Shared health Soins communs Manitoba	C02.2 - ADVANCED CARDIAC ARREST (PEDIATRIC)	
	DRAFT Version date: 2025-07-07	Effective Date: 2025-07-15 (07:00)

PCP = PCP only	**ICP** = ICP & ACP	**ACP** = ACP only	None = PCP - ACP

- ❑ Standard clinical approach (A01)
- ❑ Open the airway & initiate CPR [1, 2]
- ❑ Administer naloxone if opioid overdose is known or suspected
- ❑ Attach the defibrillator, identify the rhythm, shock if indicated
  - **PCP:** Use AED mode
  - **ICP:** Manual mode *(2 J/kg → 4 J/kg → 10 J/kg)* [3]
- ❑ Immediately resume CPR x 2 minutes
- ❑ Implement continuous capnometry [4]
- ❑ **ICP:** Administer epinephrine every 3 to 5 minutes
- ❑ Repeat the "CPR / analyze" cycle up to 2 more times on scene

→ PEA [5] | VT or VF [6] | Asystole after 3 cycles of "CPR / analyze" [8]

PEA [5] → Consider the "H's & T's" → ROSC?

VT or VF [6] →

- ❑ Consider the "H's & T's"
- ❑ **ICP:** Treat for hyperkalemia ASAP if suspected [6a]
- ❑ **ICP:** Administer bicarbonate ASAP if TCA / cocaine overdose [6b]
- ❑ **ICP:** Administer amiodarone if shock refractory
- ❑ **ACP:** Administer amiodarone or lidocaine if shock refractory (lidocaine preferred if sodium channel blocker toxicity) [6c]
- ❑ **ICP:** Administer magnesium if torsades de pointes

→ ROSC?

ROSC? Yes → Refer to C03

ROSC? No →

Asystole after 3 cycles of "CPR / analyze" [8] →

- ❑ **PCP or ICP:** Consider transporting <u>or</u> call VECTRS / OLMS [9]
- ❑ **ACP only:** Consider transport versus discontinuation

VECTRS / OLMS: (204) 949-4000

INDICATIONS
• Cardiac arrest due to nontraumatic causes in an infant, child or adolescent (up to 18 years)

WARNINGS
• Health care directive prohibiting full "cardiopulmonary resuscitation" • Obvious signs of death [12]
• For providers with the basic (EMR) work scope refer to C01 • For adults refer to C02.1 • For traumatic cardiac arrest refer to F02.2

NOTES

This care map has been adapted from the Heart&Stroke™ 2020 Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiac Care, and the Pediatric Advanced Life Support (ACLS) course content (appendix C).

1. Airway maneuvers are considered aerosol-generating medical procedures (AGMP). Chest compressions and defibrillation are not. Appropriate personnel protective equipment (PPE) is required.
2. Always maintain personal safety when performing cardiopulmonary resuscitation (CPR).

   Minimize pauses in chest compressions and limit all interruptions to 10 seconds or less. It is safe to continue chest compression while the defibrillator is charging.

   The AutoPulse is not to be used in patients under 18 years of age.
3. **DEFIBRILLATION:** Paramedics with the primary (PCP) work scope will perform pediatric defibrillation using the automated external defibrillator (AED) mode. Those with the intermediate (ICP) or advanced (ACP) work scopes will perform defibration at the following energy levels (if uncertain, do not delay - apply the highest available level).
   - 2 Joules per kilogram (J/kg) for the first shock
   - 4 J/kg (maximum = 200 J) for a second shock if the dysrhythmia persists
   - 10 J/kg (maximum = 200 J) for a third shock if the dysrhythmia persists
   - 10 J/kg (maximum = 200 J) if additional shocks are required to terminate the dysrhythmia

   If the dysrhythmia recurs after its initial termination, resume defibrillation at the last successful energy level, and escalate as above if required.

   For patients less than eight years of age or 25 kilograms weight use pediatric defibrillator pads. If the patient's age is unknown, use visible signs of puberty to differentiate a child from an adolescent. If pediatric pads are not available, use adult pads but ensure separation by at least 2.5 cm (consider antero-posterior placement).

   When defibrillating a patient with an implanted cardioverter-defibrillator (ICD) or pacemaker, place the electrodes at least 8 centimeters (3 inches) away from the pulse generator.
4. End-tidal CO_2 ($EtCO_2$) by continuous capnometry (figure 1) is a reliable technique for real-time monitoring the quality of chest compressions, and can be an early indicator of return of spontaneous circulation (ROSC). Aim for a level of 20 mmHg or more (this represents one-quarter of normal cardiac output).

5. **PULSELESS ELECTRICAL ACTIVITY (PEA):** PEA will rapidly degenerate to asystole if any underlying cause (appendix A) is not quickly corrected. Prompt identification and treatment is essential. Treatment for some reversible causes of PEA may not be within paramedic scope or available on scene, but may be accessed at the closest emergency department (ED). Scene time should be minimized.

   In certain situations, on line medical support (OLMS) at the Virtual Emergency Care & Transport Resource Service (VECTRS) may direct you to transport to an alternate destination for additional / advanced care or air intercept.

6. **VENTRICULAR TACHYCARDIA (VT) / VENTRICULAR FIBRILLATION (VF):** Pulseless VT or VF that does not respond to defibrillation (shock refractory) requires correction of the underlying cause (appendix A) or prompt administration of an antidysrhythmic agent.

   a. Renal disease is uncommon in infants and children. However, assume that cardiac arrest in a pediatric patient who on dialysis is due to hyperkalemia. Treatment of hyperkalemia takes precedence over antidysrhythmic administration. Note that hyperventilation may cause a temporary intracellular shift of potassium, while awaiting medications.

   b. In cardiac arrest from tricyclic antidepressant (TCA) or cocaine toxicity, bicarbonate administration takes precedence over over antidysrhythmic administration.

   c. In sodium channel blockade lidocaine may be the preferred antidysrhythmic agent as it competitively binds to sodium channels and displaces the offending agent, without prolonging the QRS duration.

   d. In a prolonged arrest, metabolic acidosis from the accumulation of lactate may render epinephrine ineffective. While hyperventilation may improve the acid-base status, the evidence supporting bicarbonate is conflicting.

7. If high-quality CPR, correction of the “H’s & T’s”, three shocks, and an antidysrhythmic do not terminate a shockable rhythm it is highly unlikely that further management on scene will be successful.

   Persistent organized electrical activity, such as with refractory VT, *suggests* ongoing myocardial viability and potential for survival. Advanced hospital-based interventions may be life-saving but only if rapidly applied.

   VF is not considered to be organized electrical activity and refractory VF generally has a poor outlook.

8. **ASYSTOLE:** Except for special situations (such as hypothermia or some overdoses) survival is extremely unlikely if asystole persists after 3 cycles of CPR, especially if the arrest was unwitnessed or the initial rhythm was asystole. During asystole the $EtCO_2$ level will be less than 10 mmHg as there is no pulmonary blood flow. Asystole must be confirmed in two cardiac leads.

9. A paramedic with the primary (PCP) or intermediate (ICP) work scope must consult VECTRS / OLMS prior to discontinuing resuscitative efforts on any infant, child, or adolescent.

10. **TRANSPORTING WITHOUT ROSC:** The decision to continue resuscitation and transport a patient without ROSC or discontinue treatment in the field is complex (appendix B). High-speed transport without hope of survival is not without risk to paramedics and the public.

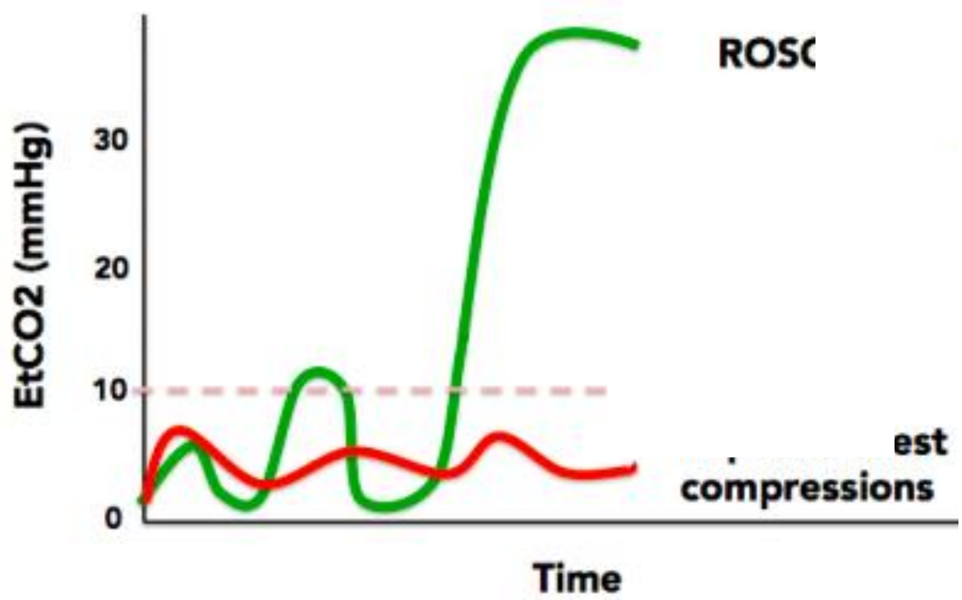
    Note that some clinical factors may indicate continuing myocardial and neurological viability include young age, the protective effects of hypothermia, persistent organized electrical activity (i.e. PEA, VT), and an $EtCO_2$ remaining above 20 mmHg. These may support extended efforts and emergency transport, as long as access to the required interventions can be promptly obtained at destination.

    And, sometimes transporting and deferring the decision about futility to another health care professional may be in the best interests of the patient’s family and paramedics. Sometimes the wish to be an organ donor has been previously expressed by the decedent, and is still a consideration when the patient has been pulseless for only a short time.

11. When calculating the transport duration, you must include the time for scene egress, as well as patient loading & unloading. When transporting, paramedics will provide appropriate pre-arrival notification to receiving ED staff.

12. Prior death can be reliably concluded by finding evidence of a significant time lapse from the cessation of circulation, or the recognition of injuries incompatible with survival. Evidence of significant time lapse includes dependent lividity, rigor mortis, generalized tissue decomposition, putrefaction, and torso freezing (such that the chest cannot be compressed). Injuries incompatible with life include decapitation, incineration, transection of the thorax or abdomen, substantial destruction of vital organs (heart, lungs, brain), or separation of vital organs from the body.

FIGURE 1: MONITORING CPR QUALITY BY CONTINUOUS CAPNOMETRY



Red - poor chest compressions   **Green** - high quality chest compressions

LINKS	
• A01 - Standard Clinical Approach • A09 - Aerosol Generating Medical Procedures • C01 - Basic Cardiac Arrest & Post Resuscitation Care • C02.1 - Advanced Cardiac Resuscitation (Adult) • C03 - Return of Spontaneous Circulation • C07.2 - Nontraumatic Hemorrhagic Shock • F02.2 - Advanced Trauma Arrest • M05 - Epinephrine	• M11 - Naloxone • M14 - Amiodarone • M18 - Sodium Bicarbonate • M20 - High Dose Insulin Therapy • M24 - Magnesium Sulfate • M25 - Lidocaine • M30 - Hyperkalemia Therapy • P04 - Needle Thoracostomy (All ages)

APPROVED BY	
EMS Medical Director	EMS Associate Medical Director

VERSION CHANGES (refer to X03 for change tracking)
• Removal of reference to mechanical CPR from last paragraph of appendix B

APPENDIX A: POTENTIAL CAUSES OF CARDIAC ARREST *("H's & T's")*	
CAUSE	**MANAGEMENT**
Hypovolemia (COMMON)	• Nontraumatic Hemorrhagic Shock (C07.2) • Shock - Pediatric (C07.4)
Hypoxia (VERY COMMON)	• Ensure patent airway & optimize oxygenation
Acidosis	• Optimize oxygenation and high-quality compressions • Hyperventilation • Sodium Bicarbonate (M18)
Hyperkalemia	• Hyperkalemia Therapy (M30)
Hypothermia	• Prolonged efforts *may* be justified until warmed
Tension pneumothorax	• Needle thoracostomy (P04)
Cardiac tamponade	• Possible *transient* benefit from fluid bolus
Overdose	• Naloxone (M11) • Sodium Bicarbonate (M18) • High Dose Insulin Therapy (M20)
Myocardial dysfunction	• Myocardial infection • Congenital heart disease • Myocardial infarction (rare)
Pulmonary embolism	• Possible *transient* benefit from fluid bolus
Trauma	• Advanced Trauma Arrest (F02.2)

APPENDIX B: FACTORS AFFECTING CARDIAC ARREST SURVIVAL & OUTCOME

- What is the likely cause of the arrest (appendix A)?
  Some causes have a better prognosis (e.g. hypothermia).
- Was the arrest witnessed?
  Unwitnessed arrests generally have poorer outcomes.
- Was bystander cardiopulmonary resuscitation (CPR) performed before EMS arrival?
  What was the quality of CPR?
- How long was the patient "down"?
  Did the patient arrest before or after EMS arrival?
- What is the prevailing rhythm?
  Asystole usually has a very poor outcome. VT and PEA suggest survivability with advanced interventions.
- What is the transport duration to the next level of care at the closest ED or NS?
  You must also factor in the time required for scene egress, patient loading and unloading, and road / weather conditions.
- What other interventions are available at the closest ED or NS?
  The work scope and experience may exceed that of local staff. You must also consider that in some smaller facilities, the physician is off-site. Pre-arrival notification will help ensure that they are present on patient arrival.
- Can high-quality CPR be safely maintained during egress and ambulance transport?
  <u>Mechanical CPR devices cannot be used in pediatric arrest victims</u>. Prolonged CPR provided by a single provider in a vehicle moving at high speed will quickly deteriorate in quality, and exposes the paramedic to a risk of injury. Consider the transport duration carefully.

APPENDIX C *(for information)*