PEDIATRIC RESUSCITATION

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Out of hospital cardiac arrest

Not witnessed (long time without CPR)

No preexisting conditions

Etiology: Respiratory

Bystander CPR late and less effective

In hospital cardiac arrest

Witnessed

Preexisting pathology

Etiology: Cardiac

Immediate high quality CPR

Pediatric Resuscitation
=PREVENTION

- Respiratory failure
- Shock
- Effective and early CPR

Updates

Prearrest care- In hospital

- Medical rapid response teams
  - May prevent cardiac and respiratory arrest
- Pediatric early warning scores (PEWS)
  - May be used, but effectiveness not established

Updates

BLS
Respiratory failure- anticipate

- Increased respiratory rate
- Signs of respiratory distress
  - Nasal flaring
  - Retractions
  - Seesaw breathing
  - Grunting
- Diminished breath sounds
- Gasping
- Cyanosis

Pediatric Anatomy &Physiology

Young infants

- obligate nose breathers, obstruction of nasal passages causes distress

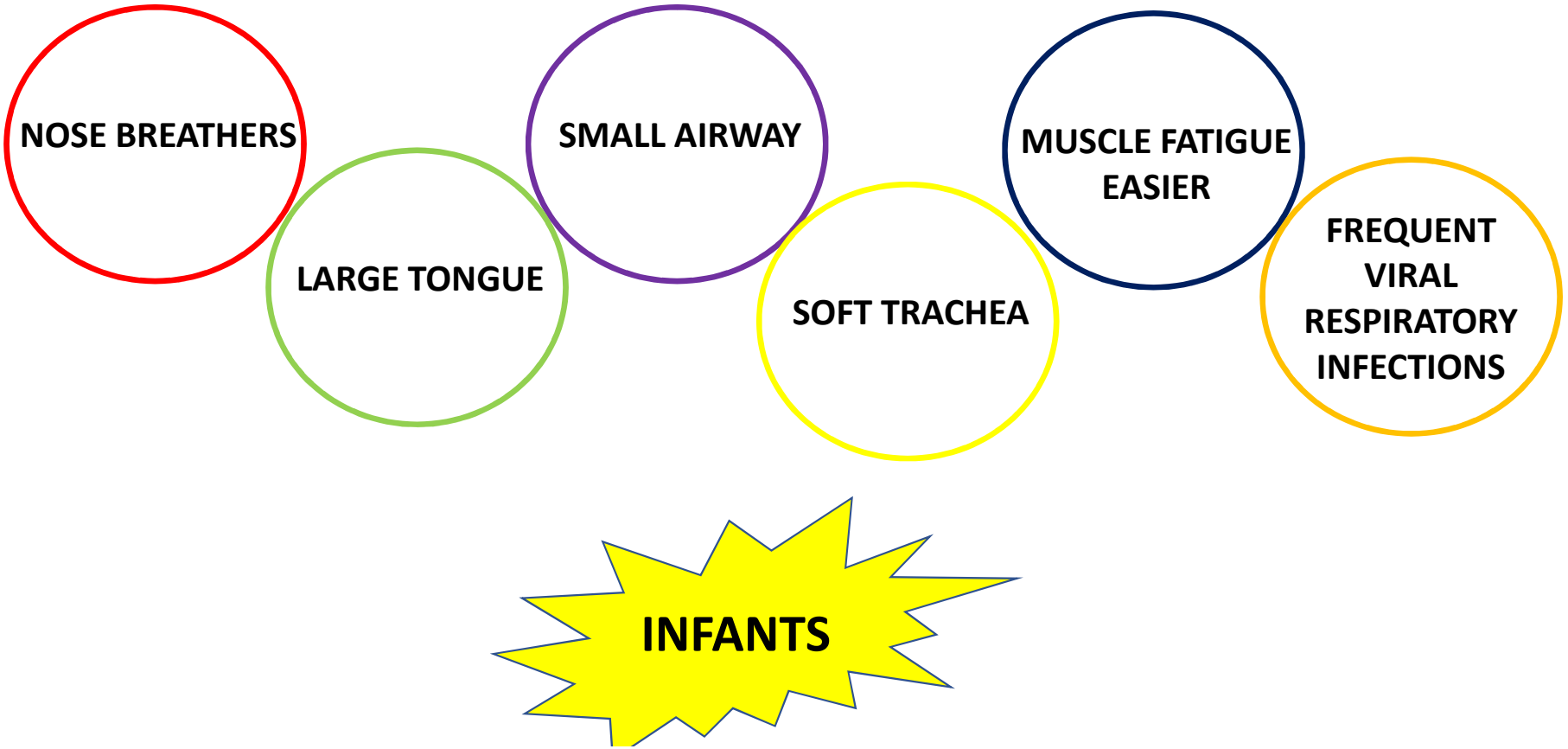
Young children

- less reserve, deteriorate quickly

Children

- more flexible chest walls, less developed chest muscles, diaphragm more prone to fatigue

RESPIRATORY FAILURE
OCCURS MORE COMMONLY IN CHILDREN



Anticipate
Pediatric airways of concern

- Altered sensorium
  - Upper airway relaxes
- Extra soft airway tissue (Laryngomalacia)
  - Obstruction with viral illnesses
- Malformations of the tongue and mandible
  - Down syndrome
- Child with noisy breathing
  - Croup, tracheitis, retropharyngeal abscess, burns, allergic reactions
- Cervical spine immobilization

Failproof interventions for respiratory distress

- Position of comfort: in mom's arms, sitting up
  - Stridor: Croup, tracheitis
- Nasal suctioning
  - Infants with bronchiolitis
- Oxygen
  - Nasal canula: infants with bronchiolitis
  - Blow by: older children
  - Face mask held by mom in front of the face

BLS
Shock- recognize

Compensated

- Tachycardia
- Cool pale extremities
- Prolonged cap refill
- Weak peripheral pulses
- Normal blood pressure

Decompensated

- Depressed mental status
- Decreased urinary output
- Tachycardia
- Weak central pulse
- Deterioration in color (mottling)

*No single sign confirms the diagnosis- integrate symptoms and signs

BLS
Hypotension: systolic blood pressure values

- Neonates <60 mm Hg
- Infants (1mo-1 year) <70 mm Hg
- Children (1-10 years) <70 + 2(age) mmHg (years)
- Adolescents (>10 years) <90 mm Hg

Updates

Prearrest care
Septic shock

- Previous recommendation: early and rapid administration of IVF
- Current recommendations:
  - Administration of 20 ml/kg bolus is reasonable
  - Reassess after each bolus
  - Either crystalloids or colloids are effective
- Why the recommendations changed
  - One large study in a limited resource area showed increased mortality with 20-40 ml/kg fluid boluses when compared with maintenance fluid alone
  - Thus, in areas with no intensive care support (mechanical ventilation, pressors) gentle approach to intravenous fluids is recommended

Updates

Prearrest care
Hypovolemic shock

- Use crystalloids: lactated Ringer's or normal saline as the initial bolus
- Treat shock with 20 mL/Kg bolus even if blood pressure is normal
  - Compensated shock

Updates

Prearrest care
Myocarditis

- Avert cardiac arrest
- Consider pre-cardiac arrest extracorporeal membrane oxygenation (ECMO) use

Pediatric cardiac arrest

- Respiratory
- Respiratory
- Respiratory
- Cardiac

Pediatric CPR

VENTILATIONS

ARE IMPORTANT

RATE FOR 2 RESCUERS

15:2

When do we use adult guidelines in children?

- At Puberty
  - physical characteristics are easier to identify than specific ages
- Puberty:
  - Girls: Breast development
  - Boys: Axillary hair

Updates

BLS
Simultaneous actions

- Chest compressions- one rescuer
- Ventilations- another rescuer
- Monitor, defibrilator, iv, prepare medication- third rescuer

*ventilations are important in pediatrics: asphyxial cardiac arrests

BLS
Assure GOOD Quality of Compressions

- Push hard
  - 1/3 the AP diameter of the chest
  - 1 ½ in in infants= 4 cm
  - 2 in in children= 5 cm
- Push fast
  - 100 compressions/min
    - Rotate compressors every 2 minutes
- Allow full recoil
- Minimize interruptions
- Firm surface

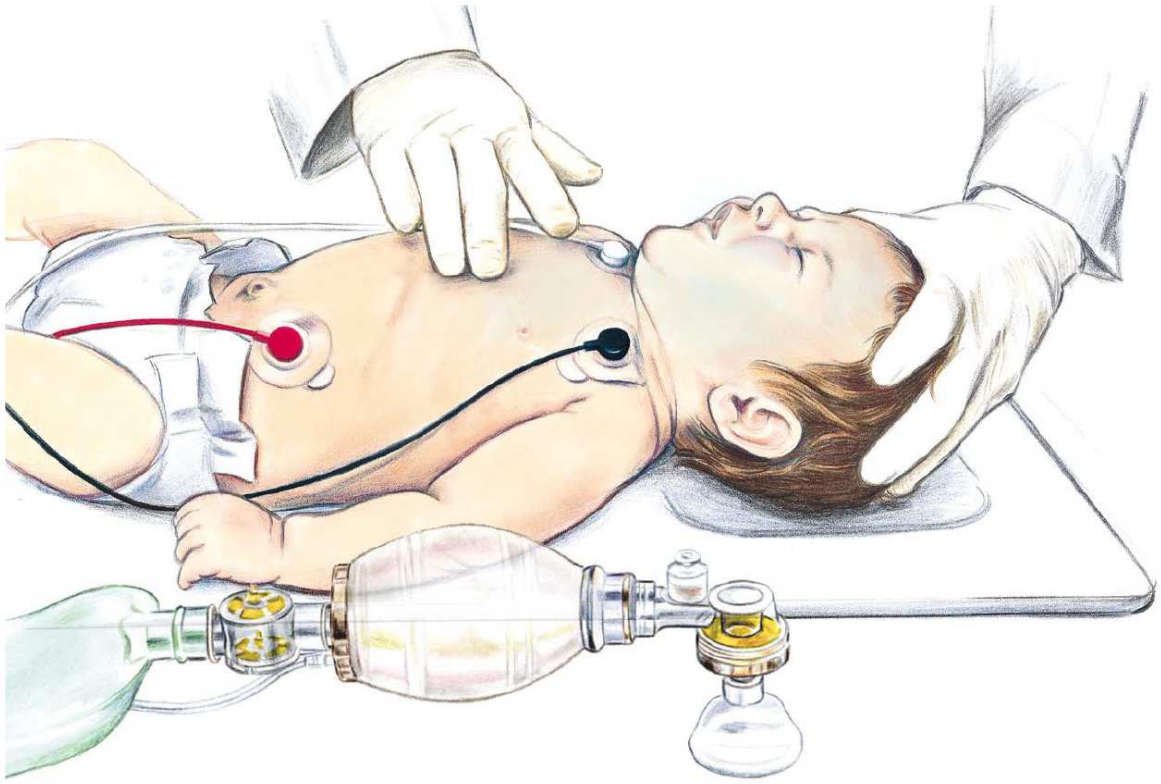
*Don’t hyperventilate

BLS
Compressions

- Is there a need to assist circulation
  - assure adequate oxygen & ventilation
  - HR < 60 with poor perfusion
- Chest compressions
  - 1 rescuer 30:2
  - 2 rescuer 15:2
  - 1/3 depth of chest

Two thumb-encircling hands chest compression in infant (2 rescuers).

Two-finger chest compression technique in infant (1 rescuer)



Updates

BLS
Compressions in monitored patients

- Use end tidal CO_2 to guide chest compressions

Updates

BLS
Oropharyngeal and nasopharyngeal airways

- Oropharyngeal
  - Absent gag reflex
  - Use correct size
    - small may push tongue back
    - large may obstruct airway
- Nasopharyngeal
  - Gag reflex present
  - Use correct size
    - short is not effective
    - long may obstruct airway
  - Suction as needed: may become obstructed with secretions

Updates

BLS
Laryngeal Mask Airway (LMA)

- Acceptable to be used by experienced providers when:
    - Bag Valve Mask is ineffective
    - Endotracheal intubation is not possible

Updates

BLS
Oxygen

- Reasonable to ventilate with 100% oxygen during CPR

- After return of spontaneous circulation, wean to O_2 Sat 94-99%

Why:

*there is insufficient information on the optimal oxygen concentration

*use enough oxygen to oxygenate but avoid hyperoxia

Updates

BLS
Pulse oximetry

- If the patient has a perfusing rhythm, monitor O_2 saturation with pulse oximeter

Updates

BLS
Bag-mask ventilation

Bag-mask ventilation might be safer than endotracheal intubation for

- Short periods
- During out-of-hospital resuscitation

*use proper mask

*provide tight seal

*assess effectiveness of ventilations- chest rise

Updates

BLS
Bag-mask ventilation

*use only the force and tidal volume to make the chest rise visibly

-avoid gastric inflation

*inspiratory time 1 sec

-Squeeze-release-release

*if the child is intubated or LMA:

-1 breath every 6 seconds (10 breaths per minute)

*if perfusing rhythm

-1 breath every 3-5 sec (12-20 breaths per minute)

Updates

BLS
Bag-mask ventilation

Two person BVM

-better seal

Cricoid pressure in the unresponsive victim (may require a 3rd person)

-reduces gastric inflation

-avoid excessive cricoid pressure (may obstruct trachea)

*may need to discontinue during intubation (if view is distorted)

Updates

BLS
Ventilation with tracheostomy

- Ventilate through tracheostomy
- If ineffective: suction tracheostomy tube
- If suctioning ineffective:
  - replace tracheostomy tube
  - place endotracheal tube
- If nothing works
  - Mouth to stoma or mask to stoma ventilations
  - Occlude stoma and perform bag-mask ventilations

Updates

BLS
Endotracheal intubation

- Only if experienced
- Both cuffed and uncuffed tubes are ok
- Cuffed tubes may decrease risk of aspiration:
  - Cuff inflation pressure 20-25 mmHg
  - Formula:

  - Uncuffed 4 + age/4
  - Cuffed 0.5 mm smaller

  *think this way: start at 4 (uncuffed) in infants

BLS
Verify endotracheal tube position

- Bilateral chest movement
- Equal breath sounds
- End tidal monitor- color change or tracing
- Pulse oximeter read (if perfusing rhythm)
- Direct laryngoscopy (if uncertain)
- Chest x ray (in hospital)

*if end tidal CO_2 is not detected in CA, confirm tube position with direct laryngoscopy

*low pulmonary blood flow may cause absence of exhaled CO_2

Updates

Atropine
for pre-medication during intubation

- Previous recommendations:
  - Use atropine
    - To prevent bradycardia (hypoxia, vagal reflex laryngoscopy)
- Current recommendations:
  - May be reasonable to use atropine
  - 0.02 mg/kg

Updates

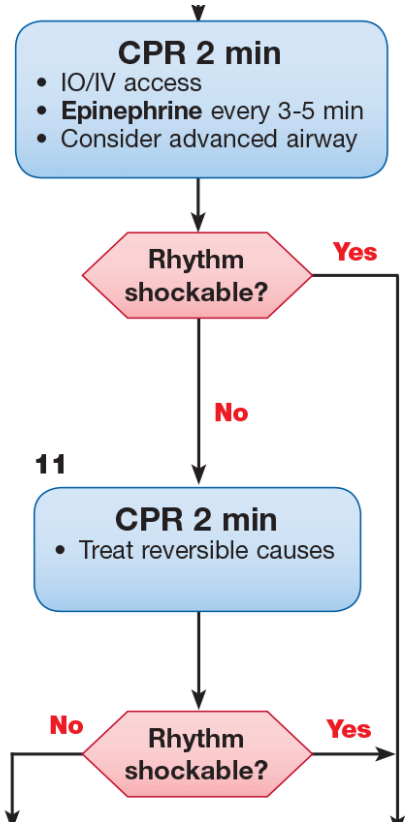
BLS
Newborns CPR rates

- 15:2 if resuscitated in the prehospital, ED, PICU

*newborn CPR is 3:1 in NICU or delivery room

*for ease of training, 15:2 is recommended

ACLS
Pulseless arrest- Asystole



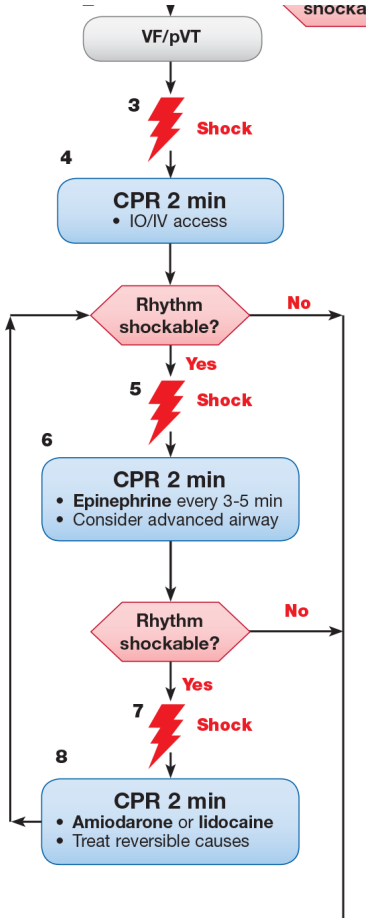
Drug Therapy

- **Epinephrine IO/IV dose:** 0.01 mg/kg (0.1 mL/kg of 1:10 000 concentration). Repeat every 3-5 minutes.
  If no IO/IV access, may give endotracheal dose: 0.1 mg/kg (0.1 mL/kg of 1:1000 concentration).

Reversible Causes

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

ACLS
Ventricular fibrillation



Shock Energy for Defibrillation

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

Drug Therapy

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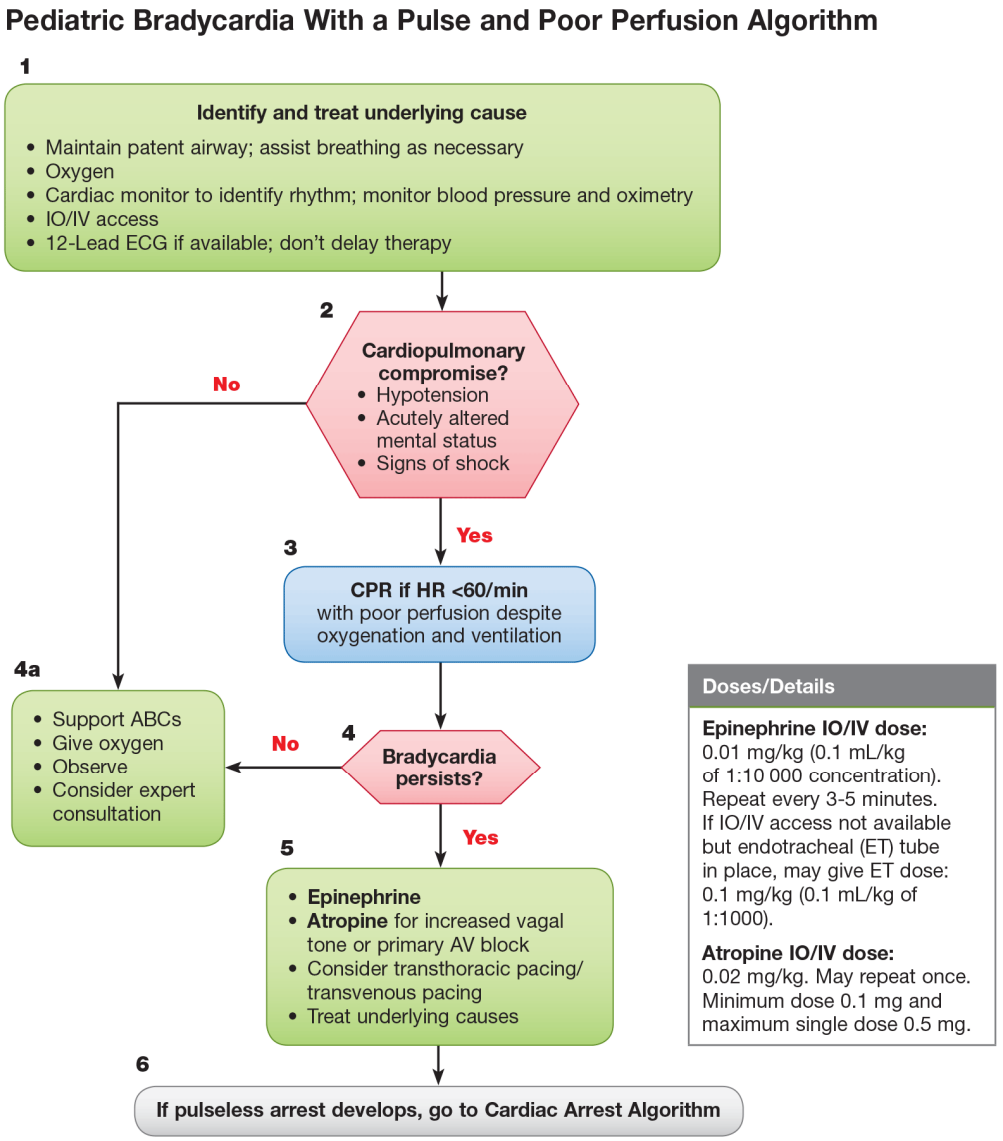
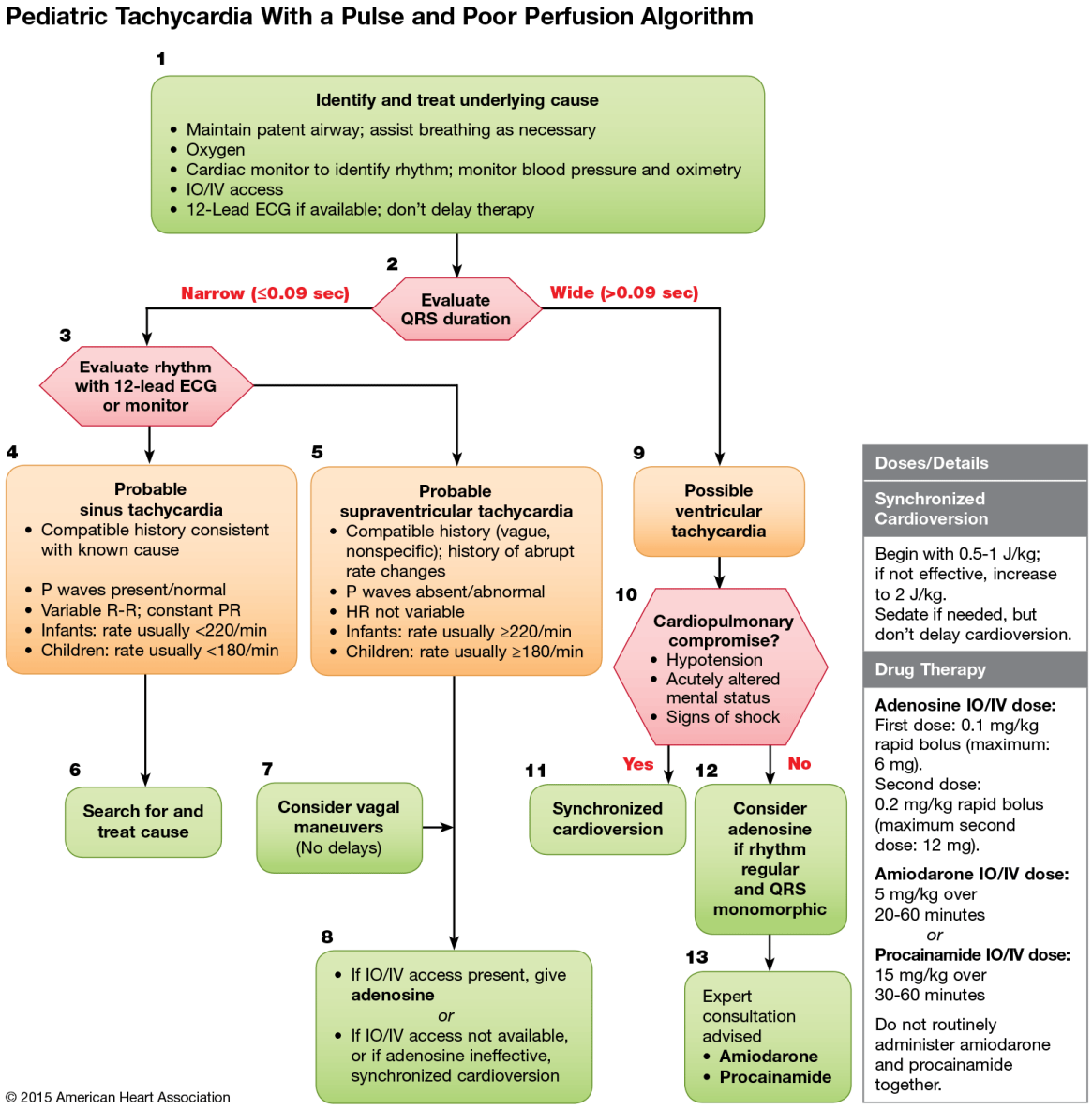
  If no IO/IV access, may give endotracheal dose: 0.1 mg/kg (0.1 mL/kg of 1:1000 concentration).
- **Amiodarone IO/IV dose:** 5 mg/kg bolus during cardiac arrest. May repeat up to 2 times for refractory VF/pulseless VT.
- **Lidocaine IO/IV dose:** Initial: 1 mg/kg loading dose. Maintenance: 20-50 mcg/kg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

ACLS Bradycardia



ACLS Tachycardia with a pulse



ACLS
Special situations

- Trauma: do not hyperventilate
- Past history of cardiac condition: consider ECMO initiation
  - EMS: notify hospital to prepare
- Family presence should be encouraged whenever possible
- Termination of resuscitation efforts: no reliable predictors of outcome to guide termination of resuscitation efforts
  - Bystander CPR, short interval form collapse to CPR, witnessed collapse increase chances of successful resuscitation

Post resuscitation care

- Target normoxia
- Target normal end tidal CO_2
- Remove IO after other intravenous access is available
- Maintain blood pressure at > 5^{th} percentile for age
  - Fluids, inotropic agents
- Temperature management
  - Avoid hyperthermia
  - 5 days of normothermia (36-37.5 C) *OR*
  - 2 days of hypothermia (32-34 C) + 3 days of normothermia (36-37.5 C)
- SIDS: refer families for screening of arrhythmia