ACLS Algorithms

1. Cardiac Arrest Algorithm
2. Cardiac Arrest Circular Algorithm
3. Immediate Post-Cardiac Arrest Care Algorithm
4. Tachycardia With a Pulse Algorithm
5. Bradycardia With a Pulse Algorithm
6. Acute Coronary Syndromes Algorithm
7. Suspected Stroke Algorithm
Cardiac Arrest Algorithm

Adult Advanced Cardiovascular Life Support

Shout for Help/Activate Emergency Response

1. Start CPR
   - Give oxygen
   - Attach monitor/defibrillator

2. Rhythm shockable?
   - Yes
     - VF/VT
     - Shock
     - CPR 2 min
       - IV/IO access
       - Epinephrine every 3-5 min
       - Consider advanced airway, capnography
     - Rhythm shockable?
       - Yes
         - Shock
       - No
         - CPR 2 min
           - Epinephrine every 3-5 min
           - Consider advanced airway, capnography
     - No
       - CPR 2 min
         - Epinephrine every 3-5 min
         - Consider advanced airway, capnography
         - Rhythm shockable?
           - Yes
             - Shock
           - No
             - CPR 2 min
               - Amiodarone
               - Treat reversible causes

3. Rhythm shockable?
   - Yes
     - Shock
     - CPR 2 min
       - Amiodarone
       - Treat reversible causes

4. CPR 2 min
   - IV/IO access
   - Epinephrine every 3-5 min
   - Consider advanced airway, capnography

5. CPR 2 min
   - IV/IO access
   - Epinephrine every 3-5 min
   - Consider advanced airway, capnography

6. CPR 2 min
   - IV/IO access
   - Epinephrine every 3-5 min
   - Consider advanced airway, capnography

7. CPR 2 min
   - IV/IO access
   - Epinephrine every 3-5 min
   - Consider advanced airway, capnography

8. CPR 2 min
   - IV/IO access
   - Epinephrine every 3-5 min
   - Consider advanced airway, capnography
   - Rhythm shockable?
     - Yes
       - Shock
     - No
       - CPR 2 min
         - Treat reversible causes

9. Asystole/PEA

10. CPR 2 min
    - IV/IO access
    - Epinephrine every 3-5 min
    - Consider advanced airway, capnography

11. CPR 2 min
    - IV/IO access
    - Epinephrine every 3-5 min
    - Consider advanced airway, capnography

12. Rhythm shockable?
    - Yes
      - CPR 2 min
        - Treat reversible causes
    - No
      - CPR 2 min
        - Treat reversible causes

CPR Quality
- Push hard (≥2 inches [5 cm]) and fast (≥100/min) and allow complete chest recoil
- Minimize interruptions in compressions
- Avoid excessive ventilation
- Rotate compressor every 2 minutes
- If no advanced airway, 30:2 compression-ventilation ratio
- Quantitative waveform capnography
  - If PetCO2 <10 mm Hg, attempt to improve CPR quality
- Intra-arterial pressure
  - If relaxation phase (diastolic) pressure <20 mm Hg, attempt to improve CPR quality

Return of Spontaneous Circulation (ROSC)
- Pulse and blood pressure
- Abrupt sustained increase in PetCO2 (typically ≥40 mm Hg)
- Spontaneous arterial pressure waves with intra-arterial monitoring

Shock Energy
- 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
- Vasopressin IV/IO Dose: 40 units can replace first or second dose of epinephrine
- Amiodarone IV/IO Dose: First dose: 300 mg bolus. Second dose: 150 mg.

Advanced Airway
- Supraglottic advanced airway or endotracheal intubation
- Waveform capnography to confirm and monitor ET tube placement
- 8-10 breaths per minute with continuous chest compressions

Reversible Causes
- Hypovolemia
- Hypoxia
- Hydrogen ion (acidosis)
- Hypo-/hyperkalemia
- Hypothermia
- Tension pneumothorax
- Tamponade, cardiac
- Toxins
- Thrombosis, pulmonary
- Thrombosis, coronary

Go to 5 or 7

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Cardiac Arrest
Circular Algorithm

Adult Advanced Cardiovascular Life Support

Shout for Help/Activate Emergency Response

Start CPR
- Give oxygen
- Attach monitor/defibrillator

2 minutes

Check Rhythm

if VF/VT
Shock

Continue CPR

Drug Therapy
IV/IO access
Epinephrine every 3-5 minutes
Amiodarone for refractory VF/VT

Consider Advanced Airway
Quantitative waveform capnography

Treat Reversible Causes

Continuous CPR

Monitor CPR Quality

CPR Quality
- Push hard (≥2 inches [5 cm]) and fast (≥100/min) and allow complete chest recoil
- Minimize interruptions in compressions
- Avoid excessive ventilation
- Rotate compressor every 2 minutes
- If no advanced airway, 30:2 compression-ventilation ratio
- Quantitative waveform capnography
  - If PETCO₂ < 10 mm Hg, attempt to improve CPR quality
- Intra-arterial pressure
  - If relaxation phase (diastolic) pressure < 20 mm Hg, attempt to improve CPR quality

Return of Spontaneous Circulation (ROSC)
- Pulse and blood pressure
- Abrupt sustained increase in PETCO₂ (typically ≥ 40 mm Hg)
- Spontaneous arterial pressure waves with intra-arterial monitoring

Shock Energy
- 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
- Vasopressin IV/IO Dose:
  40 units can replace first or second dose of epinephrine
- Amiodarone IV/IO Dose:
  First dose: 300 mg bolus. Second dose: 150 mg.

Advanced Airway
- Supraglottic advanced airway or endotracheal intubation
- Waveform capnography to confirm and monitor ET tube placement
- 8-10 breaths per minute with continuous chest compressions

Reversible Causes
- Hypovolemia
- Hypoxia
- Hydrogen ion (acidosis)
- Hypo-/hyperkalemia
- Hypothermia
- Tension pneumothorax
- Tamponade, cardiac
- Toxins
- Thrombosis, pulmonary
- Thrombosis, coronary

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Immediate Post-Cardiac Arrest Care Algorithm

Return of Spontaneous Circulation (ROSC)

Optimize ventilation and oxygenation
- Maintain oxygen saturation ≥94%
- Consider advanced airway and waveform capnography
- Do not hyperventilate

Treat hypotension (SBP <90 mm Hg)
- IV/IO bolus
- Vasopressor infusion
- Consider treatable causes
- 12-Lead ECG

Doses/Details

Ventilation/Oxygenation
Avoid excessive ventilation. Start at 10-12 breaths/min and titrate to target P_{ETCO_2} of 35-40 mm Hg. When feasible, titrate F_{IO_2} to minimum necessary to achieve Sp_{O_2} ≥ 94%.

IV Bolus
1-2 L normal saline or lactated Ringer’s. If inducing hypothermia, may use 4°C fluid.

Epinephrine IV Infusion:
0.1-0.5 mcg/kg per minute (in 70-kg adult: 7-35 mcg per minute)

Dopamine IV Infusion:
5-10 mcg/kg per minute

Norepinephrine IV Infusion:
0.1-0.5 mcg/kg per minute (in 70-kg adult: 7-35 mcg per minute)

Reversible Causes
- Hypovolemia
- Hypoxia
- Hydrogen ion (acidosis)
- Hypo-/hyperkalemia
- Hypothermia
- Tension pneumothorax
- Tamponade, cardiac
- Toxins
- Thrombosis, pulmonary
- Thrombosis, coronary

Consider induced hypothermia

Follow commands?

Yes

STEMI OR high suspicion of AMI

Advanced critical care

No

Coronary reperfusion

No
Assess appropriateness for clinical condition. Heart rate typically ≥150/min if tachyarrhythmia.

**Identify and treat underlying cause**
- Maintain patent airway; assist breathing as necessary
- Oxygen (if hypoxemic)
- Cardiac monitor to identify rhythm; monitor blood pressure and oximetry

**Persistent tachyarrhythmia causing:**
- Hypotension?
- Acutely altered mental status?
- Signs of shock?
- Ischemic chest discomfort?
- Acute heart failure?

**Yes**
- **Synchronized cardioversion**
  - Consider sedation
  - If regular narrow complex, consider adenosine

**No**
- **Wide QRS? ≥0.12 second**
  - **Yes**
    - IV access and 12-lead ECG if available
    - Consider adenosine only if regular and monomorphic
    - Consider antiarrhythmic infusion
    - Consider expert consultation
  - **No**
    - IV access and 12-lead ECG if available
    - Vagal maneuvers
    - Adenosine (if regular)
    - β-Blocker or calcium channel blocker
    - Consider expert consultation

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**Doses/Details**

**Synchronized Cardioversion**
Initial recommended doses:
- Narrow regular: 50-100 J
- Narrow irregular: 120-200 J
- Biphasic or 200 J monophasic
- Wide regular: 100 J
- Wide irregular: defibrillation dose (NOT synchronized)

**Adenosine IV Dose:**
First dose: 6 mg rapid IV push; follow with NS flush.
Second dose: 12 mg if required.

**Antiarrhythmic Infusions for Stable Wide-QRS Tachycardia**

**Procarbazine IV Dose:**
20-50 mg/min until arrhythmia suppressed, hypotension ensues, QRS duration increases >50%, or maximum dose 17 mg/kg given. Maintenance infusion: 1-4 mg/min. Avoid if prolonged QT or CHF.

**Amiodarone IV Dose:**
First dose: 150 mg over 10 minutes. Repeat as needed if VT recurs. Follow by maintenance infusion of 1 mg/min for first 6 hours.

**Sotalol IV Dose:**
100 mg (1.5 mg/kg) over 5 minutes. Avoid if prolonged QT.

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Bradycardia
With a Pulse Algorithm

Assess appropriateness for clinical condition. Heart rate typically <50/min if bradyarrhythmia.

Identify and treat underlying cause
- Maintain patent airway; assist breathing as necessary
- Oxygen (if hypoxemic)
- Cardiac monitor to identify rhythm; monitor blood pressure and oximetry
- IV access
- 12-Lead ECG if available; don’t delay therapy

Persistent bradyarrhythmia causing:
- Hypotension?
- Acutely altered mental status?
- Signs of shock?
- Ischemic chest discomfort?
- Acute heart failure?

Monitor and observe

No

Yes

Atropine
If atropine ineffective:
- Transcutaneous pacing OR
- Dopamine infusion OR
- Epinephrine infusion

Consider:
- Expert consultation
- Transvenous pacing

Doses/Details
Atropine IV Dose:
First dose: 0.5 mg bolus
Repeat every 3-5 minutes
Maximum: 3 mg

Dopamine IV Infusion:
2-10 mcg/kg per minute

Epinephrine IV Infusion:
2-10 mcg per minute
Acute Coronary Syndromes Algorithm

Symptoms suggestive of ischemia or infarction

EMS assessment and care and hospital preparation
- Monitor, support ABCs. Be prepared to provide CPR and defibrillation
- Administer aspirin and consider oxygen, nitroglycerin, and morphine if needed
- Obtain 12-lead ECG; if ST elevation:
  - Notify receiving hospital with transmission or interpretation; note time of onset and first medical contact
- Notify hospital should mobilize hospital resources to respond to STEMI
- If considering prehospital fibrinolysis, use fibrinolytic checklist

Concurrent ED assessment (<10 minutes)
- Check vital signs; evaluate oxygen saturation
- Establish IV access
- Perform brief, targeted history, physical exam
- Review/complete fibrinolytic checklist; check contraindications
- Obtain initial cardiac marker levels, initial electrolyte and coagulation studies
- Obtain portable chest x-ray (<30 min)

Immediate ED general treatment
- If O₂ sat <94%, start oxygen at 4 L/min, titrate
- Aspirin 160 to 325 mg (if not given by EMS)
- Nitroglycerin sublingual or spray
- Morphine IV if discomfort not relieved by nitroglycerin

ECG interpretation

ST elevation or new or presumably new LBBB; strongly suspicious for injury
ST-elevation MI (STEMI)
- Start adjunctive therapies as indicated
- Do not delay reperfusion

Time from onset of symptoms ≤12 hours

ST depression or dynamic T-wave inversion; strongly suspicious for ischemia
High-risk unstable angina/ non-ST-elevation MI (UA/NSTEMI)
- Troponin elevated or high-risk patient
  Consider early invasive strategy if:
  - Refractory ischemic chest discomfort
  - Recurrent/persistent ST deviation
  - Ventricular tachycardia
  - Hemodynamic instability
  - Signs of heart failure
- Start adjunctive treatments as indicated
  - Nitroglycerin
  - Heparin (UFH or LMWH)
  - Consider: PO β-blockers
  - Consider: Clopidogrel
  - Consider: Glycoprotein IIb/IIIa inhibitor

Normal or nondiagnostic changes in ST segment or T wave
Low-/Intermediate-risk ACS

Consider admission to ED chest pain unit or to appropriate bed and follow:
- Serial cardiac markers (including troponin)
- Repeat ECG/continuous ST-segment monitoring
- Consider noninvasive diagnostic test

Develops 1 or more:
- Clinical high-risk features
- Dynamic ECG changes consistent with ischemia
- Troponin elevated

Abnormal diagnostic noninvasive imaging or physiologic testing?

If no evidence of ischemia or infarction by testing, can discharge with follow-up

Reperfusion goals:
Therapy defined by patient and center criteria
- Door-to-balloon inflation (PCI) goal of 90 minutes
- Door-to-needle (fibrinolysis) goal of 30 minutes

Admit to monitored bed
Assess risk status
Continue ASA, heparin, and other therapies as indicated
- ACE inhibitor/ARB
- HMG CoA reductase inhibitor (statin therapy)
Not at high risk: cardiology to risk stratify

Yes

Yes

No

No
Suspected Stroke Algorithm

Identify signs and symptoms of possible stroke
Activate Emergency Response

Critical EMS assessments and actions
- Support ABCs; give oxygen if needed
- Perform prehospital stroke assessment
- Establish time of symptom onset (last normal)
- Triage to stroke center
- Alert hospital
- Check glucose if possible

Immediate general assessment and stabilization
- Assess ABCs, vital signs
- Provide oxygen if hypoxemic
- Obtain IV access and perform laboratory assessments
- Check glucose; treat if indicated
- Perform neurologic screening assessment
- Activate stroke team
- Order emergent CT scan or MRI of brain
- Obtain 12-lead ECG

Immediate neurologic assessment by stroke team or designee
- Review patient history
- Establish time of symptom onset or last known normal
- Perform neurologic examination (NIH Stroke Scale or Canadian Neurological Scale)

Does CT scan show hemorrhage?

No Hemorrhage

Probable acute ischemic stroke; consider fibrinolytic therapy
- Check for fibrinolytic exclusions
- Repeat neurologic exam: are deficits rapidly improving to normal?

Patient remains candidate for fibrinolytic therapy?

Candidate

Review risks/benefits with patient and family;
If acceptable:
- Give rtPA
- No anticoagulants or antiplatelet treatment for
  24 hours

- Begin post-rtPA stroke pathway
- Aggressively monitor:
  - BP per protocol
  - For neurologic deterioration
  - Emergent admission to stroke unit or intensive care unit

Not a Candidate

Consult neurologist or neurosurgeon;
consider transfer if not available

Administer aspirin

Hemorrhage

Consult neurologist or neurosurgeon;
consider transfer if not available

Administer aspirin

Begin stroke or hemorrhage pathway
Admit to stroke unit or intensive care unit

ED Arrival
10 min

ED Arrival
25 min

ED Arrival
45 min

ED Arrival
60 min

Stroke Admission
3 hours