2 to 4 months, may continue up to 2 years; Topical steroids and oral antihistamines. Row 4: Eosinophilic pustular folliculitis; Polymorphous eruption with pruritic vesiculopustules, coalesce to form exudative and crusted plaques; Mainly on scalp and face, but also on trunk and extremity, Intermittent; High potency steroid cream. Row 5: Miliaria; Tiny fragile, clear or crystallina vesicles over healthy skin to pruritic erythematous papules or rubra; In intertriginous areas, face, scalp, and trunk; Benign. Row 6: Milia; 1 to 2 millimeter white cysts; Forehead, cheeks, nose and upper lip, starting by day 4 to 5, resolves by 2 months; Self-limited. Row 7: Transient benign vascular phenomena; Acrocyanosis; Blue, purple discoloration due to cold; Benign. Row 8: Transient benign vascular phenomena; Cutis marmorata; Reticulated cyanosis or marbling of skin, symmetrically involving the trunk and extremity; Benign. Row 9: Transient benign vascular phenomena; Dependent part becomes bright red in contrast to pale upper half; Benign.

Back to Unnumbered Table

There are four columns: Type, Characteristics, Distribution, and Treatment. Row 1: Irritant contact dermatitis; Lesions have erythema, oozing, weeping, and formation of microvesicles within

epidermis. Over convex surfaces of perineum, lower abdomen, buttocks, and thighs sparing intertriginous areas. Removal of stimulus and temporary treatment with topical steroids and barrier pastes. Row 2: Seborrheic Dermatitis; Salmon-colored patches with greasy yellow scales; In intertriginous areas, diaper area, axilla, and scalp Mild keratolytics, emollients, low potency steroids, antifungal shampoo.

Back to Unnumbered Table

There are three columns: Rash, Characteristics, and Treatment. Row 1: Tinea versicolor or Malassezia globosa; Reddish brown to hypo-pigmented macules covered with fine scales, enlarge to coalesce to form confluent patches, No pruritus, area does not tan with exposure to sun. Antifungal shampoo, topical antifungal agents, oral antifungal if diffuse. Row 2: Dermatophytoses (Trichophyton, Microsporum, Epidermophyton); Black dot ringworm, circular patches of alopecia with hair broken close to follicle or diffuse scaling with minimal hair loss; Oral griseofulvin, terbinafine, itraconazole with antifungal shampoo. Row 3: Dermatophytoses (Trichophyton, Microsporum, Epidermophyton); Kerion; Severe inflammatory response producing a boggy granulomatous mass often studded with small pustules. Oral griseofulvin, terbinafine, itraconazole with antifungal shampoo. Row 4: Dermatophytoses (Trichophyton, Microsporum, Epidermophyton); Tinea corporis; Elevated scaly plaque that spread centrifugally and clears centrally to form annular lesions; Topical antifungals. Row 5: Dermatophytoses (Trichophyton, Microsporum, Epidermophyton); Tinea unguium, Numerous white patches on the surface of the nail or thick, brittle, yellow nail that may separate from nail bed, Oral antifungals. Row 6: Candida, Bright red with sharp borders, satellite red papules and pustules in skin creases and areas of skin that are constantly moist or occluded, Topical antifungals.

Back to Unnumbered Table

A table lists Select serious diseases causing rashes in the new born period.
There are three columns: Disease, Characteristics, and Treatment. Row 1: Congenital syphilis; Erythematous maculopapular or vesiculobullous lesions followed by desquamation involving hands and feet with mucous patches, persistent rhinitis, and condylomatous lesions also present. Systemic disease will manifest as lymphadenopathy, pneumonitis, nephritis, enteritis, pancreatitis, meningitis, osteochondritis; Penicillin. Row 2: Acrodermatitis enteropathica; Erythematous dry, scaly patches and plaques may evolve into crusted, vesiculobullous, erosive lesions involving perioral, acral, and intertriginous areas, associated with diarrhea and hair loss; PO or IV Zinc. Row 3: Herpes simplex; Presents at 5 to 11 days of life with small clustered pustules and vesicles that get denuded. May occur at site of trauma; Acyclovir.

Back to Unnumbered Table

There are seven columns: Disease, etiology, infectivity, morphology, distribution, incubation period, associated symptoms. Row 1: Measles, first disease; paramyxovirus; several days before to four days after rash; erythematous confluent, maculopapular rash; begins at hairline and spreads inferiorly; eight to twelve days; koplik's spots, cough, coryza, conjunctivitis, forchheimer spots. Row 2: Scarlet fever, second disease; streptococcus pyogenes; until fever present up to 24 hours of antibiotics; generalized erythematous, sandpaper, lasts 5 to 6 days; begins on face and upper trunk, spreads inferiorly, two to five days; Passtia’s lines, strawberry tongue, exudative pharyngitis, abdominal pain, rheumatic fever, circumoral pallor, Forchheimer spots. Row 3: Rubella, third disease, Rubivirus; seven days before to seven days

after, rose-pink maculopapular; spreads inferiorly; fourteen to twenty-one days; tender occipital and posterior auricular Lymph Nodes or LN, arthralgia, Forchheimer spots. Row 4: Erythema infectiosum, fifth disease; Parvovirus; Start at exposure to four to fourteen days after; Slapped cheek, lacy reticular, worsens with sunlight; Erythematous cheek Reticular extremities; four to twenty-one days; Lymphadenopathy absent, rash waxes and wanes over weeks, arthritis, aplastic crisis. Row 5: Roseola infantum, sixth disease, Human herpes virus six and seven; for 1 to 2 days after fever subsides; Rose-pink maculopapular, rash appears after fever falls; Neck and trunk; 10 to 15 days; LN-pathy, febrile seizure may occur, Nagayama spots.

Back to Unnumbered Table

A table shows the common steroid preparations, along with their approximate and physiological dose.
"There are three columns. Glucocorticoid, Approximate equivalent dose in milligram, Physiologic dose in milligrams per meter square. Row entries are as follows. Row 1: Hydrocortisone; 20; 6 to 12 milligrams per meter square per day. Row 2: Prednisone or Prednisolone; 5; 1.5 to 3 milligrams per meter square per day. Row 3: Methylprednisolone; 4; 1.2 to 2.4 milligrams per meter square per day. Row 4: Dexamethasone; 0.75; 0.2 to 0.4 milligrams per meter square per day."

Back to Unnumbered Table

A table shows the criteria for cerebral edema.
"There are two columns. The data from the table are as follows. Diagnostic criteria: Abnormal motor or verbal response to pain; Decorticate or decerebrate posture; Cranial nerve palsy, especially III, IV, and VI; Abnormal neurogenic respiratory pattern, for

example, grunting, tachypnea, Cheyne-Stokes respiration, apneusis. Major criteria: Altered mentation or fluctuating level of consciousness, GCS less than or equal to 13; Sustained heart rate deceleration, decline greater than 20 bpm not attributable to improved intravascular volume or sleep state; Age-inappropriate incontinence. Minor criteria: Vomiting; Headache; Lethargy or not easily arousable from sleep; Diastolic blood pressure greater than 90 millimeters Mercury; Age younger than 5 years."

Back to Unnumbered Table

A table shows causes of increased osmolal gap.
There is a single column. Data from the table are as follows.
Causes of increased osmolal gap: Alcohols, methanol, ethylene glycol, isopropanol; Sugars, glycerol, mannitol; Ketones, acetone, diabetic ketoacidosis.

Back to Unnumbered Table

A table shows appropriate compensation during simple acid base disorder.
"There are two columns. Row entries are as follows. Row 1: Metabolic acidosis; PCO2 = 1.5 into (HCO3-) plus (8 plus or minus 2). Row 2: Metabolic alkalosis; PCO2 increases by 7 millimeters Mercury for each 10 milliequivalent per liter increase in serum HCO3. Row 3: Respiratory acidosis acute; (HCO3-) increases by 1 for each 10 millimeters Mercury increase in PCO2. Row 4: Respiratory acidosis chronic; (HCO3-) increases by 3.5 for each 10 millimeters Mercury increase in PCO2. Row 5: Respiratory alkalosis acute; (HCO3-) falls by 2 for each 10 millimeters Mercury decrease in PCO2. Row 6: Respiratory alkalosis chronic; (HCO3-) falls by 4 for each 10 millimeters Mercury decrease in PCO2."

Back to Unnumbered Table

There are four columns. Total body, deficit (chronic), Total body, deficit (acute), Shift ECF to ICF, and Other. Data from the table are as follows. Prolonged diuretic use, Inadequate K intake; Laxative use; Diuretics; Hyperhidrosis; Hypomagnesemia; RTA; Dengue. DKA; Severe GI loss; Dialysis and diuretic treatment; Alcohol intoxication and overdose. Alkalosis; Insulin use; Catecholamine use; Sympathomimetic use; Diuretic therapy; Alkalinization; Hyperthermia. Mineralocorticoid excess; Renal disease, RTA, periodic hypokalemic paralysis; Increased aldosterone; Celiac disease.

Back to Unnumbered Table

The table shows three column headings: Test, Source person who is baseline and exposed persons with sub-headings of baseline, 4–6 weeks after exposure, 3 months after exposure, and 6 months after exposure. For all those considered for or prescribed nPEP for any exposure. Row 1: HIV Ag or Ab testing, Yes, Yes, Yes, Yes, Yes. Row 2: Hepatitis B serology, Yes, Yes, Nil, Nil, Yes. Row 3: Hepatitis C antibody testing ,Yes, Yes, Nil, Nil, Yes. Row 4: Syphilis, Yes, Yes, Yes, Nil, Yes. Row 5: Gonorrhea, Yes, Yes, Nil, Nil, Nil. Row 6: Chlamydia, Yes, Yes, Nil, Nil, Nil. Row 7: Pregnancy, Nil, Yes, Yes, Nil, Nil. For those started on nPEP: Row 8: Serum creatinine, Yes, Yes, Yes, Nil, Nil. Row 9: AST and ALT, Yes, Yes, Yes, Nil, Nil. For all persons with HIV infection confirmed at any visit: Row 10: HIV Viral load, Yes, Yes, Yes, Yes, Yes. Row 11: HIV genotypic resistance, Yes, Yes, Yes, Yes, Yes.

Back to Unnumbered Table

A table lists Most common causes of bacterial arthritis in children

according to age, superscript 1.
There are two columns: Age group, most common bacteria. Row 1: less than 3 months; Staphylococcus aureus, MSSA and MRSA, Group B Streptococcus, Streptococcus agalactiae, Gram-negative bacilli Neisseria gonorrhoeae. Row 2: 3 months to 3 years; S. aureus, MSSA and MRSA, Kingella kingae, Group A Streptococcus, Streptococcus pyogenes, Streptococcus pneumonia, Haemophilus influenzae type b, Hib, in incompletely immunized children in regions with low Hib immunization rates. Row 3: greater than 3 years S. aureus, MSSA and MRSA, Group A Streptococcus, S. pneumonia, N. gonorrhoeae, in sexually active adolescents. Superscript 1 text reads MSSA is methicillin-susceptible S. aureus; MRSA is methicillin-resistant S. aureus.

Back to Unnumbered Table

A table lists Suggested doses of parenteral antibiotics commonly used in the treatment of osteoarticular infections in infants and children.
There are three columns: Intravenous agent, Dose for infants 8 to 28 days, Dose for children greater than 28 days. Row 1: Ampicillin, 150 milligrams per kilogram per day divided in 2 doses 200 to 400 milligrams per kilogram per day divided in 4 doses Max dose 12 gram per day. Row 2: Cefazolin, 100 to 150 milligrams per kilogram per day divided in 3 doses 100 to 150 milligrams per kilogram per day divided in 3 doses Max dose 6 grams per day. Row 3: Cefepime, 60 to 100 milligrams per kilogram per day divided in 2 doses 100 to 150 milligrams per kilogram per day divided in 3 doses Max dose 6 grams per day. Row 4: Cefotaxime 150 to 200 milligrams per kilogram per day divided in 3 doses 150 to 200 milligrams per kilogram per day divided in 3 to 4 doses Max dose 8 grams per day. Row 5: Ceftazidime 150 milligrams per kilogram per day divided in 3 doses 125 to 150 milligrams per kilogram per day

divided in 3 doses Max dose 6 grams per day.

Back to Unnumbered Table

A table lists Clinical features associated with bacterial pathogens that cause acute hematogenous osteomyelitis in children, superscript 1.
There are two columns. Row 1: Gram-positive bacteria. Row 2: Staphylococcus aureus; All ages, Possible associated skin or soft tissue infection, MRSA may be associated with venous thrombo embolism and pulmonary disease. Row 3: Coagulase-negative staphylococci; Neonates in intensive care unit, children with indwelling vascular catheters for example for chronic hemodialysis. Row 4: Group A Streptococcus; more common in children less than 4 years, may occur as a complication of concurrent varicella-zoster virus infection. Row 5: Group B Streptococcus; Infants less than 3 months, usually 2 to 4 weeks. Row 6: Gram-positive bacteria. Row 7: Streptococcus pneumonia; Children less than 2 years who are incompletely immunized, Children greater than 2 years with underlying medical conditions, example, sickle cell disease, asplenia, splenic dysfunction, immunodeficiency, chronic heart disease, chronic lung disease, diabetes mellitus. Row 8: Actinomyces: May affect the facial bones, the pelvis, or vertebral bodies. Row 9: Gram-negative bacteria. Row 10: Kingella kingae; Children 6 to 36 months, Indolent onset, Oral ulcers preceding musculoskeletal findings, may affect nontubular bones. Row 11: Nonsalmonella gram negative bacilli for example Escherichia coli, Serratia; Birth to 3 months, Children with sickle cell disease, instrumentation of the gastrointestinal or urinary tract, immune compromised host, for example CGD. Row 12: Haemophilus influenzae type b; incompletely immunized children in areas with low Hib immunization rates. Row 13: Bartonella henselae; Children with cat exposure, may affect the vertebral column and pelvis girdle,

may cause multifocal infection. Row 14: Pseudomonas Aeruginosa: Injectable drug use. Row 15: Brucella; Travel to or living in an endemic area, Ingestion of unpasteurized dairy products. Row 16: Mycobacterium Tuberculosis; Birth in, travel to, or contact with a visitor from a region endemic for M. tuberculosis. Row 17: Nontuberculous Mycobacteria, surgery or penetrating injury, CGD, other underlying immunodeficiency, HIV infection. Row 18: Salmonella species; Children with sickle cell disease or related hemoglobinopathies, exposure to reptiles or amphibians children with gastrointestinal symptoms, children in developing countries. Row 19: Polymicrobial infection; more likely with direct inoculation for example, penetrating trauma or contiguous spread for example from skull, face, hands, feet. Superscript 1: MRSA is methicillin-resistant S. aureus, CGD is chronic granulomatous disease, Hib, H. influenza type b.

Back to Unnumbered Table

A table lists Growth Plates.
There are three columns: Ossification center, Years at ossification as appear on X-ray, Years at fusion as appear on X-ray. Row 1: Capitellum, 1, 12. Row 2: Radius, 4, 15. Row 3: Internal, medial, epicondyle, 6, 17. Row 4: Trochlea, 8, 12. Row 5: Olecranon, 10, 15. Row 6: External, lateral, epicondyle, 12, 12.

Back to Unnumbered Table