Shared health Soins communs Manitoba	C02 - ADVANCED CARDIAC ARREST (ALL AGES)	
	Version date: 2024-12-06	Effective Date: 2024-12-17 (07:00)

- ❑ Open the airway & initiate CPR [4, 5]
- ❑ Consider naloxone if opioid OD
- ❑ Attach defibrillator & identify rhythm [6]
- ❑ Perform the "CPR-analyze" sequence every 2 min & shock if indicated [7]
- ❑ Implement continuous capnometry [8]
- ❑ Establish vascular access
- ❑ **ICP:** Administer epinephrine every 3 to 5 minutes
- ❑ **ICP:** Administer bicarbonate if hyperkalemia or TCA OD

ERS WORK SCOPE:
EMR – not applicable
PCP – PCP only
ICP – ICP & ACP
ACP – ACP only
None – all providers

SHOCKABLE RHYTHM:
- ❑ **ICP:** Assume hyperkalemia if ESRD [9]
- ❑ **ICP:** Administer amiodarone if VF / VT
- ❑ **ICP:** Administer magnesium if torsade

NONSHOCKABLE RHYTHM:
- ❑ Correct the "H's & T's" (appendix A) [10]
- ❑ Consider fluid bolus if hypovolemia
- ❑ Consider early transport if PEA [11]

Is ROSC achieved in 3 cycles or less of the "CPR-analyze" sequence? [12, 13]

Yes

- ❑ Secure airway if required
- ❑ Maintain SpO_2 (≥ 92% adult ; ≥ 94% child) [16]
- ❑ Support breathing / avoid hyperventilation ($EtCO_2$ @ 35 – 45 mmHg) [17]
- ❑ Establish vascular access if not yet done
- ❑ Support adequate perfusion [18]
- ❑ Exclude hypoglycemia if not yet done
- ❑ Correct the "H's & T's" (appendix A) [10]
- ❑ Acquire ECG (activate Code-STEMI if indicated
- ❑ **ICP:** Consider amiodarone if not yet given [19]

No

- ❑ **PCP:** Call VECTRS / OLMS while preparing for transport [3]
- ❑ **ICP:** Consider transport versus discontinuation [14]
- ❑ **ICP:** Call VECTRS / OLMS before discontinuing if patient is 18 years or less [3]

IF TRANSPORTING:
- ❑ Consider AutoPulse [5]
- ❑ **ICP:** Consider VECTRS /OLMS for destination support [3]
- ❑ **ICP:** Continue epinephrine

DURING TRANSPORT:
- ❑ **PCP:** Call VECTRS / OLMS for destination support [20]
- ❑ **ICP:** Consider VECTRS / OLMS for destination support [20]

VECTRS / OLMS: (204) 949-4000

INDICATIONS

- Cardiac arrest not due to trauma

CONTRAINDICATIONS

- Health care directive prohibiting cardiopulmonary resuscitation (CPR)
- Obvious signs of death [15]
- For cardiac arrest due to trauma, refer to F02.2

NOTES

1. Managing a cardiac arrest can be complex. The decision to transport a patient without a return of spontaneous circulation (ROSC) or discontinue resuscitation in the field is sometimes difficult and frequently stressful.

   Emergency transport without ROSC (and no realistic hope of survival) exposes paramedics and the public to unnecessary risk. Alternatively, transporting the patient in arrest to a health care facility and deferring the decision about discontinuation to a health care provider with additional training and experience *may* be in the best interests of the patient's family and providers (e.g. child victim, family distress, provider uncertainty). And, organ donation may be a consideration for a patient who has been pulseless for only a short time.

   - **PCP:** A paramedic with the primary work scope must call the VECTRS-OLMS for all cases of cardiac arrest before discontinuing resuscitative efforts or while preparing for transport. Consider consulting VECTRS / OLMS as early as possible after the primary assessment.
   - **ICP:** A paramedic with the intermediate work scope must call VECTRS-OLMS for all cardiac arrest victims under 18 years of age. Consider VECTRS - OLMS at any time for assistance with clinical care and destination decision making.
2. Paramedics should also anticipate the need for additional resources and make the request early. Radio the Medical Transportation Coordination Center (MTCC) early for backup, advanced life support (ALS) intercept, and/or additional personnel (e.g. fire service) to assist with egress and loading.
3. In the event of an air EMS pre-alert or auto launch, MTCC will request an initial report by radio as soon as possible to enable the transport physician to decide on launching or standing down the air asset (A12).
4. Airway maneuvers are considered aerosol-generating medical procedures (AGMP). Chest compressions and defibrillation are not. Appropriate personnel protective equipment (PPE) is required (A09).
5. Always maintain personal safety when performing CPR during transport.
6. For patients less than eight years of age or 25 kilograms weight use pediatric 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.
7. The "CPR-analyze" sequence represents two minutes of CPR, followed by a brief pause for rhythm analysis, and immediate defibrillation if indicated. Minimize pauses in chest compressions and limit all interruptions to ten seconds or less. It is safe to continue chest compression while the defibrillator is charging.

8. End-tidal CO_2 ($EtCO_2$) by continuous capnometry (figure 1) is a reliable technique of monitoring the quality of chest compressions, and can be an earlier indicator of return of spontaneous circulation (ROSC) before a scheduled pulse check. Aim for an EtCO2 level of 20 mmHg or more (this represents one-quarter of normal cardiac output).
9. Cardiac arrest in a patient who is dialysis-dependent or has known advanced stage chronic kidney disease (end-stage renal disease - ESRD) is considered to be due to hyperkalemia until proven otherwise. Both calcium chloride and sodium bicarbonate should be administered (bicarbonate alone may not be effective). By creating alkalosis, hyperventilation may cause a temporary intracellular shift of potassium.
10. Reversible causes of cardiac arrest (appendix A) may present initially with a shockable rhythm or pulseless electrical activity (PEA). All will rapidly progress to asystole if uncorrected. Prompt identification and treatment of the "H's & T's" (while maintaining high-quality CPR) is the priority.

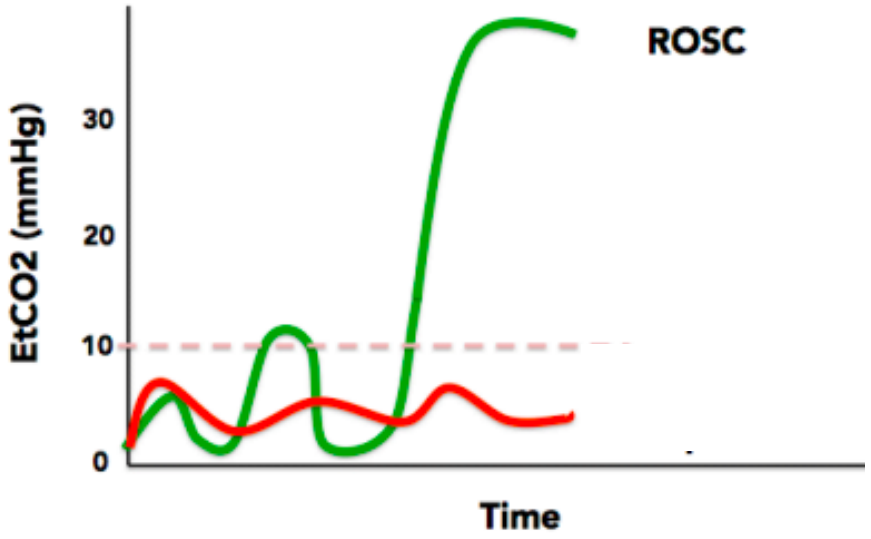
    Shockable rhythms (ventricular tachycardia - VT, ventricular fibrillation - VF) due to a reversible cause such as hyperkalemia overdose may not respond to defibrillation until the underlying cause is addressed.
11. In pulseless electrical activity (PEA) treatments for certain causes (e.g. tension pneumothorax, hemorrhage) that may not be in scope and available on the scene *may* be accessible at a local emergency department (ED). Scene time should be minimized.
12. With VF or VT, if high-quality CPR and three shock and available on-scene interventions (e.g. epinephrine, antidysrhythmic) do not lead to a return of spontaneous circulation (ROSC) it is highly unlikely that further prehospital management will be effective. Advanced interventions in a hospital may be life-saving, but only if they are rapidly available.
13. Except for special situations, such as an overdose or hypothermia, prolonged efforts at resuscitating a patient in asystole are inevitably futile. Asystole must be confirmed in two cardiac leads. The EtCO2 level will be less than 10 mmHg during true asystole as there is no pulmonary blood flow.
14. The odds of survival depend on multiple factors including, but not limited to, the following.
    - What is the likely cause of the arrest?
    - Was the arrest witnessed?
    - Was bystander cardiopulmonary resuscitation (CPR) performed before EMS arrival?
    - What was the downtime prior to EMS arrival?
    - Did the patient arrest after EMS arrival?
    - What is the transport duration (including egress and loading) to the next level of care?
    - What additional therapies are available at the closest next level of care?
    - Can high-quality CPR be safely maintained during egress and ambulance transport?

    Clinical factors that favor continued myocardial viability include younger patient age, the protective effects of hypothermia, ongoing organized electrical activity, and an $EtCO_2$ persistently elevated above 20 mmHg. These may support extended efforts and emergency transport if access to a higher level of care can be promptly achieved. [3]
15. 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.

RETURN OF SPONTANEOUS CIRCULATION:

16. Provide supplemental oxygen if necessary to achieve an oxyhemoglobin saturation (SpO_2) of 92% to 98% in adults and adolescents, and 94% to 99% in infants and children.
17. Excessive ventilation may compromise cerebral blood flow. Target an $EtCO_2$ level of 35 to 45 mmHg.
18. In adults aim for a mean arterial pressure (MAP) of greater than 65 mmHg (or a systolic blood pressure of approximately 90 mmHg).
19. When administering amiodarone to a patient with a perfusing rhythm, note that the dose is lower and the administration rate is slower than when administering during cardiac arrest. Rapid administration may cause hypotension.
20. Determining the appropriate destination for care after ROSC depends on the suspected cause of arrest. Distance, duration, and travel conditions must always be factored into every transport decision. VECTRS-OLMS may conference in the transport physician and air medical crew for consideration of air intercept or transport.
21. Paramedics will provide notification (including an estimated time of arrival) to receiving ED staff at an appropriate interval before arrival.

FIGURE 1: MONITORING CPR QUALITY BY CONTINUOUS CAPNOMETRY



Red - poor chest compressions

Green - high quality chest compressions

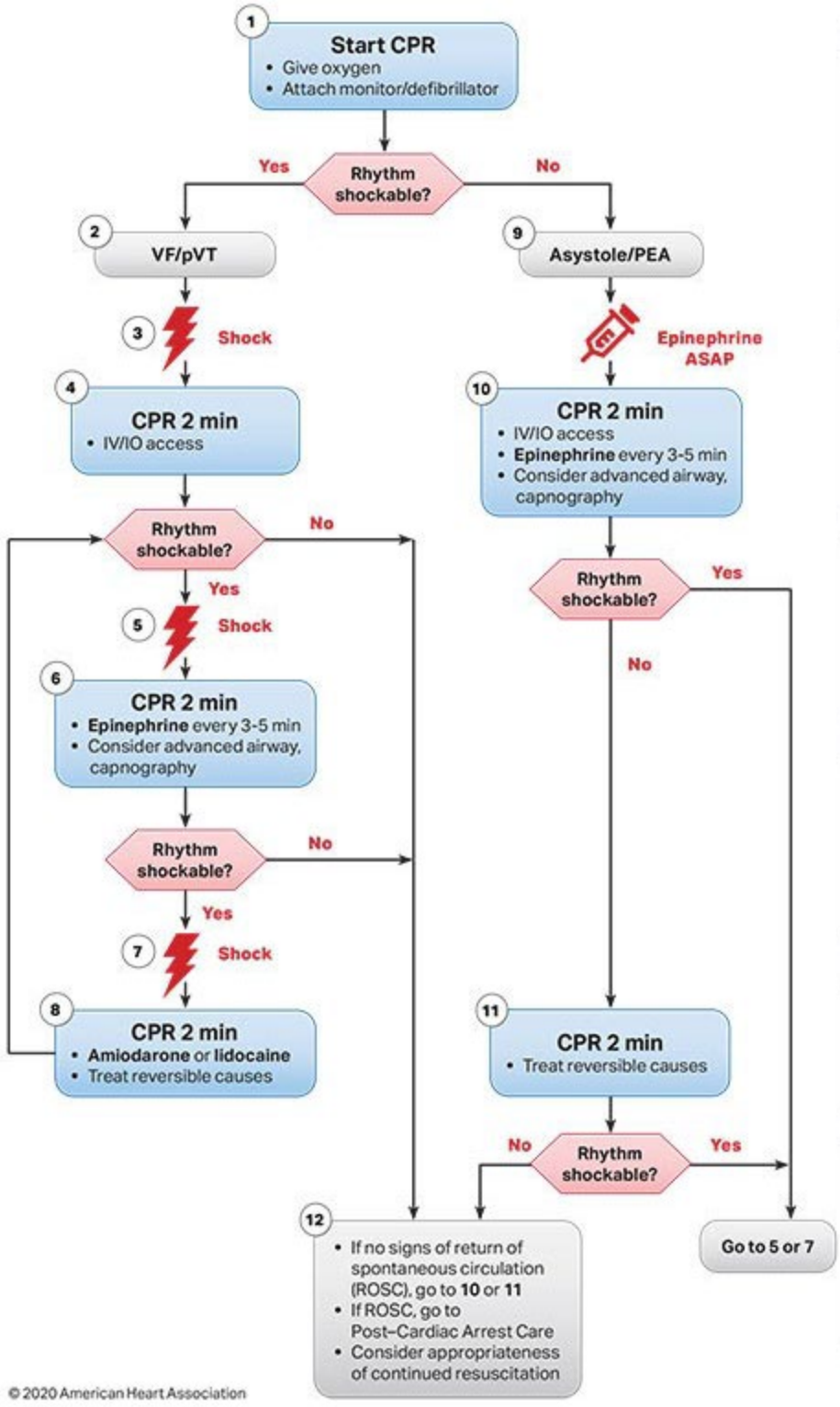
LINKS / REFERENCES
• A09 - AEROSOL GENERATING MEDICAL PROCEDURES • A12 - AIR PREALERT & AUTOLAUNCH • C07.1 - HYPOVOLEMIC & SEPTIC SHOCK • C07.2 - HEMORRHAGIC SHOCK • E04 - ACS & STEMI & ACS & NSTE-ACS • M05.2 - EPINEPHRINE FOR CARDIAC ARREST • M11 - NALOXONE • M14 - AMIODARONE • M18 - SODIUM BICARBONATE • M24 - MAGNESIUM SULFATE • M26 - CALCIUM CHLORIDE

APPROVED BY	
	
EMS Medical Director	EMS Associate Medical Director

VERSION CHANGES (refer to X03 for change tracking)
• Correction of prior error that mandated ICP to call VECTRS - OLMS • Addition of “AIR PRE-ALERT” indicator to flow chart • Revised flow chart & notes for greater clarity & ease of use • Separation of shockable & nonshockable rhythms • Prompt to transport early with PEA • Addition of Heart & Stroke ROSC adult algorithm (appendix E) and pediatric checklist (appendix F)

APPENDIX A: POTENTIAL CAUSES OF CARDIAC ARREST *("H's & T's")*	
CAUSE	**MANAGEMENT**
Hypovolemia / hemorrhage	• HYPOVOLEMIC & SEPTIC SHOCK (C07.1) • HEMORRHAGIC SHOCK (C07.2)
Hypoxia	• Ensure patent airway & optimize oxygenation
Acidosis	• Optimize oxygenation and high-quality compressions • Sodium bicarbonate
Hyperkalemia	• Calcium chloride (M26) & sodium bicarbonate (M18)
Hypothermia	• Prolonged efforts *may* be justified until warmed
Tension pneumothorax	• Decompression
Cardiac tamponade	• Possible *transient* benefit from fluid bolus
Overdose	• Naloxone (M11) • Sodium bicarbonate (M18)
Myocardial infarction	• ACS & STEMI & ACS & NSTE-ACS (E04)
Pulmonary embolism	• Possible *transient* benefit from fluid bolus
Trauma	• ADVANCED TRAUMA ARREST (F02.2)

APPENDIX B: HEART & STROKE ADULT CARDIAC ARREST ALGORITHM (ACLS)



CPR Quality

- Push hard (at least 2 inches [5 cm]) and fast (100-120/min) and allow complete chest recoil.
- Minimize interruptions in compressions.
- Avoid excessive ventilation.
- Change compressor every 2 minutes, or sooner if fatigued.
- If no advanced airway, 30:2 compression-ventilation ratio.
- Quantitative waveform capnography
  - If P_{ETCO_2} is low or decreasing, reassess CPR quality.

Shock Energy for Defibrillation

- **Biphasic**: Manufacturer recommendation (eg, initial dose of 120-200 J); if unknown, use maximum available. Second and subsequent doses should be equivalent, and higher doses may be considered.
- **Monophasic**: 360 J

Drug Therapy

- **Epinephrine IV/IO dose:** 1 mg every 3-5 minutes
- **Amiodarone IV/IO dose:** First dose: 300 mg bolus. Second dose: 150 mg.
  or
  Lidocaine IV/IO dose: First dose: 1-1.5 mg/kg. Second dose: 0.5-0.75 mg/kg.

Advanced Airway

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

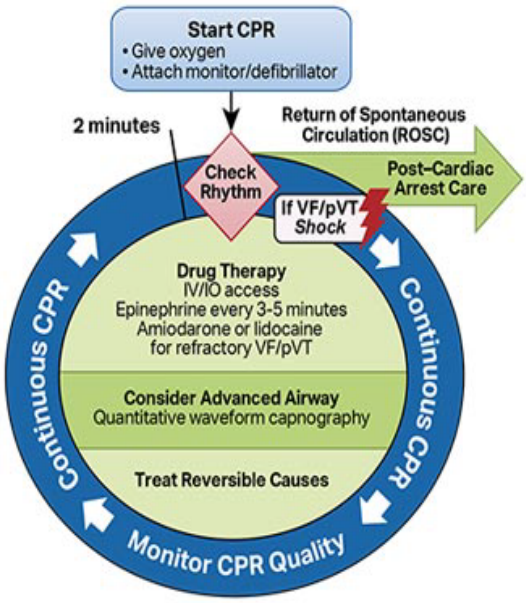
Return of Spontaneous Circulation (ROSC)

- Pulse and blood pressure
- Abrupt sustained increase in P_{ETCO_2} (typically ≥40 mm Hg)
- Spontaneous arterial pressure waves with intra-arterial monitoring

Reversible Causes

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

APPENDIX C: HEART & STROKE ADULT CARDIAC ARREST CIRCULAR ALGORITHM (ACLS)



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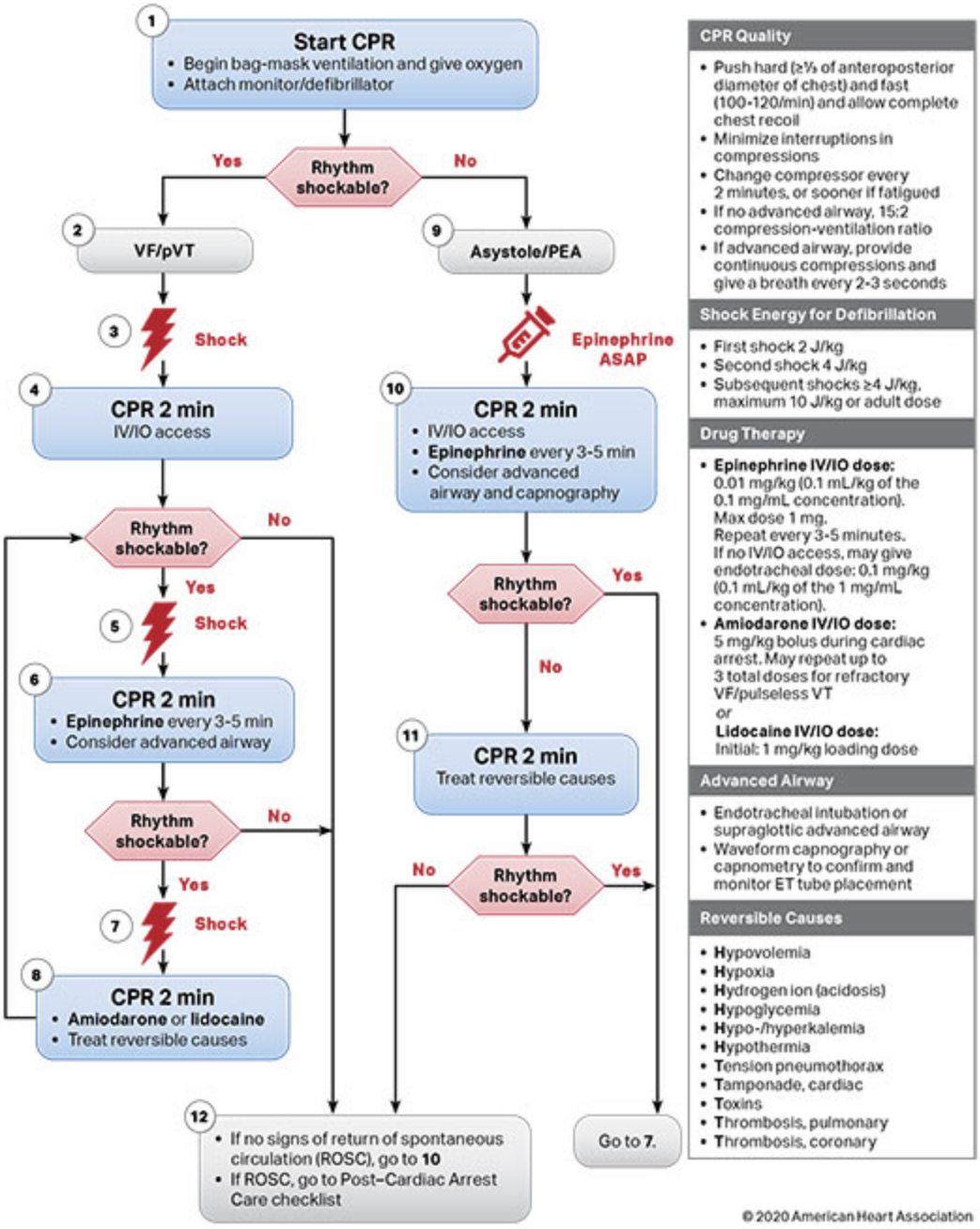
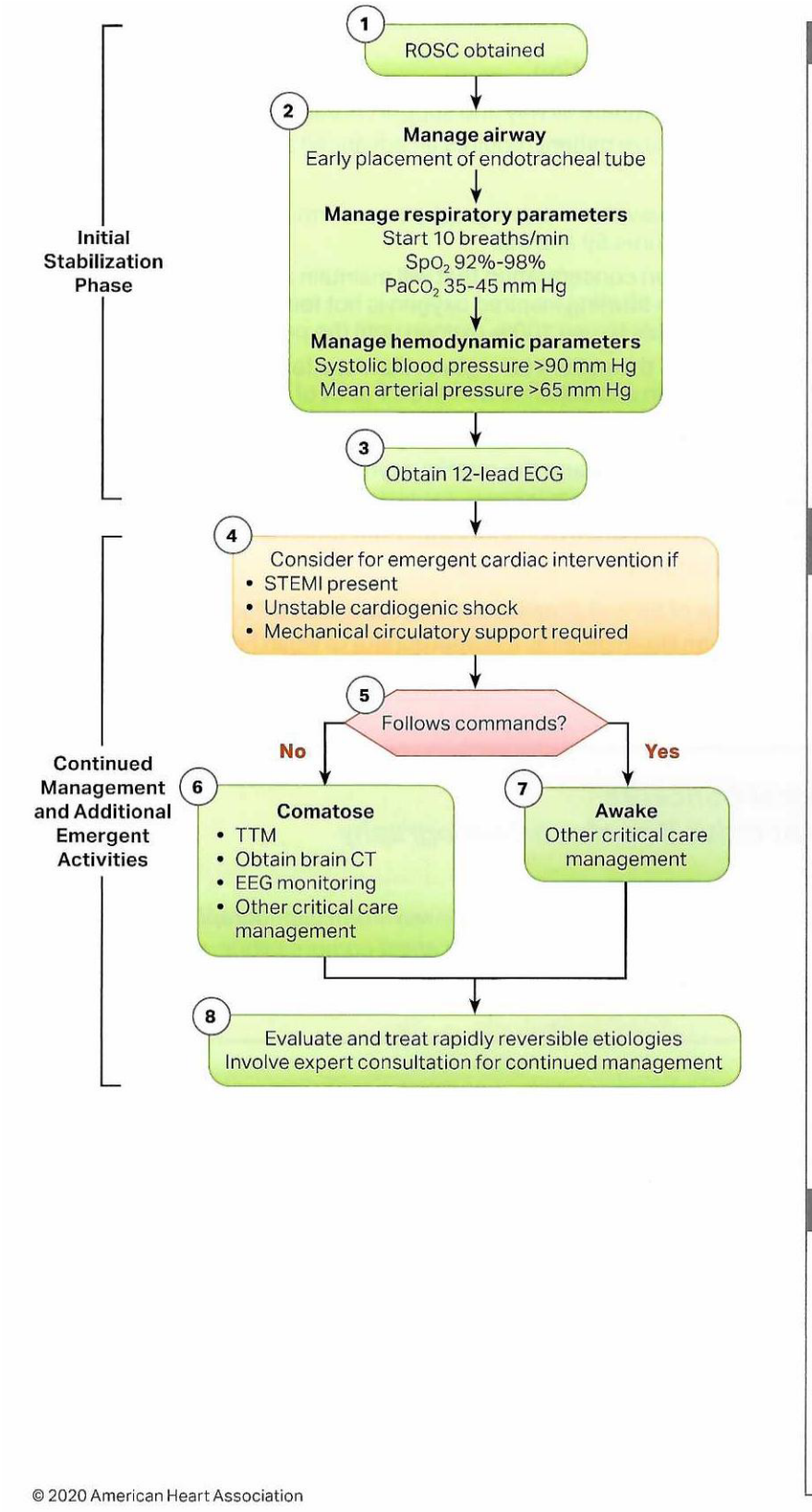
- **T**ension pneumothorax
- **T**amponade, cardiac
- **T**oxins
- **T**hrombosis, pulmonary
- **T**hrombosis, coronary

APPENDIX D: HEART & STROKE PEDIATRIC CARDIAC ARREST ALGORITHM (PALS)



APPENDIX E: HEART & STROKE ADULT ROSC ALGORITHM (ACLS)



Initial Stabilization Phase

Resuscitation is ongoing during the post-ROSC phase, and many of these activities can occur concurrently. However, if prioritization is necessary, follow these steps:

- Airway management: Waveform capnography or capnometry to confirm and monitor endotracheal tube placement
- Manage respiratory parameters: Titrate FIO_2 for SpO_2 92%-98%; start at 10 breaths/min; titrate to $PaCO_2$ of 35-45 mm Hg
- Manage hemodynamic parameters: Administer crystalloid and/or vasopressor or inotrope for goal systolic blood pressure >90 mm Hg or mean arterial pressure >65 mm Hg

Continued Management and Additional Emergent Activities

These evaluations should be done concurrently so that decisions on targeted temperature management (TTM) receive high priority as cardiac interventions.

- Emergent cardiac intervention: Early evaluation of 12-lead electrocardiogram (ECG); consider hemodynamics for decision on cardiac intervention
- TTM: If patient is not following commands, start TTM as soon as possible; begin at 32-36°C for 24 hours by using a cooling device with feedback loop
- Other critical care management
  - Continuously monitor core temperature (esophageal, rectal, bladder)
  - Maintain normoxia, normocapnia, euglycemia
  - Provide continuous or intermittent electroencephalogram (EEG) monitoring
  - Provide lung-protective ventilation

H's and T's

Hypovolemia
Hypoxia
Hydrogen ion (acidosis)
Hypokalemia/**h**yperkalemia
Hypothermia
Tension pneumothorax
Tamponade, cardiac
Toxins
Thrombosis, pulmonary
Thrombosis, coronary

APPENDIX F: HEART & STROKE PEDIATRIC ROSC CHECKLIST (PALS)

Components of Post–Cardiac Arrest Care	Check
Oxygenation and ventilation	
Measure oxygenation and target normoxemia 94%-99% (or child's normal/appropriate oxygen saturation).	☐
Measure and target $Paco_2$ appropriate to the patient's underlying condition and limit exposure to severe hypercapnia or hypocapnia.	☐
Hemodynamic monitoring	
Set specific hemodynamic goals during post–cardiac arrest care and review daily.	☐
Monitor with cardiac telemetry.	☐
Monitor arterial blood pressure.	☐
Monitor serum lactate, urine output, and central venous oxygen saturation to help guide therapies.	☐
Use parenteral fluid bolus with or without inotropes or vasopressors to maintain a systolic blood pressure greater than the fifth percentile for age and sex.	☐
Targeted temperature management (TTM)	
Measure and continuously monitor core temperature.	☐
Prevent and treat fever immediately after arrest and during rewarming.	☐
If patient is comatose apply TTM (32°C-34°C) followed by (36°C-37.5°C) or only TTM (36°C-37.5°C).	☐
Prevent shivering.	☐
Monitor blood pressure and treat hypotension during rewarming.	☐
Neuromonitoring	
If patient has encephalopathy and resources are available, monitor with continuous electroencephalogram.	☐
Treat seizures.	☐
Consider early brain imaging to diagnose treatable causes of cardiac arrest.	☐
Electrolytes and glucose	
Measure blood glucose and avoid hypoglycemia.	☐
Maintain electrolytes within normal ranges to avoid possible life-threatening arrhythmias.	☐
Sedation	
Treat with sedatives and anxiolytics.	☐
Prognosis	
Always consider multiple modalities (clinical and other) over any single predictive factor.	☐
Remember that assessments may be modified by TTM or induced hypothermia.	☐
Consider electroencephalogram in conjunction with other factors within the first 7 days after cardiac arrest.	☐
Consider neuroimaging such as magnetic resonance imaging during the first 7 days.	☐