Pediatric Cardiac Arrest – General

This protocol should be followed for all pediatric cardiac arrests.

- If an arrest is of a known traumatic origin refer to the **Traumatic Arrest-Treatment Protocol**.
- If it is unknown whether the arrest is traumatic or medical, and the patient does not meet dead on scene criteria per **Dead on Scene Termination of Resuscitation-Procedure Protocol**, start CPR and continue with this protocol.
- If patient is hypothermic refer to **Hypothermic/Frostbite-Treatment Protcol** for warming techniques when applicable.

Note: Primary cardiac arrest in the pediatric patient is rare. Most arrests are secondary to respiratory failure. Maintaining basic airway management techniques unless unable or ineffective. Advanced airway insertion attempts should be performed only if BLS airway management is ineffective. Keep CPR interruptions to a minimum. Medications given during cardiac arrest are given IV or IO.

HIGH QUALITY CPR & DEFIBRILLATION

- CPR and electrical therapy should be consistent with current American Heart Association guidelines. For all patients, **anterior/posterior placement** of pads is preferred and should be used, if possible, and if defibrillation not delayed.
- Once arrest is confirmed, emphasis should be on avoiding interruptions in CPR.
- CPR should be done in accordance with current guidelines established by the American Heart Association.
- Compressions at least 1.5” in depth for infants, 2” in depth for children (at least one third the anteroposterior diameter of the chest).
- Compression rate of at least 100-120 per minute
- Allow full chest recoil with each compression for maximum perfusion.
- Avoid excessive ventilation (volume and rate).
- Continue CPR with minimal interruptions, changing the rescuer doing compressions
- Verify CPR quality frequently and any time rescuer providing compressions or ventilations change.
- Change rescuer performing compressions at least every 2 minutes to avoid fatigue.
- Interruption in compressions must be less than 10 seconds
- If an advanced airway is placed, provide continuous CPR, without pauses for ventilation and ventilate at 20 breaths per minute or 1 breath every 3 seconds

OPERATIONAL CONSIDERATIONS

1. Prior to advanced airway placement, utilize ventilation periods to visualize the ECG rhythm without compression artifact, this will allow you to plan for the assessment period at the end of the two-minute CPR cycle.
2. If AED has been applied by BLS personnel, skip to appropriate place in protocol that

incorporates previous care. ALS personnel should switch to manual defibrillator after initial AED defibrillation or place AED in manual mode.

PROCEDURE

1. Request additional assistance, as needed, and initiate ALS response, if available.
2. Confirm Arrest
    a. Assess for signs of normal breathing. Agonal breathing is associated with cardiac arrest.
    b. Check a carotid or brachial pulse as age appropriate for no more than 10 seconds.
3. Initiate CPR or continue CPR if already in progress and apply and use AED/manual defibrillator per **Electrical Therapy-Procedure Protocol** as soon as possible. Use AED pediatric pads and settings per AED manufacturer instriuctions for use.
4. Ensure CPR quality
    a. Manual chest compressions remain the standard of care. Mechanical chest compression devices may be a reasonable alternative to conventional CPR in specific settings where the delivery of high quality manual compession may be challenging or dangers for the provider (e.g., limited rescuers, prolonged CPR, CPR during hypothermic cardiac arres, CPR in a moving ambulance). An FDA approved, MCA authorized mechanical CPR device operating at the manufacturers pre-set rate may be utilized. See **Mechanical Chest Compression Device-Procedure Protocol** for age/weight requirements and limitations. (MCA Optional)
    b. An impedance threshold device may be utilized during CPR for children > 10kg (if available). Device should be discontinued immediately upon return of spontaneous circulation. See **Impedance Threshold Device-Procedure Protocol** (MCA Optional Protocol)
5. Establish a patent airway, maintaining C-Spine precautions if indicated, beginning with BLS airway adjuncts and a BVM with high flow oxygen. Ventilations with BVM (2 -rescuer technique) and airway adjuncts are at least as effective as endotracheal intubation in children.
    a. 2-person bag-valve-mask ventilation with oral airway should be standard technique
    b. If only 2 rescuers, rescuer performing compressions can squeeze bag while 2nd rescuer maintains face to mask seal with both hands
    c. If unable to ventilate or unable to maintain a patent airway, establish an advanced airway per the **Airway Management-Procedure Protocol**. (Supraglottic airways are first choice advanced airway for pediatrics when age approved sizes are available)
        i. All advanced airways (includes supraglottic) require EtCO2 monitoring.
6. If Return of Spontaneous Circulation (ROSC) has **not** been achieved after three, two-minute cycles of CPR AND ALS is not available or delayed, contact Medical Control to discuss initiation of BLS transport while continuing to focus on high quality CPR.
7. Reassess ABC's as indicated by rhythm or patient condition change. Pulse checks should take no more than 10 seconds. If no pulse after 10 seconds, assume pulselessness, continue CPR beginning with compressions.

8. Continuously monitor $EtCO_2$ per MCA selection in End-Tidal Carbon Dioxide Montioring-Procedure Protocol.
    a. EtCO2 of 0 is indicative of failed airway.
    b. If EtCO2 is <10 mmHG, attempt to improve CPR quality. If CPR quality good, may indicate futility state.
    c. Monitor EtCO2 for trends and indications of patient status.
9. Start an IV/IO **NS** or **LR** KVO. IO may be the first choice. See **Vascular Access & IV Fluid Therapy-Procedure Protocol.**
10. Check rhythm, every 2 minutes, defibrillate according to MI MEDIC card. If MI MEDIC are not available:
    a. Initial defibrillation at 2 J/kg (or closest energy setting specific to defibrillator being utilized), and continue CPR.
    b. Subsequent defibrillations must be at least 4 J/kg, but may escalate to 10J/kg or adult dosage.
11. Administer **epinephrine** according to MI MEDIC cards.
    a. Initial dose should ideally be administered within 5 minutes of ALS/LALS contact of confirmed pediatric cardiac arrest.
    b. If MI MEDIC cards are not available administer:
        i. 1 mg/10 ml, 0.01 mg/kg (0.1 ml/kg)
        ii. Max dose 1mg (10 ml)
        iii. Repeat every 3-5 minutes
12. If shockable rhythm persists administer aniarrhythmc (per MCA selecetion) according to MI MEDIC cards.
    a. If MI MEDIC cards are not available administer antiarrhythmic (per MCA selection) as follows:

Per MCA Selection

☑ **Amiodarone** 5 mg/kg (max single dose 300 mg) IV/IO (May repeat twice) Do not exceed 450 mg total IV/IO

or

☐ **Lidocaine** 1 mg/kg IV/IO (May repeat 0.5 mg/kg twice at 5-10 minute intervals. Maximum 3 doses total

13. Identify and treat reversible causes of arrest
    a. Hypovolemia (including vomiting/diarrhea)– Administer 20 ml/kg **NS** or **LR** IV/IO bolus
    b. Hypoglycemia – check blood glucose (may be MFR skill, see **Blood Glucose Testing-Procedure Protocol**)
        i. If blood glucose is less than 60 mg/dL administer dextrose according to MI MEDIC cards.
        ii. If MI-MEDIC unavailable, administer **dextrose** 0.5 g/kg per Pediatric Altered Mental Status.
    c. Tension pneumothorax – see **Pleural Decompression-Procedure Protocol**
    d. Hyperkalemia (renal failure) – Contact Medical Control
        i. Administer **calcium chloride 10%** per MI MEDIC cards
            1. If MI MEDIC cards are unavailable administer 20 mg/kg (0.2 ml/kg), max single dose 1 gm

ii. FLUSH line with 20 mL **NS** between calcium chloride and sodium bicarbonate administration.
iii. Administer **sodium bicarbonate** per MI MEDIC cards
2. If MI MEDIC cards are unavailable administer 1 mEq/kg IV/IO

5. If ROSC is not achieved, continue resuscitation while contacting Medical Control
   a. BLS/LALS: If ROSC has not been achieved and ALS is not available or is delayed, contact Medical Control after **20 minutes** of high-quality CPR for further direction AND before initiating transport. Continue high quality CPR unless directed otherwise by Medical Control per **Dead on Scene & Termination of Resuscitation Protocol**.
   b. ALS: If ROSC is not present after **30 minutes of ALS time** contact Medical Control for further direction AND before initiating transport.
   c. Continue high quality CPR unless directed otherwise by Medical Control per **Dead on Scene & Termination of Resuscitation Protocol**.

Notes:
1. Chest Compression Fraction (CCF) is the proportion of time during cardiac arrest when compressions are being performed. CCF should be as high as possible: ideally greater than 80% (AHA, ACLS, pg.115)
2. Identify and communicate to Medical Control potentially reversible causes. Treat EMS reversible causes, using other protocols, as applicable.
   A. Hyper/hypokalemia (known renal failure), other metabolic disorders
   B. Hypothermia
   C. Hypovolemia (including vomiting/diarrhea)
   D. Hypoxia
   E. Hydrogen ion excess (acidosis)
   F. Toxins/ overdose (e.g., beta-blocker or calcium channel-blocker)
   G. Tamponade
   H. Tension pneumothorax
   I. Thrombosis (pulmonary or coronary)
3. Routine use of **sodium bicarbonate** and **calcium chloride** in cardiac arrest is not indicated.
4. If ROSC is achieved refer to **Pediatric Return of Spontaneous Circulation - Treatment Protocol**

Medication Protocols
Amiodarone
Calcium Chloride
Dextrose
Epinephrine
Lidocaine
Sodium Bicarbonate

Pediatric Bradycardia

This protocol is for paramedic use only

Aliases: Slow heart rate, heart block

Bradycardia should be considered to be due to hypoxia until proven otherwise. This protocol applies to pediatric patients with bradycardia, a pulse, and poor perfusion (cardiopulmonary compromise).

NOTES: Signs of cardiopulmonary compromise include:

1. Hypotension:
    a. In neonates, SBP less than 60
    b. In infants 1 month to 1 year, SBP less than 70
    c. In children aged 2 to 10 years, SBP less than 70 + (age x 2).
    d. For children greater than 10, SBP less than 90
2. Acutely altered mental status.
3. Signs of shock - indicated by absent and/or weak peripheral and femoral pulses, increased capillary refill time (> 3 seconds), skin cool/mottled.
4. Respiratory difficulty indicated by increased work of breathing (retractions, nasal flaring, grunting, tracheal tugging), cyanosis, altered level of consciousness (unusual irritability, lethargy, failure to respond to parents), stridor, wheezing.

General Treatment

A. Pediatric patients (≤ 14 years of age) utilize MI MEDIC cards for appropriate medication dosage. When unavailable utilize pediatric dosing listed within protocol.
B. Manage airway as necessary
C. Provide supplemental oxygen as needed to maintain O2 saturation > 94%
D. Initiate monitoring

1. If pulse is < 60 confirm and support adequate oxygenation and ventilation.
2. If pulse remains < 60 and patient remains symptomatic perform CPR
3. Establish vascular access
4. Apply cardiac monitor to identify rhythm
5. If pulse remains < 60, despite oxygenation & ventilation
    A. Administer **epinephrine** according to MI MEDIC cards.
        i. If MI MEDIC cards are not available administer **epinephrine**:
            1. 1mg/ 10mL,
            2. 0.01 mg/kg (0.1 ml/kg) IV/IO up to 1 mg (10 ml),
            3. Repeat every 3-5 minutes.
    B. If patient remains unstable and pulse < 60 administer **atropine** according to MI MEDIC cards.
        i. If MI MEDIC cards are not available administer **atropine**:

1. 0.02 mg/kg IV/IO (minimum dose 0.1 mg, maximum single dose 0.5 mg)
2. May repeat once in 5 minutes, if effective.

ii. Continue administration of epinephrine as above

6. If patient remains unstable and pulse <60 after **epinephrine** and **atropine** administration:
   i. Begin transcutaneous pacing at rate up to 100 bpm per **Electrical Therapy-Procedure Protocol.**
   ii. Sedation may be used to facilitate transcutaneous pacing per MCA selection. Refer to **Patient Procedural Sedation-Procedure Protocol**.
7. Continuously monitor for pulses. If pulse is not present, refer to **Pediatric Cardiac Arrest-Treatment Protocol**.
8. Ensure adequate patient warming.

Notes:

When CPR is required, a precise diagnosis of the specific bradyarrhythmia is not important.

Medication Protocols
Atropine
Epinephrine

Pediatric Tachycardia

This protocol is for paramedic use only

Aliases: Supraventricular tachycardia (SVT), atrial fibrillation (a-fib), atrial flutter, ventricular tachycardia (V-tach)

This protocol is intended for symptomatic pediatric patients with elevated heart rate, relative to their age. Refer to MI-MEDIC for appropriate vital signs and medication doses.

I. General Treatment
- A. Pediatric patients (≤ 14 years of age) utilize MI MEDIC cards for appropriate medication dosage. When unavailable utilize pediatric dosing listed within protocol.
- B. Follow General Pre-Hospital Care-Treatment Protocol
- C. Determine if patient is stable or unstable
- D. Manage airway as necessary
- E. Provide supplemental oxygen as needed to maintain O2 saturation > 94%
- F. Initiate monitoring
- G. Perform 12-lead EKG but do not delay care for 12-lead EKG on unstable patients
- H. Establish vascular access
- I. Identify and treat underlying causes of tachycardia such as dehydration, fever, vomiting, sepsis and pain.
- J. Administer **NS** or **LR** bolus 20ml/kg with possible hypovolemia.
- K. Consider the following additional therapies if specific dysrhythmias are recognized:

II. **UNSTABLE**
- A. Regular Narrow Complex Tachycardia – Unstable
  - i. Prepare for immediate cardioversion. In conscious patients consider sedation prior to electrical cardioversion. Refer to **Patient Procedural Sedation-Procedure Protocol.**
  - ii. Deliver a synchronized shock; 1 J/kg for the first dose
  - iii. Repeat doses should be 2 J/kg
  - iv. DO NOT EXCEED ADULT DOSING.
- B. Regular, Wide Complex Tachycardia – Unstable
  - i. Prepare for immediate cardioversion. In conscious patients consider sedation prior to electrical cardioversion. Refer to **Patient Procedural Sedation-Procedure Protocol.**
  - ii. Synchronized cardioversion 1 J/kg
  - iii. For recurrent or refractory wide complex – unstable tachycardia, consult Medical Control prior to medication administration (medication per MCA selection)

Per MCA Selection

☑ Amiodarone 5 mg/kg (max single dose 300 mg) IV/IO (May repeat twice). Do not exceed 450 mg total IV/IO

or

☐ Lidocaine 1 mg/kg IV/IO (May repeat 0.5 mg/kg twice at 5-10 minute intervals). Maximum 3 doses total

C. Irregular, Wide Complex Tachycardia – Unstable
   i. Defibrillate according to **Electrical Therapy Procedure**
   ii. Refer to **Pediatric General Cardiac Arrest Protocol**

D. If able to convert tachycardia, maintain full cardiac monitoring including pulse oximetry and supportive care until transfer of care at the receiving facility.

III. **STABLE**

A. Regular Narrow Complex Tachycardia – Stable (SVT)
   i. Perform vagal maneuvers
      1. Ensure the patient is on oxygen and on a cardiac monitor.
      2. Run ECG strip during the procedure.
      3. If child is able to follow instructions:
         a. Blow into a into a 10 mL syringe for 15 seconds
         b. Squat and bear down
      4. If child is not able to follow instructions:
         a. While supine elevate the patient's legs to the knee chest position for 60 seconds.
         b. If available consider quickly placing a bag of ice on the eyes and forehead. Do NOT occlude the nose or place below the bridge of the nose.
            i. Results are generally seen within 15 seconds.
            ii. This is not an ongoing intervention, it is an abrubt maneuver not be maintained for more than 15 seconds.
      5. DO NOT USE CAROTID MASSAGE.

   ii. Contact Medical Control prior to administration. Administer **adenosine** according to MI MEDIC cards if vagal maneuvers are ineffective**.**
      1. If MI MEDIC cards are not available administer **adenosine**
         a. 0.1 mg/kg (max of 6 mg) rapid IV push through the most proximal injection site, immediately followed by a 10 mL flush.
         b. May repeat once with 0.2 mg/kg (max of 12 mg) administered as above.

B. Regular, Wide Complex Monomorphic QRS Tachycardia – Stable
   i. Contact Medical Control
   ii. Consider **adenosine** per MI MEDIC cards.
      1. If MI MEDIC cards are not available administer **adenosine**
         a. 0.1 mg/kg (max of 6 mg) rapid IV push through the most proximal injection site, immediately followed by a 10 mL flush.
         b. May repeat once with 0.2 mg/kg (max of 12 mg) administered as above.

Medication Protocols
Adensoine
Amiodarone
Lidocaine

Return of Spontaneous Circulation (ROSC)

This protocol should be followed for all cardiac arrests with ROSC. If an arrest is of a known traumatic origin, refer to the **Traumatic Arrest-Treatment Protocol** and MCA Transport Protocol. If it is unknown whether the arrest is traumatic or medical, consider other treatable causes. Initiate ALS response if available. After ROSC, patients should be stabilized on scene prior to transport, ideally for at least five minutes before moving the patient. Refer to **Pediatric Crashing Patient/Impending Arrest-Treatment Protocol.**

1. Pediatric patients (≤ 14 years) utilize MI MEDIC cards for appropriate medication dosage. When unavailable utilize pediatric dosing listed within protocol.
2. If ventilation assistance is required, ventilate at 10-12 breaths per minute. Do not hyperventilate.
3. Reassess patient, if patient becomes pulseless
    a. Begin CPR
    b. Follow **Pediatric Cardiac Arrest-Treatment Protocol**.
4. Monitor vital signs.
5. Check blood glucose (may be MFR skill, see **Blood Glucose Testing-Procedure Protocol**)
6. Start an IV/IO **NS** or **LR** KVO**.**
7. Treat hypotension with an IV/IO fluid bolus 20 ml/kg consistent with **Shock-Treatment Protocol**.
8. May perform 12- lead ECG (Per MCA selection, may be BLS skill per **12 Lead ECG-Procedure Protocol**) but must not delay or take precedence over other critical assessments and interventions.
9. Monitor waveform ETCO2. If ventilation assistance is required, target ETCO2 of 35-45 mm Hg per **End Tidal Carbon Dioxide Monitoring-Procedure Protocol**
10. If hypotension persists after IV/IO fluid bolus, administer push dose **epinephrine** (diluted boluses) according to MI MEDIC cards.
    a. If MI MEDIC cards are not available prepare (10 mcg/mL) by adding 1mL of 1mg/10mL **epinephrine** in 9mL **NS**, then
        i. Administer 1 mcg/kg (0.1 mL/kg **epinephrine** 10 mcg/mL)
        ii. Maximum dose 10 mcg (1 mL)
        iii. Repeat every 3-5 minutes
        iv. Titrate to age appropriate SBP per MI MEDIC cards. If MI MEDIC cards are unavailable titrate SBP > 70 mmHg + (2 x age in years) up to 100 mmHg.
2. Anticipate airway intolerance and prepare for patient sedation. If patient becomes agitated with advanced airway in place, refer to **Patient Procedural Sedation-Procedure Protocol.**

Medication Protocols
Epinephrine