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Advanced Cardiac Life Support (ACLS) Provider Handbook

Presented By:
National Health Care Provider Solutions (NHCPS)

Exclusive Offer Inside!

ACLS

ADVANCED CARDIAC LIFE SUPPORT (ACLS) PROVIDER HANDBOOK

PRESENTED BY:

NATIONAL HEALTH CARE PROVIDER SOLUTIONS (NHCPS)

WRITTEN BY:
DR. KARL "FRITZ" DISQUE

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NOTE FROM THE AUTHOR

Thank you for your purchase of the Advanced Cardiac Life Support (ACLS) Provider Handbook, presented to you by National Health Care Provider Solutions (NHCPS). NHCPS and I are very excited to deliver this invaluable resource to you. We hope it will not only aid you with any upcoming ACLS Certification or Recertification course you have enrolled in, but also that it will serve as a reference you can utilize on a repeated basis thereafter.

Additionally, as a token of our gratitude, we would like to extend an exclusive discount for any Certification or Recertification needs you may have. NHCPS is the premier online provider for Basic Life Support (BLS), Advanced Cardiac Life Support (ACLS), and Pediatric Advanced Life Support (PALS) Certification and Recertification Courses. All of our courses can be completed 100% online, were created by board certified medical professionals, and adhere to the latest American Heart Association standards and guidelines.

To all who have purchased our handbook, we are offering a **15% discount** for all Certification and Recertification Courses provided through our website: www.nhcps.com. To redeem this offer, please search "National Health Care Provider Solutions" in your Internet browser, or follow this link: https://www.nhcps.com/. Select the course(s) needed and on the checkout page, enter the Coupon Code: **ACLSHANDBOOK**. The discount will automatically be added to your total, and will be visible prior to completing your purchase.

If you are already registered for an ACLS Certification or Recertification course, you can still take advantage of this offer. User accounts on our site never expire, so you can purchase your course today, and it will remain in your account until the day you need it.

I sincerely hope you enjoy the ACLS Provider Handbook, and hope it serves as a valuable resource for you. Thank you again for your support, and please continue saving lives! You are an inspiration to all of us at NHCPS.

Sincerely,
Dr. Karl "Fritz" Disque
Co-Founder & Chief Medical Officer of NHCPS

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INTRODUCTION

The goal of Advanced Cardiovascular Life Support (ACLS) is to achieve the best possible outcome for patients who are experiencing a life-threatening cardiac event. ACLS is a series of responses to discrete clinical events. These responses are designed to be simple enough to be committed to memory and recalled under moments of stress. ACLS protocols have been developed from thorough review of basic research, patient case studies, clinical studies, and reflect the consensus opinion of experts in the field. The gold standard in the United States and other countries is the course curriculum published by the American Heart Association (AHA). Approximately every five years the AHA updates the guidelines for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiovascular Care (ECC). The content contained herein is based on the most recent AHA publication on ACLS and will periodically compare old versus new recommendations for a more comprehensive review. [1]

✓ ***IMPORTANT:*** *Refer to the Basic Life Support (BLS) Provider Handbook, presented by NHCPS, for a more comprehensive review of the BLS Survey if warranted. This handbook specifically covers ACLS algorithms and only briefly describes BLS. All ACLS providers are assumed to be able to perform BLS appropriately. While this guide covers BLS basics, it is recommended that ACLS providers be proficient in BLS first.*

While ACLS providers should always be mindful of timeliness, it is important to provide the intervention that most appropriately fits the needs of the patient. Proper utilization of ACLS requires rapid and accurate assessment of the patient's condition. This not only applies to the provider's initial assessment of a patient in distress, but also to reassessment throughout the course of treatment with ACLS.

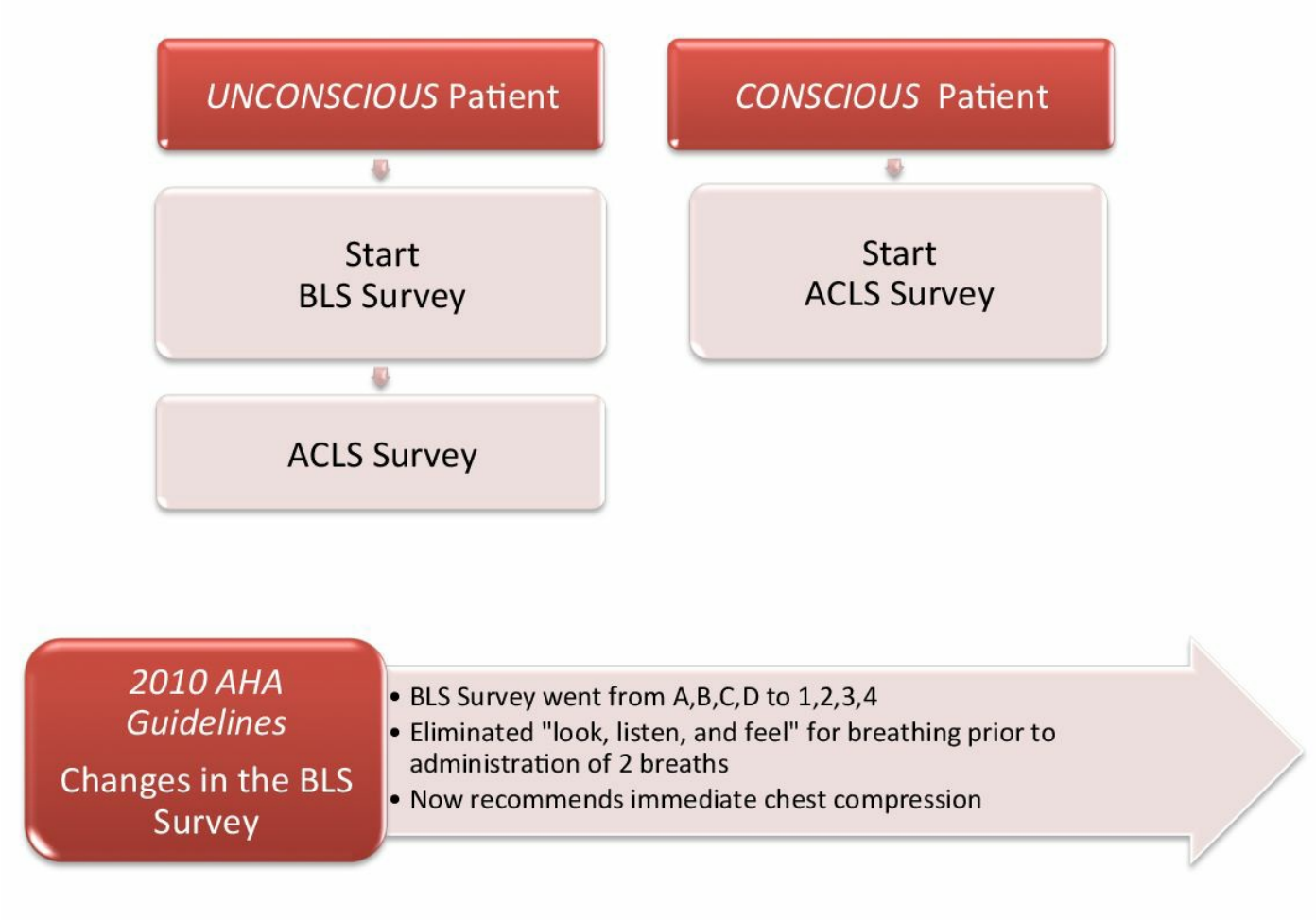
ACLS protocols assume the provider may not have all of the information needed from the victim and resources needed to properly utilize ACLS in all cases. For example, if a provider is utilizing ACLS on the side of the road, they will not have access to sophisticated devices to measure breathing or arterial blood pressure. In these situations, ACLS providers have the framework to provide the best possible care in the given circumstances. Again, the algorithms are based on past performance in similar life-threatening cases and are intended to achieve the best possible outcome for the patient during emergency. The foundation of all algorithms involve the systematic approach of the BLS Survey (using steps 1, 2, 3, 4) and the ACLS Survey (using steps A, B, C, D).

[1]American Heart Association. Advanced Cardiovascular Life Support Provider Manual. AHA: 2011; p 183.

THE FIRST ASSESSMENT

Determining whether a patient is conscious or unconscious can be done very quickly. If you notice a person looks like they are in distress, you find them lying down in a public place, or you think they might be injured, call out to them.

- ***When encountering a person who is "down," the first assessment to make is whether the patient is conscious or unconscious.***
- ***Make sure the scene is safe before conducting the BLS or ACLS Survey.***



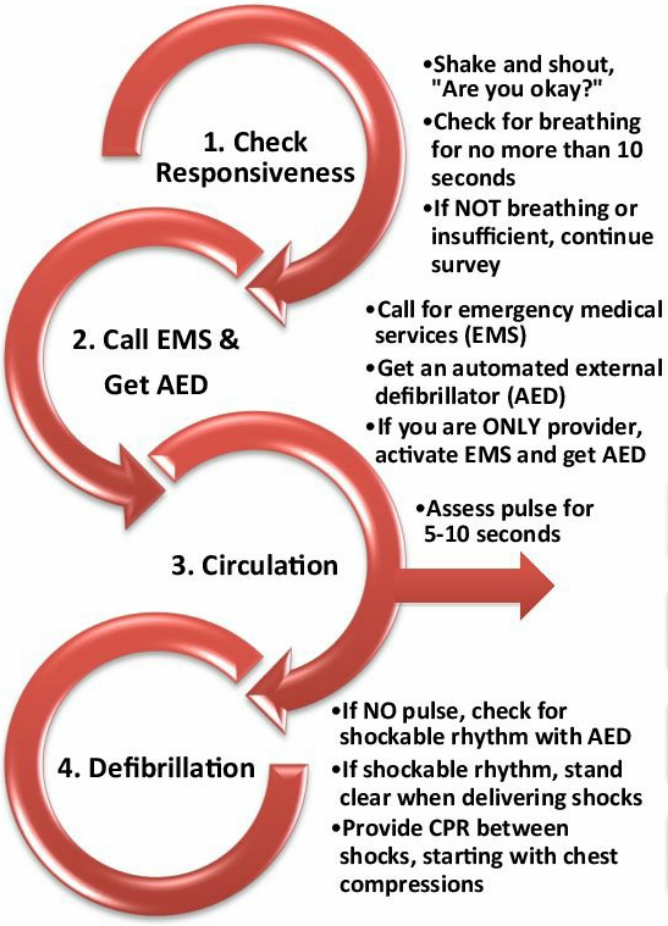
BASIC LIFE SUPPORT

THE BLS SURVEY (1-2-3-4)

Basic Life Support (BLS) utilizes Cardiopulmonary Resuscitation (CPR) and cardiac defibrillation. Both of these can be performed anywhere an Automated External Defibrillator (AED) is available. AEDs can be found in an increasing number of public places ranging from airports to grocery stores. The BLS Survey uses a systematic approach of assessment followed by appropriate action, focusing on early CPR as well as defibrillation. It does not involve advanced interventions, such as advanced airway devices or cardiovascular medications. BLS can be learned and used by everyone, not just health care professionals. BLS is usually the life support method used outside of hospitals when there is limited access to medications and monitors. In general, BLS is performed until EMS arrives and/or ACLS begins.

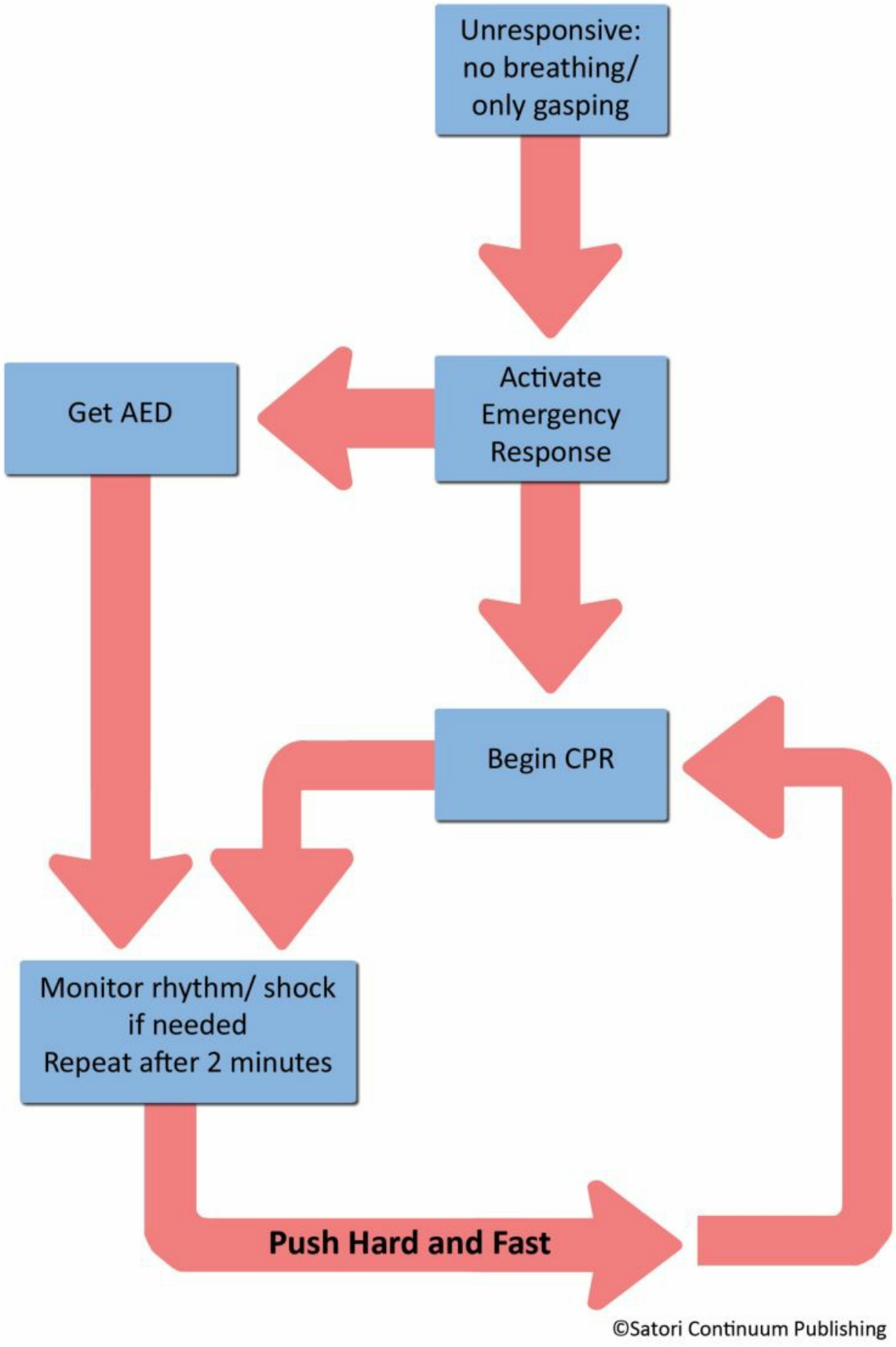
- ✓ ***BLS Survey focuses on early CPR and early defibrillation.***
- ✓ ***Remember assess then perform appropriate action.***

BLS Survey



PULSE	NO PULSE
Start rescue breathing	Start CPR
ONE breath every 5-6 seconds 10-12 breaths every minute	AT LEAST 30 compressions per 2 breaths
Check pulse every 2 minutes	AT LEAST 100 compressions per minute

Simple Adult BLS Algorithm



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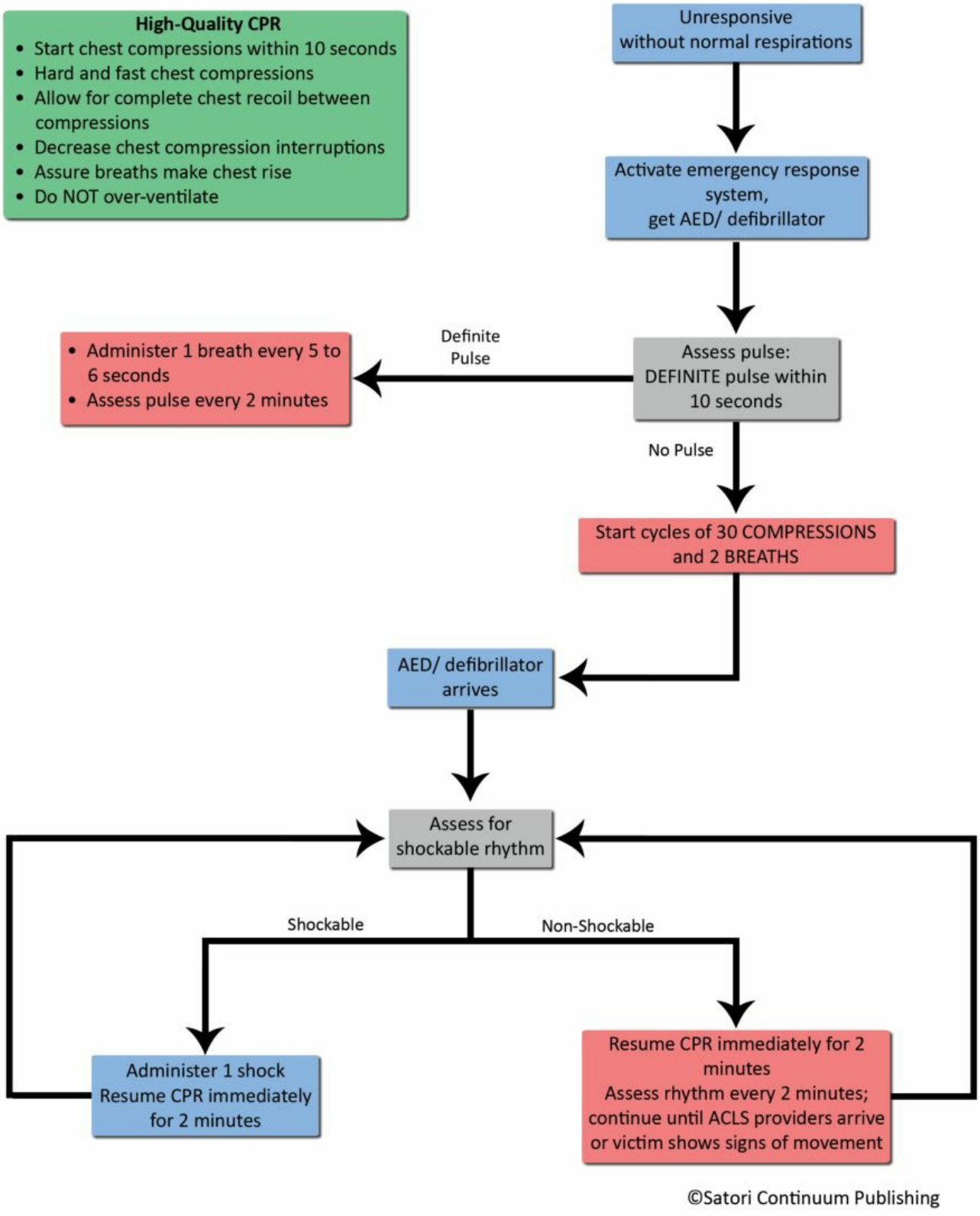
Adult BLS Algorithm



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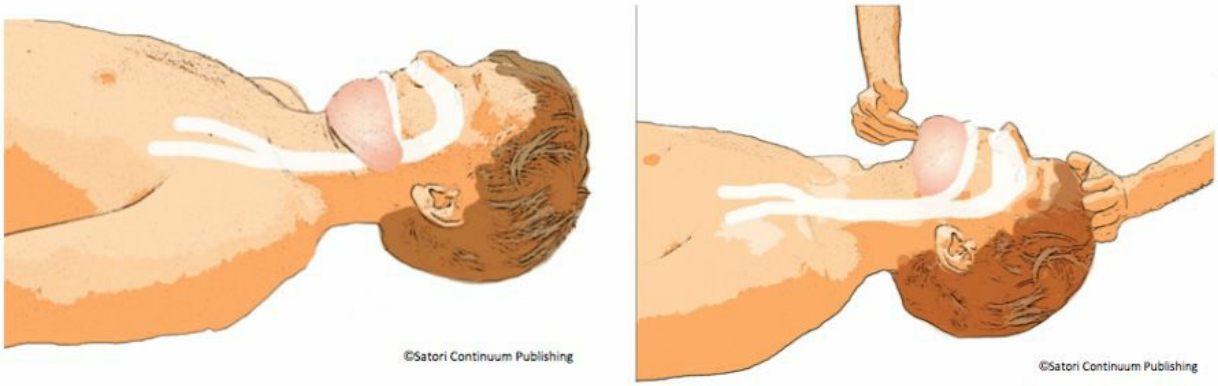
ONE-RESCUER ADULT BLS/CPR

FIGURE 1: ADULT CPR

1. Check for the carotid pulse on the side of the neck. Remember not to waste time trying to feel for a pulse; feel for NO MORE THAN 10 seconds. If you are not sure you feel a pulse, begin CPR with a cycle of 30 chest compressions and two breaths.
2. Use the heel of one hand on the lower half of the sternum in the middle of the chest.
3. Put your other hand on top of the first hand.

4. Straighten your arms and press straight down. Compressions should be AT LEAST two inches into the victim's chest and a rate of AT LEAST 100 per minute.
5. Stop pressing and let the chest expand after each compression - this will allow the blood back into the heart.
6. After 30 compressions, stop compressions and open the airway by tilting the head and lifting the chin.
    1. Put your hand on the victim's forehead and tilt the head back.
    2. Lift the victim's jaw by placing your index and middle fingers on the lower jaw; lift up.
    3. Do not perform head tilt/chin lift if you suspect the victim may have a neck injury.



7. Give a breath while watching the chest rise. Repeat while giving a second breath.
8. Begin compressions.

TWO-RESCUER ADULT BLS/CPR

Many times, there will be a second person available that can act as a second team member. Send this person to call EMS and find an AED while you begin CPR. When the second rescuer returns, the CPR tasks can be shared:

1. Have the second rescuer prepare the AED for use.
2. Begin chest compressions and count the compressions aloud.
3. The second rescuer should apply the AED pads.
4. The second rescuer should open the victim's airway and give rescue breaths.
5. Switch positions after every five cycles of compressions and breaths.
6. When the AED is connected, minimize interruptions of CPR by switching rescuers while the AED analyzes the heart rhythm.

ADULT MOUTH-TO-MASK VENTILATION

In one-rescuer CPR, breaths should be supplied using a pocket mask.

1. Give 30 high-quality compressions.
2. Seal the mask against the victim's face by placing four fingers of one hand across the top of the mask and the thumb of the other hand along the bottom edge of the mask.
3. Using the fingers of your hand on the bottom of the mask, open the airway using a head tilt/chin lift (do not do this if you suspect the victim may have a neck injury).
4. Press firmly around the edges of the mask and ventilate over 1 second as you watch the victim's chest rise.

ADULT BAG-MASK VENTILATION IN TWO-RESCUER CPR

If two people are available and you have a bag-mask device, the second rescuer should be at the victim's head while you do high-quality chest compressions.

1. Do 30 high-quality compressions saying the numbers aloud.
2. The second team member holds the mask with one hand using the thumb and index finger in the shape of a "C" on one side of the mask. Form a seal between the mask and the face while the other fingers open the airway by lifting the victim's lower jaw.
3. The second team member gives two breaths over one second each.

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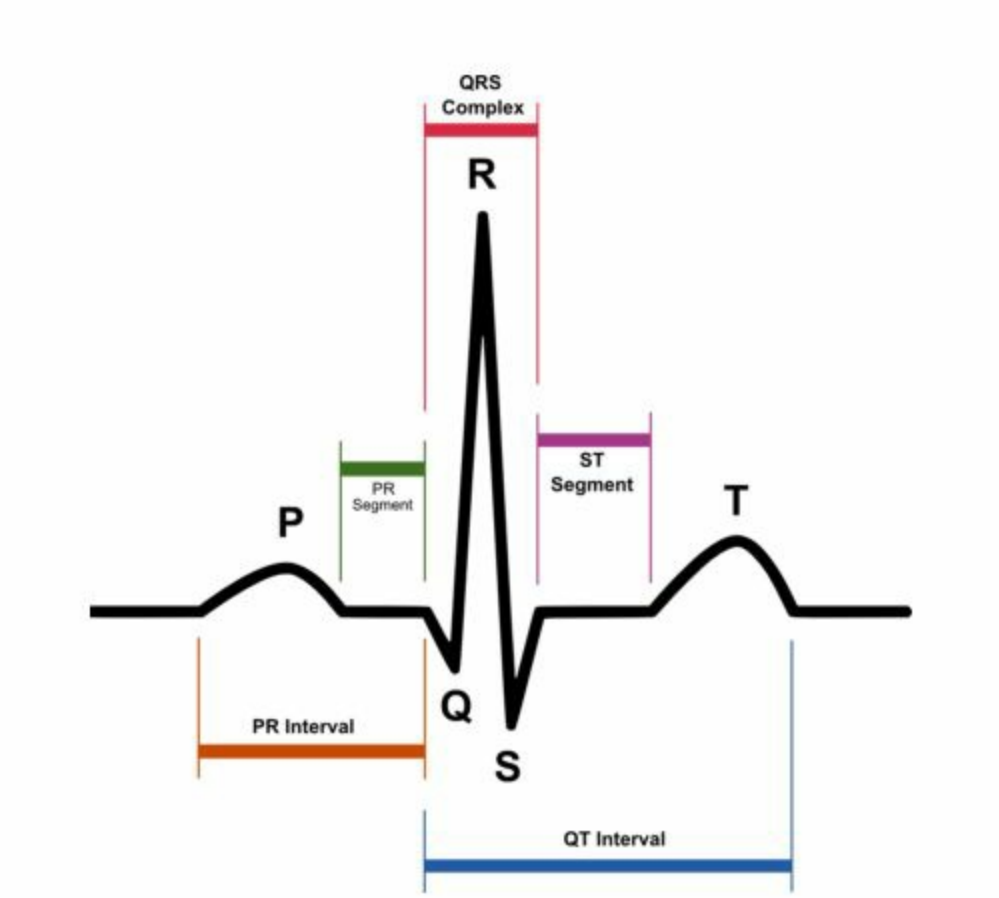
ADVANCED CARDIAC LIFE SUPPORT

NORMAL HEART ANATOMY AND PHYSILOGY



Understanding the hearts normal anatomy and physiology is an important component to interpreting and performing Advanced Cardiac Life Support (ACLS). The heart is a hollow muscle comprised of four chambers delineated by thick walls of tissue (**septum**). The **atria** are the two upper chambers whereas the **ventricles** are the two lower chambers. The left and right halves of the heart work together to pump blood throughout the body. The right atrium (RA) and right ventricle (RV) pump deoxygenated blood to the lungs to be oxygenated after which the left atrium (LA) and left ventricle (LV) receive then pump the newly oxygenated blood throughout the rest of the body. Valves between each pair of connected chambers prevent reverse blood flow. The two atria contract simultaneously, as do the ventricles, making the contractions of the heart go from top to bottom. Each beat begins in the RA. The LV is the largest and thickest-walled of the four chambers, as it is responsible for pumping the newly oxygenated blood to the rest of the body. The **sinoatrial node** (SA node) in the RA creates the strong and organized rhythm of electrical activity for the rest of the cardiac cells to follow. This pulse then carries to the **atrioventricular node** (AV node), which is between the atria and ventricles. After remaining there briefly, it moves on to the **Purkinje system**, which is the group of cells that branches into the LV and RV stimulating them to contract and pump blood.

By comprehending the normal electrical pathways in the heart, it will be easier to detect sudden abnormal functions. When blood enters the atria of the heart, an electrical impulse is sent out from the SA node that conducts through the atria resulting in *atrial contraction*. This atrial contraction registers on an ECG strip as the **P wave**. This impulse then travels to the AV node, which in turn sends out an electrical impulse that travels through the Bundle of His, bundle branches, and through the Purkinje fibers of the ventricles resulting in ventricular contraction. The *time between atrial and ventricular contraction* registers on an ECG strip as the **PR interval**. The *ventricular contraction* registers on the ECG strip as the **QRS complex**. Following ventricular contraction, the *ventricles rest and repolarize*, which is registered on the ECG strip as the **T wave**. The atria repolarize also, but this coincides with the QRS complex and therefore cannot be observed on the ECG strip. Together a P wave, QRS complex, and T wave are indicative of **Normal Sinus Rhythm** (NSR).

THE ACLS SURVEY (A - B - C - D)

AIRWAY

Monitor and maintain an open airway at all times. The provider must decide if the benefit of adding an advanced airway is worth the risk of pausing CPR. If the victim's chest is rising without using an advanced airway, continue giving CPR without pausing. However, if you are in a hospital or near trained professionals who can insert and use the airway, consider pausing CPR.

BREATHING

In cardiac arrest, administer 100% oxygen. Keep blood O_2 sats $\geq$ 94% measured by a pulse oximeter. Use quantitative waveform capnography when possible. Normal partial pressure of CO_2 is between 35 and 40 mmHg, but the target during CPR is above 10 mmHg.

CIRCULATION

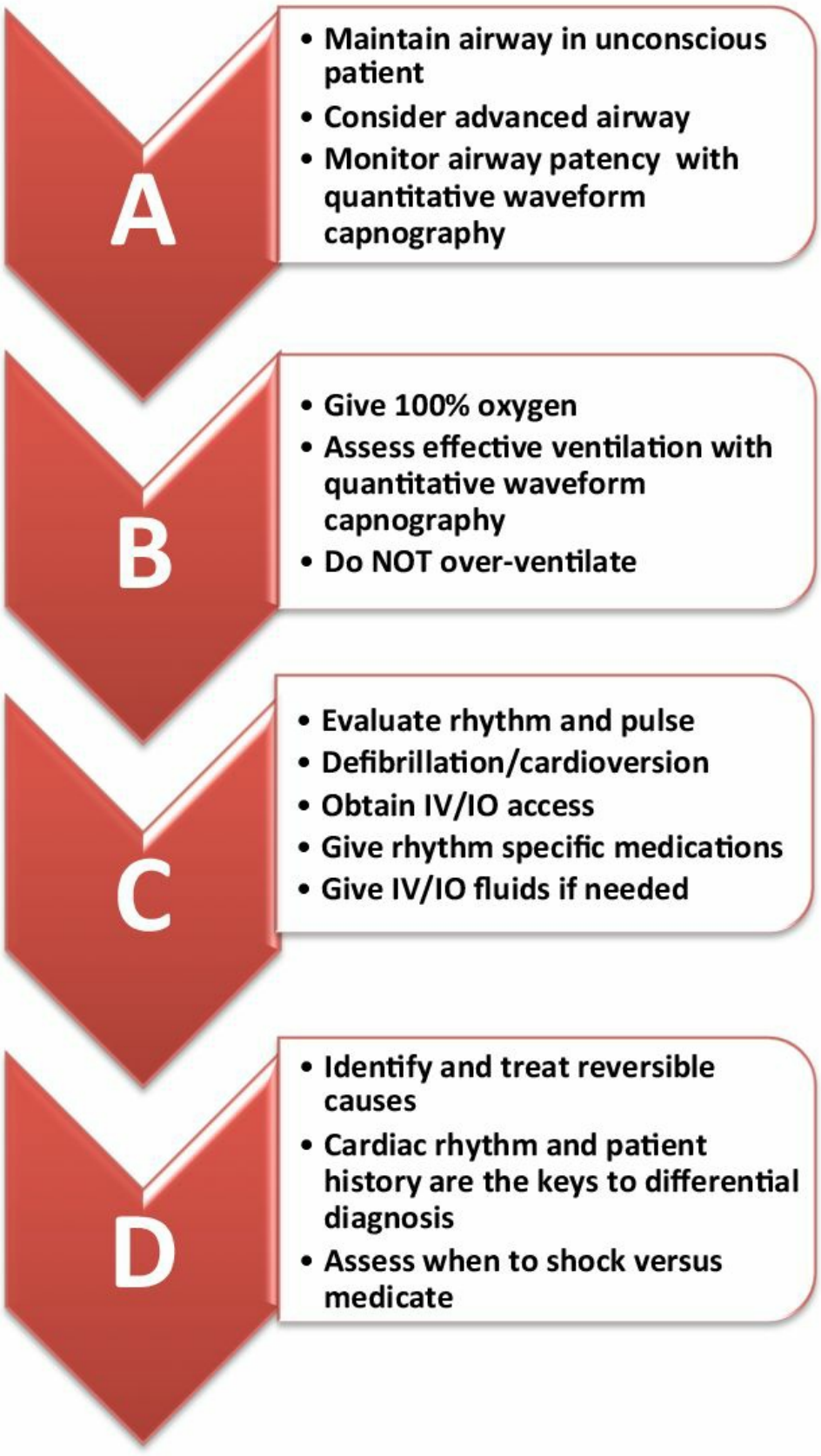
Obtain intravenous (IV) access when possible; intraosseus (IO) is also acceptable. Monitor blood pressure with a blood pressure cuff or intra-arterial line if available. Monitor the heart rhythm using pads. When using an AED, follow the directions (i.e.,

shock a shockable rhythm). Give fluids when appropriate. Use cardiovascular medications when indicated.

DIFFERENTIAL DIAGNOSIS

Start with the most likely cause of the arrest and then assess for less likely causes. Treat reversible causes and remember to continue CPR as you create a differential diagnosis. Stop only briefly to confirm a diagnosis or to treat reversible causes.

ACLS Survey


A
• Maintain airway in unconscious patient
• Consider advanced airway
• Monitor airway patency with quantitative waveform capnography
B
• Give 100% oxygen
• Assess effective ventilation with quantitative waveform capnography
• Do NOT over-ventilate
C
• Evaluate rhythm and pulse
• Defibrillation/cardioversion
• Obtain IV/IO access
• Give rhythm specific medications
• Give IV/IO fluids if needed
D
• Identify and treat reversible causes
• Cardiac rhythm and patient history are the keys to differential diagnosis
• Assess when to shock versus medicate

AIRWAY MANAGEMENT

If bag-mask ventilation is adequate, providers may defer insertion of an advanced airway. Health care providers should make the decision as to the appropriateness of placement an advanced airway during the ACLS Survey.

Basic airway equipment includes the oropharyngeal airway (OPA) and the nasopharyngeal airway (NPA). The primary difference between an OPA (Figure 2) and a NPA (Figure 3) is that an OPA is placed in the mouth (Figure 4), while a NPA is inserted through the nose (Figure 5). Both terminate in the pharynx. The main advantage of an NPA over an OPA is that it can be used in either conscious or unconscious patients because the device does not stimulate the gag reflex.

Advanced airway equipment includes the laryngeal mask airway, laryngeal tube, esophageal-tracheal tube, and endotracheal tube. If it is within your scope of practice, you may use advanced airway equipment when appropriate and available.

Figure 2

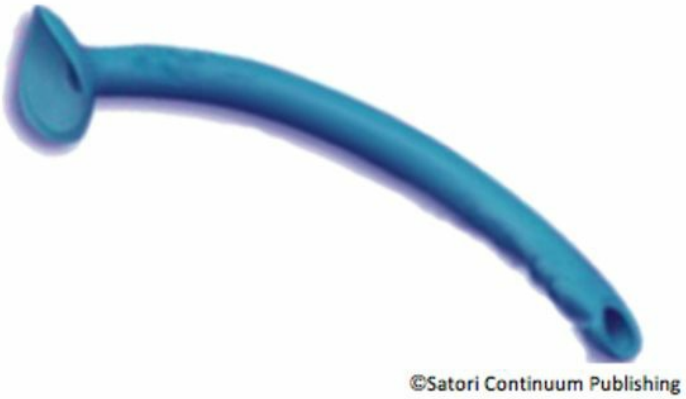


Figure 3

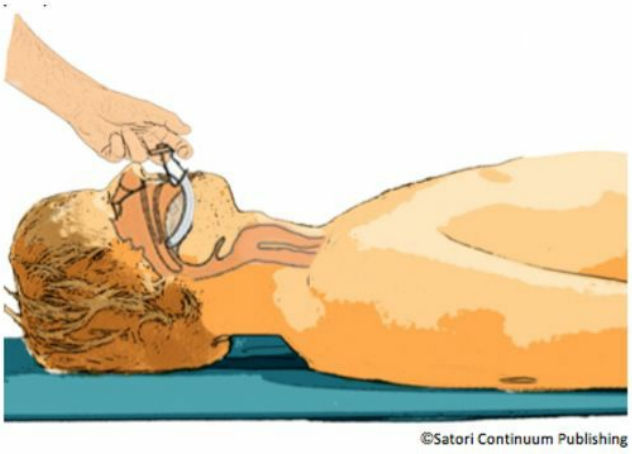


Figure 4

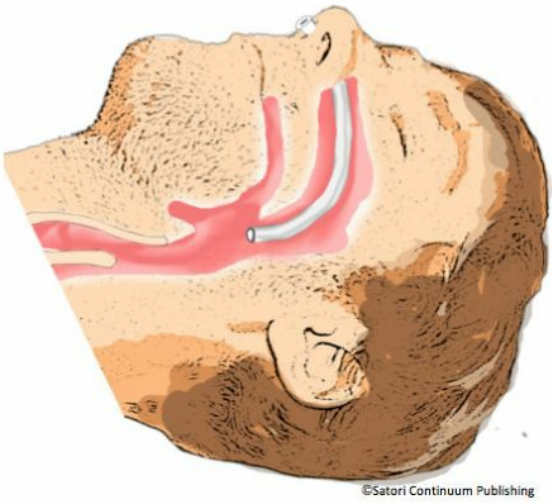


Figure 5

BASIC AIRWAY ADJUNCTS

OROPHARYNGEAL AIRWAY (OPA)

The OPA is used in patients who are at risk for developing airway obstruction from the tongue or from relaxed upper airway muscle. This J-shaped device fits over the tongue to hold it and the soft hypopharyngeal structures away from the posterior wall of the pharynx.

The OPA is used in unconscious patients if efforts to open the airway fail to provide and maintain a clear, unobstructed airway. An OPA should not be used in a conscious or

semiconscious patient because it may stimulate gagging and vomiting. The key assessment is to check whether the patient has an intact cough and gag reflex. If so, do NOT use an OPA. A properly sized and inserted OPA results in proper alignment with the glottis opening.

NASOPHARYNEGEAL AIRWAY (NPA)

The NPA is used as an alternative to an OPA in patients who need a basic airway management adjunct. The NPA is a soft rubber or plastic uncuffed tube that provides a conduit for airflow between the nares and the pharynx.

Unlike the oral airway, NPAs may be used in conscious or semiconscious patients (patients with intact cough and gag reflex). The NPA is indicated when insertion of an OPA is technically difficult or dangerous.

SUCTIONING

Suctioning is an essential component of maintaining a patient's airway. Providers should suction the airway immediately if there are copious secretions, blood, or vomit. Attempts at suctioning should not exceed 10 seconds. To avoid hypoxemia, follow suctioning attempts with a short period of 100% oxygen administration.

Monitor the patient's heart rate, pulse oxygen saturation, and clinical appearance during suctioning. If a change in monitoring parameters is seen, interrupt suctioning and administer oxygen until the heart rate returns to normal and clinical condition improves. Assist ventilation as warranted.

- ✓ ***Only use OPA in unresponsive patients with NO cough or gag reflex. Otherwise, OPA may stimulate vomiting and laryngeal spasm.***

- ✓ ***NPAs may be used in conscious patients with intact cough and gag reflex. However, use carefully in patients with facial trauma because of risk of displacement.***

- ✓ ***Remember patient is not receiving 100% oxygen while suctioning. Interrupt suctioning and administer oxygen if any change in monitoring parameters is witnessed during suctioning.***

BASIC AIRWAY TECHNIQUE

INSERTING AN OROPHARYNGEAL AIRWAY (OPA)

- If possible, clear the mouth of blood or secretions with suction.
- Select an airway device that is the correct size for the patient.
  - Too large of an airway can damage the throat.
  - Too small of an airway can press the tongue into the airway.
- Place the device at the side of the patient's face. Choose the device that extends from **the corner of the mouth to the earlobe.**
- Insert the device so the point is toward the roof of the mouth or parallel to the teeth.
  - DO NOT press the tongue back into the throat.
- Once the device is almost fully inserted, turn it until the tongue is cupped by the interior curve of the device.

INSERTING A NASOPHARYNGEAL AIRWAY (NPA)

- Select an airway device that is the correct size for the patient.
- Place the device at the side of the patient's face. Choose the device that extends from the **tip of the nose to the earlobe**. Use the largest diameter device that will fit.
- Lubricate the airway with a water-soluble lubricant or anesthetic jelly.
- Insert the device slowly, moving straight into the face (not towards the brain).
- It should feel snug; do not force the device. If it feels stuck, remove it and try the other nostril.

TIPS ON SUCTIONING

- When suctioning the oropharynx, do not insert the catheter too deeply. Extend the catheter to the maximum safe depth and suction as you withdraw.
- When suctioning an endotracheal tube, remember the tube is within the trachea and you maybe near the bronchi/lung. Therefore sterile technique should be used.
- Each suction attempt should be for no longer than 10 seconds. **Remember the patient will not oxygen during suctioning.**
- Monitor vital signs during suctioning and stop suctioning immediately if the patient experiences hypoxemia (0_2 sats <94%), has a new arrhythmia, or becomes cyanotic.
- A rigid catheter (also referred to as "Yankauer") provides the most effective suctioning of the oropharynx and thick particulate matter.

✓ ***OPAs too large or too small may obstruct the airway.***

✓ ***NPAs sized incorrectly may enter the esophagus.***

✓ ***Always check for spontaneous respirations after insertion of both.***

ADVANCED AIRWAY ADJUNCTS

LARYNGEAL MASK AIRWAY (LMA)

The laryngeal mask airway is an advanced airway alternative to endotracheal intubation and provides comparable ventilation. It is acceptable to use the laryngeal mask airway as an alternative to an esophageal-tracheal tube for airway management in cardiac arrest.

LARYNGEAL TUBE

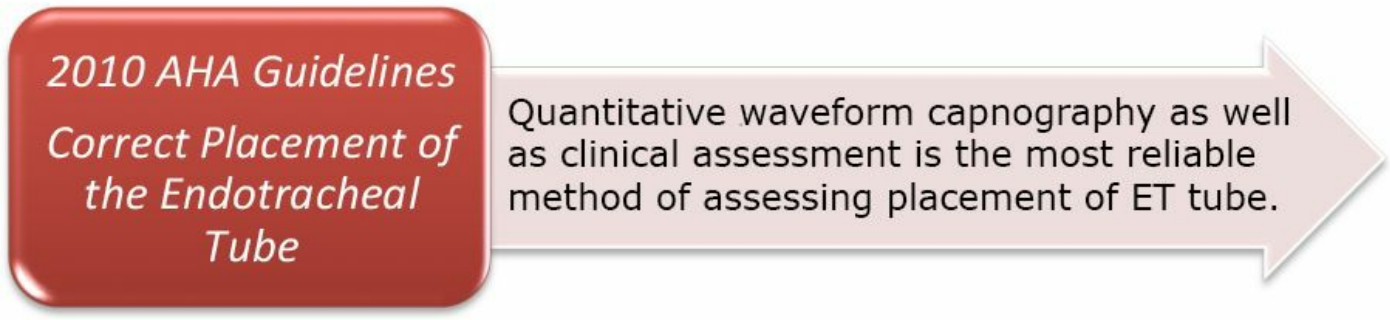
The advantages of the laryngeal tube are similar to those of the esophageal-tracheal tube; however, the laryngeal tube is more compact and less complicated to insert.

ESOPHAGEAL-TRACHEAL TUBE (COMBITUBE)

The esophageal-tracheal tube (sometimes referred to as a "combitube") is an advanced airway alternative to endotracheal intubation. This device provides adequate ventilation comparable to an endotracheal tube.

ENDOTRACHEAL TUBE (ET)

The endotracheal tube is an advanced airway alternative to all other airways listed. It is a specific type of tracheal tube that is inserted through the mouth or nose. It is the most technically difficult airway to place, however the most secure airway available. Only experienced providers should perform endotracheal intubation.



- ✓ ***During CPR, the chest compression to ventilation ratio is 30:2.***
- ✓ ***If advanced airway is placed, no need to interrupt chest compressions for breaths. Give 1 breath every 6 - 8 seconds.***

ROUTES OF ACCESS

Historically in ACLS, providers have administered drugs via the IV or ET route. ET absorption of drugs is poor and optimal drug dosing is not known. For this reason, the intraosseous route is now preferred when intravenous access is not available. Priorities for vascular access are:

INTRAVENOUS ROUTE (IV) A peripheral IV is preferred for drug and fluid administration unless central line access is already available. Central line access is not necessary during most resuscitation attempts, as it may cause interruptions in CPR and complications during insertion. Placing a peripheral line does not require CPR interruption.

If a drug is given via peripheral route of administration, give as follows:

1. IV push bolus injection (unless told otherwise)
2. Flush with 20 mL of fluid/saline
3. Raise extremity for 10-20 seconds to enhance delivery of drug to circulation

INTRAOSSEOUS ROUTE (IO) Drugs and fluids during resuscitation can be delivered safely and effectively via the IO route if IV access is not available.

Key points to IO access includes:

1. Used for all age groups
2. Can be placed in less than one minute
3. More predictable absorption than endotracheal route

✓ ***When using peripheral IV route of administration, drugs can take up to 2 minutes or more to reach central circulation.***

✓ ***Any ACLS drug or fluid administered IV can be given IO.***

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PHARMACOLOGICAL TOOLS

Use of any of the following medications should be done within your scope of practice and after thorough study of the actions and side effects. This table only provides a brief reminder for those who are already knowledgeable in the use of these medications. Moreover, the table contains only adult doses for the most common ACLS indication and route of administration (IV/IO).

DRUG	MAIN ACLS USE	DOSE/ROUTE	NOTES
Adenosine	• Narrow PSVT/SVT • Wide QRS Tachy	• 6 mg IV over 1-3 seconds followed by 12 mg in 1-2 min	• Rapid IV push close to the hub followed by a saline bolus • Continuous cardiac monitoring during administration
Amiodarone	• V-Fib/pulseless VT • VT with pulse • Tachy rate control	• VF/VT: 300 mg dilute in 20-30 mL, may repeat 150 mg in 3-5 min • Tachy: 150 mg IV push dilute in 100 mL and give over 8-10 mins, may repeat in 10min • Dysrhythmia: 360 mg IV drip over 6 hrs. (1 mg/min) and then 560 mg IV over 18 hours (0.5 mg/min)	• Expect hypotension, bradycardia, and gastrointestinal toxicity • Continuous cardiac monitoring • Very long half life (up to 40 days) • Do not use in 2nd or 3rd degree heart block • Do not administer via the ET tube route
Magnesium Sulfate	• Cardiac Arrest/pulseless Torsades	• Cardiac Arrest: 1-2 gm diluted in 10 mL D5W IVP	• Cardiac and BP monitoring • Rapid bolus may cause hypotension and bradycardia • Use with caution in renal failure
	• Torsades de	• If not Cardiac Arrest: 1-2 gm IV	

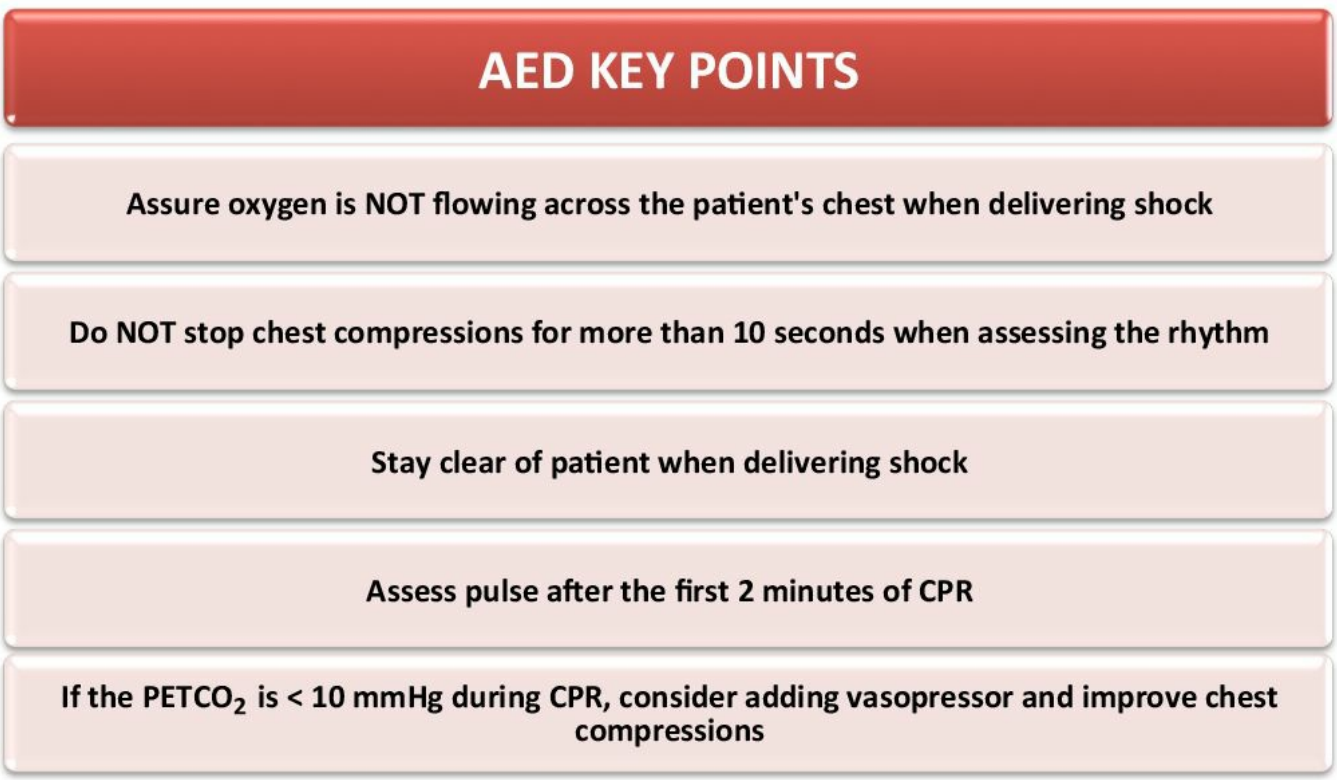
	Pointes with pulse	over 5-60 min Maintain: 0.5-1 gm/hr IV	• Calcium chloride can reverse hypermagnesemia
Procainamide	• Wide QRS Tachycardia • Preferred for VT with • pulse (stable)	• 20-50 mg/min IV until rhythm improves, hypotension occurs, QRS widens by 50% or MAX dose given • MAX: 17 mg/kg • Drip = 1-2 gm in 250-500 mL at 1-4 mg/min	• Cardiac and BP monitoring • Caution with acute MI • May reduce dose with renal failure • Do not give with amiodarone • Do not use in prolonged QT or CHF
Sotalol	• Tachyarrhythmia • Monomorphic VT • 3rd line anti-arrhythmic	• 100 mg (1.5 mg/kg) IV over 5 min	• Do not use in prolonged QT
Lidocaine	• Cardiac Arrest (VF/VT)	• Initial: 1-1.5 mg/kg IV loading • Second: Half of first dose in 5-10 min • Maintain: 1-4 mg/min	• Cardiac and BP monitoring • Do not use in wide complex bradycardia • May cause seizures
	• Wide Complex Tachycardia with Pulse	• Initial: 0.5-1.5 mg/kg IV • Second: Half of first dose in 5-10 min • Maintain: 1-4	

		mg/min	
Atropine	• Symptomatic Bradycardia	• 0.5 mg IV/ETT every 3-5 minutes • Max: 3 mg	• Cardiac and BP monitoring • Do not use in glaucoma or tachyarrhythmias • Minimum dose 0.5 mg
	• Toxins/overdose	• 2-4 mg IV/ETT may be needed	
Dopamine	• Shock/CHF	• 2-20 mcg/kg/minute • Titrate to desired blood pressure	• Fluid resuscitation first • Cardiac and BP monitoring
Epinephrine	• Cardiac Arrest	• nitial: 1.0 mg (1:10000) IV or 2-2.5 mg (1:1000) ETT every 3-5 mins • Maintain: 0.1-0.5 mcg/kg/min Titrate to desire blood pressure	• Continuous cardiac monitoring • Distinguish between 1:1000 and 1:10000 concentrations • Give via central line when possible
	• Anaphylaxis	• 500 mcg IM • Repeat every 5 mins as needed	
	• Symptomatic	• 2-10 mcg/minute infusion	

	bradycardia/Shock	• Titrate to response	
Vasopressin	• Cardiac Arrest	• 40 units IV as replacement for 2nd or 3rd dose of epinephrine	• Monitor BP and distal pulses • Give via central line when possible
	• Shock	• 0.02-0.04 units/minute IV	

PRINCIPLES OF EARLY DEFIBRILLATION

The earlier defibrillation occurs, the higher the survival rate. When a fatal arrhythmia is present, CPR can provide a small amount of blood flow to the heart and brain, but cannot directly restore an organized rhythm. The likelihood of restoring a perfusing rhythm is optimized with immediate CPR and defibrillation. The purpose of defibrillation is to stun the heart and allow its normal pacemakers to resume electrical activity.



DELIVERING SHOCK

The appropriate energy dose is determined by the identity of the defibrillator - monophasic or biphasic. If you are using a monophasic defibrillator, give a single 360J shock. Use the same energy dose on subsequent shocks.

Biphasic defibrillators use a variety of waveforms, each of which is effective for terminating a fatal arrhythmia over a specific dose range. When using biphasic defibrillators, providers should use the manufacturer's recommended energy dose. Many biphasic defibrillator manufacturers display the effective energy dose range on the face of the device.

To minimize interruptions in chest compressions during CPR, continue CPR while the defibrillator is charging. Immediately after the shock, resume CPR, beginning with chest compressions. Give CPR for 2 minutes (approximately 5 cycles). A cycle consists of 30 compressions followed by 2 ventilations for a patient without an advanced airway.

KEYS TO USING AN AUTOMATED EXTERNAL DEFIBRILLATOR (AED)

If you look around the public places you visit, you are likely to find an AED. An AED is both sophisticated and easy to use, providing lifesaving power in a user-friendly device. This makes the devise useful for people who have never opened one and for anyone in stressful scenarios. However, proper use of an AED is very important.

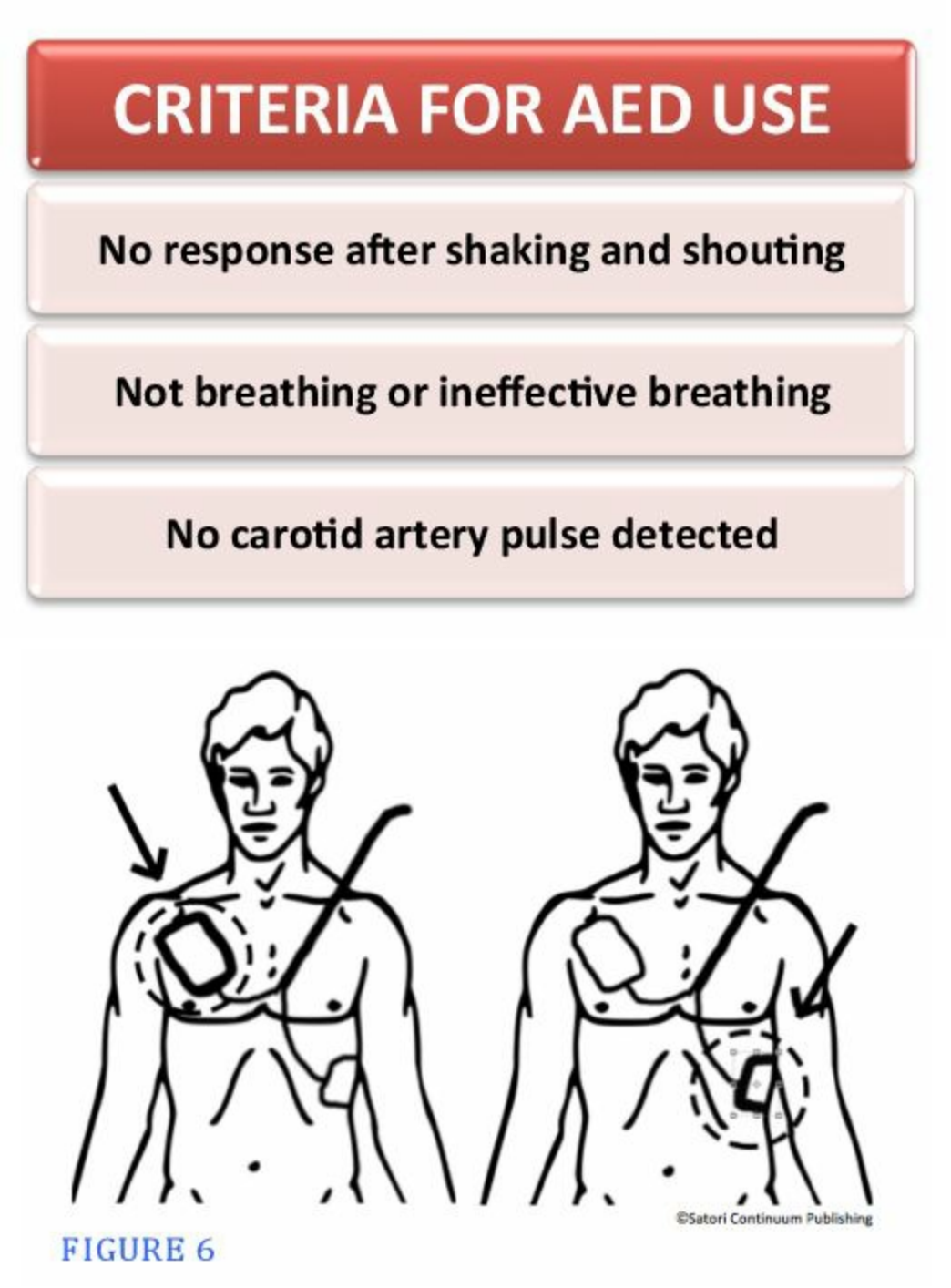


FIGURE 6

Attach the pads to the upper right side and left side of the patient's chest (Figure 6). Once pads are attached correctly, the device will read the patient's heart rhythm. If the pads are not attached appropriately, the device will indicate through prompts. Once the rhythm is detected, the device will give you the ability to "shock" the patient if the

rhythm is one that is "shockable." Remember, a "shock" does not restart the heart, but is meant to defibrillate. In other words, the shock is intended to reset the heart's abnormal electrical activity into a normal rhythm.

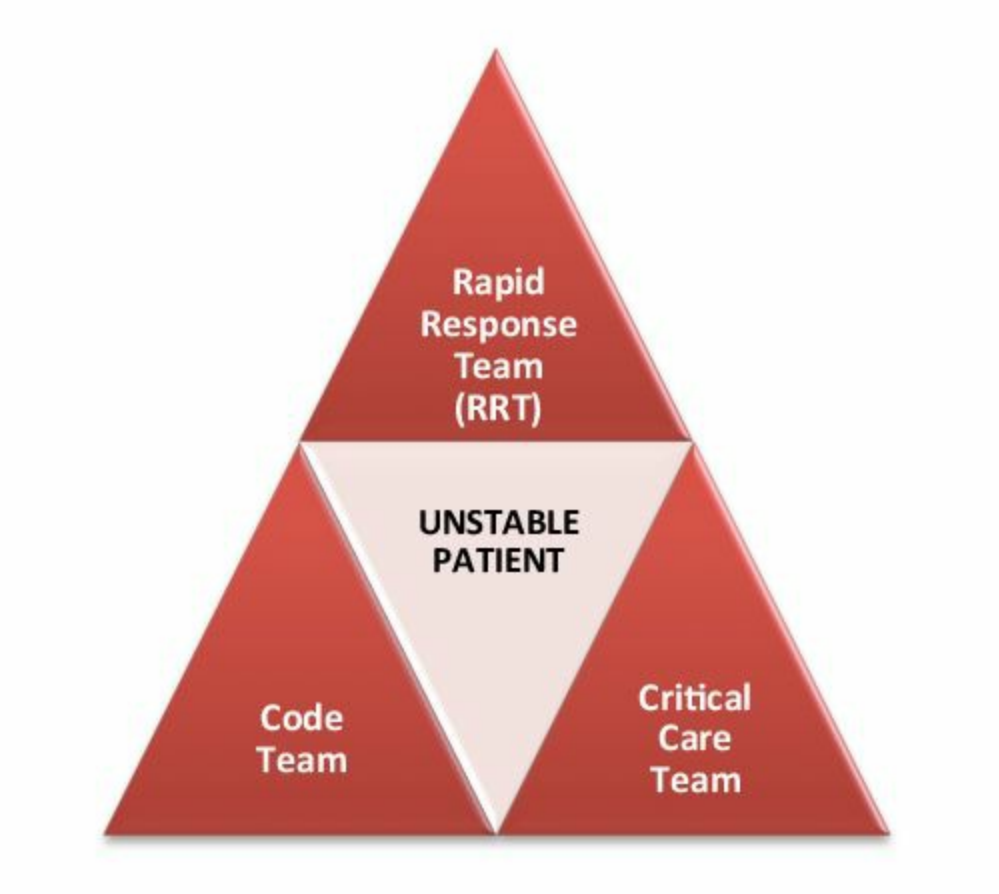
- ✓ ***If the AED is not working properly, continue giving CPR. Do NOT waste excessive time troubleshooting the AED. CPR always comes FIRST - AEDs are supplemental.***

- ✓ ***Do NOT use AED in water.***

- ✓ ***AED is NOT contraindicated in patients with implanted defibrillator/pacemaker, however do not place pad directly over.***

SYSTEMS OF CARE

The 2010 AHA Guidelines describe Systems of Care as a separate and important part of ACLS provider training. These Systems of Care describe the organization of professionals most often necessary to achieve the best possible result for a given patient's circumstances. They include an overview of the ways lifesaving interventions should be organized to ensure they are delivered efficiently and effectively. Hospitals, EMS staff, and communities that follow comprehensive Systems of Care demonstrate better outcomes for their patients than those who do not.



✓ ***Management of life threatening emergencies requires this integration of a multidisciplinary team that can involve Rapid Response Teams (RRT), cardiac arrest teams, and intensive care specialists to increase patient survival rates.***

CARDIOPULMONARY RESUSCITATION

Successful CPR requires the use of a CPR System of Care (shown below). As with a metal chain, it is only as strong as its weakest link. Thus, people who may need to perform CPR one day should strive to make sure each link is strong. For instance, community leaders can work to increase awareness of the signs and symptoms of cardiac arrest and make AEDs available in public places. EMS crews must stay abreast of updates and innovations in resuscitation and hone the skills required to deliver CPR quickly and effectively. Hospitals should be ready to receive patients in cardiac arrest and provide excellent care. Critical care and reperfusion centers should be at a constant state of readiness. The success of these efforts can be measured objectively, by self-rating and quality improvement metrics, or through benchmarking efforts like Cardiac Arrest Registry to Enhance Survival (CARES) and Get with the Guidelines®.

POST-CARDIAC ARREST CARE

Integrated post-cardiac arrest care is the last link in the Chain of Survival. The quality of this care is critical to providing resuscitated patients with the best possible results. When the interventions below are provided there is an increased likelihood of survival.

THERAPEUTIC HYPOTHERMIA

- Recommended for comatose patients with return of spontaneous circulation after a cardiac arrest event.
- Patients should be cooled to 89.6 to 93.2º F for 12-24 hours

OPTIMIZATION OF HEMODYNAMICS AND VENTILATION

- 100% oxygen is acceptable for early intervention, but not for extended periods of time.
- Oxygen should be titrated so that patient pulse oximetry is >94% to avoid O_2 toxicity.
- Do NOT over-ventilate to avoid potential adverse hemodynamic effects.
- Ventilation rates of 10-12 breaths per minute to achieve $PETCO_2$ at 35-40 mmHg.
- Fluids and vasoactive medications should be titrated as warranted.

PERCUTANEOUS CORONARY INTERVENTION (PCI)

- PCI is preferred over thrombolytics.
- Patient should be taken by EMS directly to hospital that performs PCI.
- If the patient is delivered to a center that only delivers thrombolytics, the patient should be transferred to a center that offers PCI if time permits.

GLUCOSE CONTROL

- Optimal blood glucose is 144-180 mg/dL in patients with ROSC after cardiac arrest.
- This is higher than standard levels to improve glucose deliver to tissues and avoid hypoglycemia.

NEUROLOGICAL CARE

Neurology assessment is key, especially when withdrawing care (i.e., brain death) to decrease false positive

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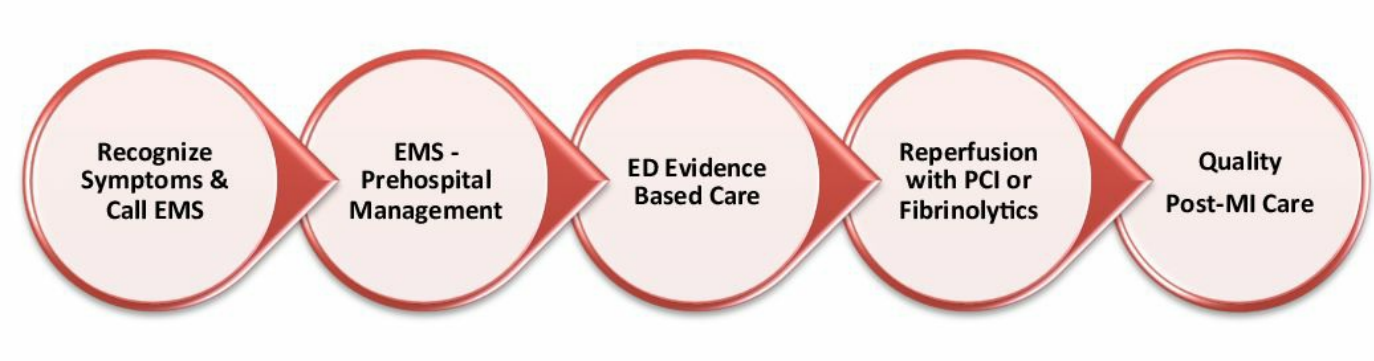
ACUTE CORONARY SYNDROME

For patients with Acute Coronary Syndrome (ACS), proper care starts during the call to EMS. First responders must be aware of and look for signs of ACS. Quick diagnosis and treatment yield the greatest benefit for myocardial salvage. It is very important that health care providers recognize patients with potential ACS in order to initiate evaluation, appropriate triage, and timely management.

STEMI CHAIN OF SURVIVAL

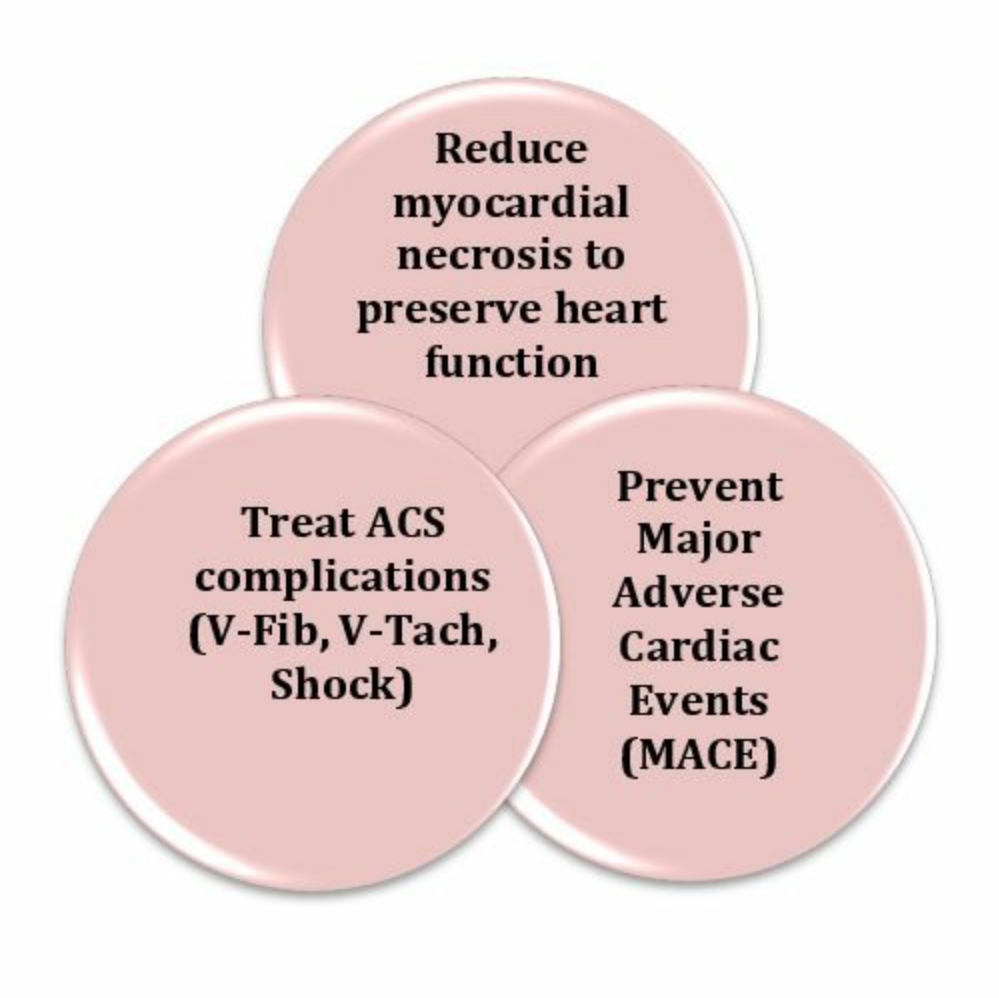


GOALS OF ACUTE CORONARY SYNDROME TREATMENT

Early EMS communication allows for preparation of emergency department personnel and cardiac catheterization lab and staff. Once the ACS patient arrives at the receiving facility, established protocols should direct care. The shorter the time is until reperfusion, the greater the amount of heart tissue that can be saved, and the more optimal the overall outcome.

MACE, or Major Adverse Cardiac Events, includes death and non-fatal myocardial infarction. Life-threatening complications of ACS include ventricular fibrillation, pulseless ventricular tachycardia, bradyarrhythmias, cardiogenic shock, and pulmonary edema. EMS should have ECGs on hand before reaching the hospital - the receiving hospital should be made aware of possible ACS, especially ST (STEMI) and non-ST

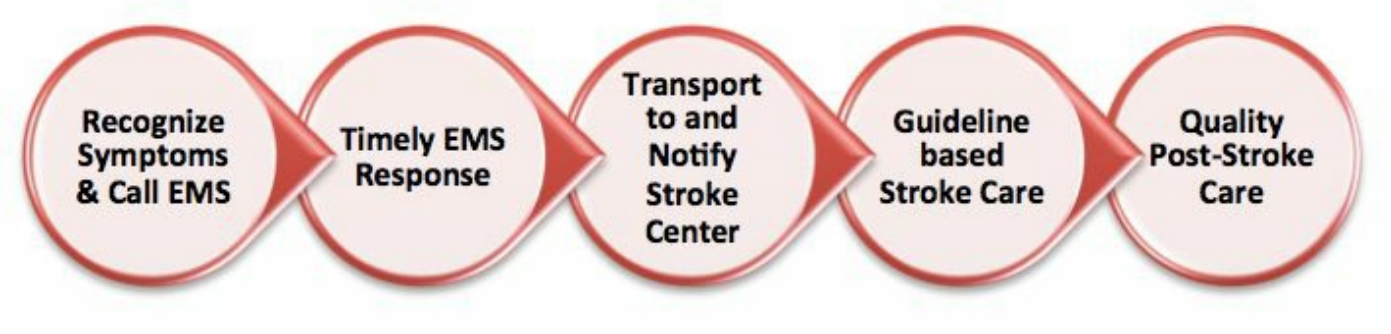
(NSTEMI) segment elevation myocardial infarction.



ACUTE STROKE

Outcomes for patients with stroke have improved significantly due to the implementation of Acute Stroke Systems of Care. The community is better equipped to recognize stroke as a "brain attack" and there is greater awareness of the importance of medical care within one hour of symptom onset. Likewise, EMS systems have been enhanced to transport patients to regional stroke care centers that are equipped to administer fibrinolytics.

STROKE CHAIN OF SURVIVAL



GOALS OF ACUTE ISCHEMIC STROKE CARE

The overall goal of stroke care is to minimize brain injury and optimize the patient's recovery. If available within a reasonable transport interval, patients with acute stroke who require hospitalization should be admitted to a stroke unit with a multidisciplinary team experienced in stroke care. The goal of the stroke team, emergency physician, or other experts should be to assess the patient with suspected stroke within 10 minutes of arrival in the ED - "TIME IS BRAIN!"

THE 8 D'S OF STROKE CARE	
DETECTION	Rapid recognition of stroke systems
DISPATCH	Early activation and dispatch of EMS by 911
DELIVERY	Rapid EMS identification, management, and transport
DOOR	Transport to stroke center
DATA	Rapid triage, evaluation, and management in ED
DECISION	Stroke expertise and therapy selection
DRUG	Fibrinolytic therapy, intra-arterial strategies.
DISPOSITION	Rapid admission to the stroke unit or critical care unit

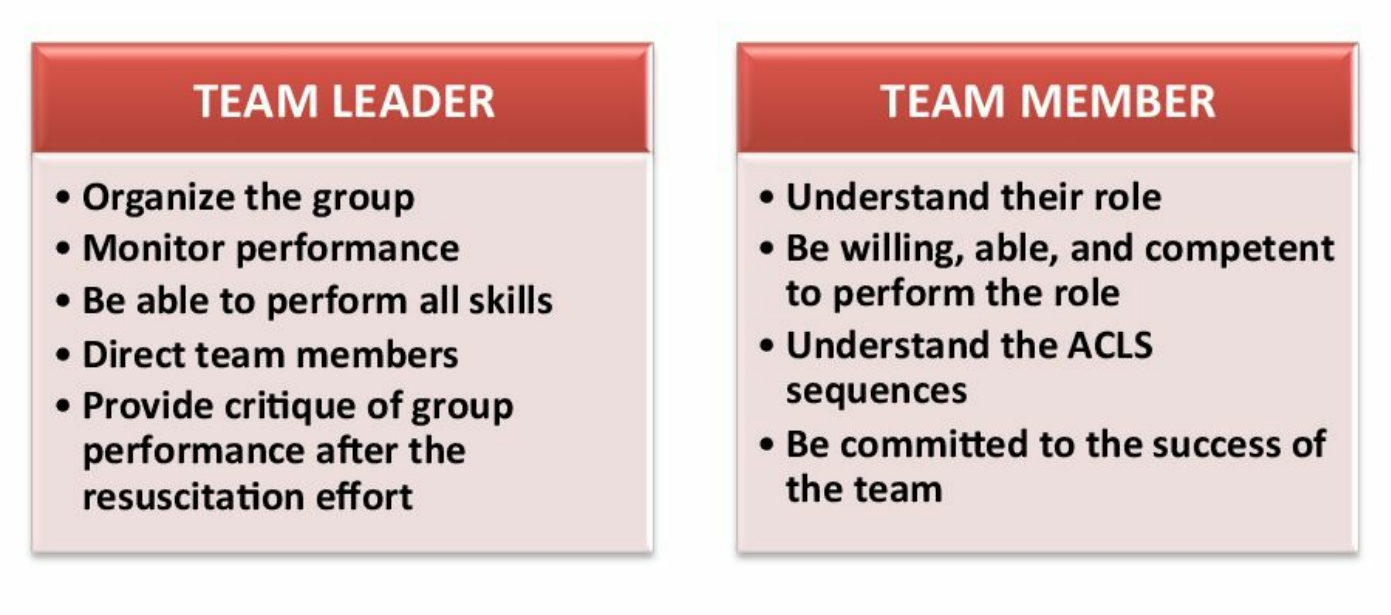
✓ ***The 8 D's of Stroke Care highlight the major steps of diagnosis and treatment of stroke and key points at which delays can occur.***

THE RESUSCITATION TEAM

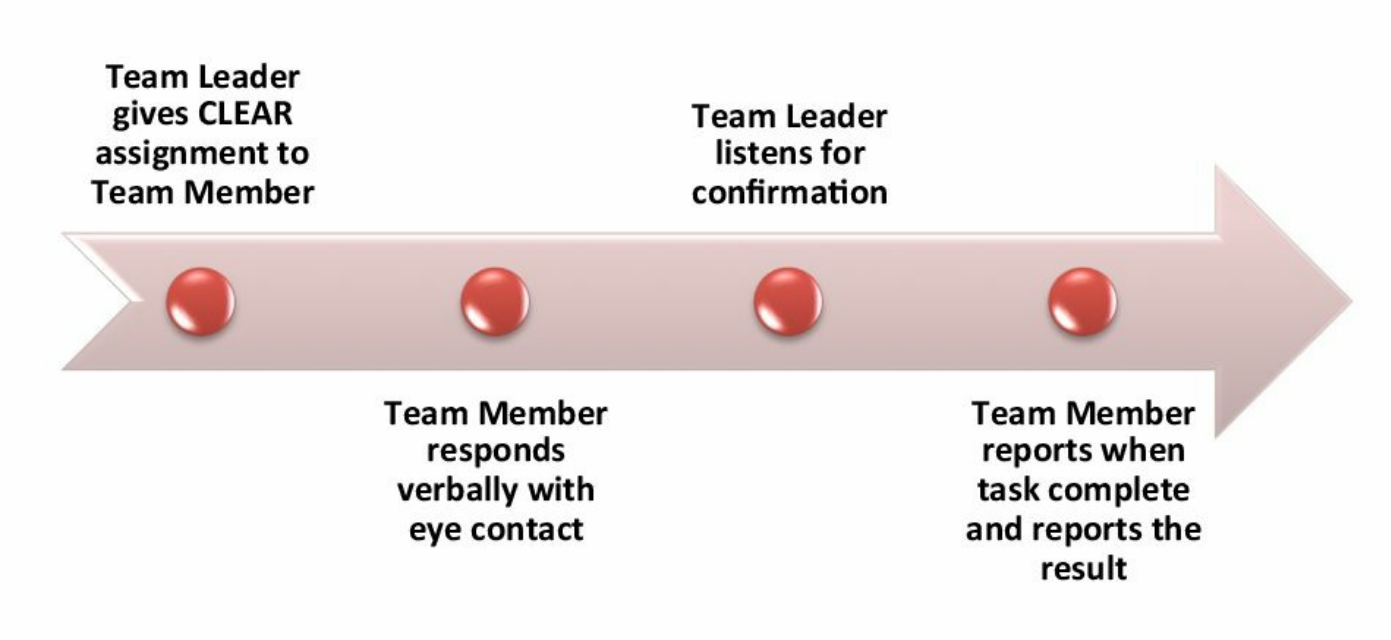
The 2010 edition of the AHA ACLS Guidelines highlights the importance of effective team dynamics during resuscitation. In the community, the first person on the scene may

be performing CPR alone. However, a "Code Blue" in a hospital may bring dozens of responders to a patient's room. It is important to rapidly and efficiently organize everyone participating in ACLS. The AHA suggests a team structure with each provider assuming a specific role on the resuscitation team. The team structure consists of a team leader and several team members.

✓ ***Clear communication between Team Leader and Team Members is essential.***



It is important to know your own limitations. Resuscitation is the time for implementing acquired skills, not trying new ones. Only take on what you can successfully perform at one time. Make it clear when you need help and call for help early. Adult resuscitation demands mutual respect, knowledge sharing, constructive criticism, and follow- up discussion after the event.

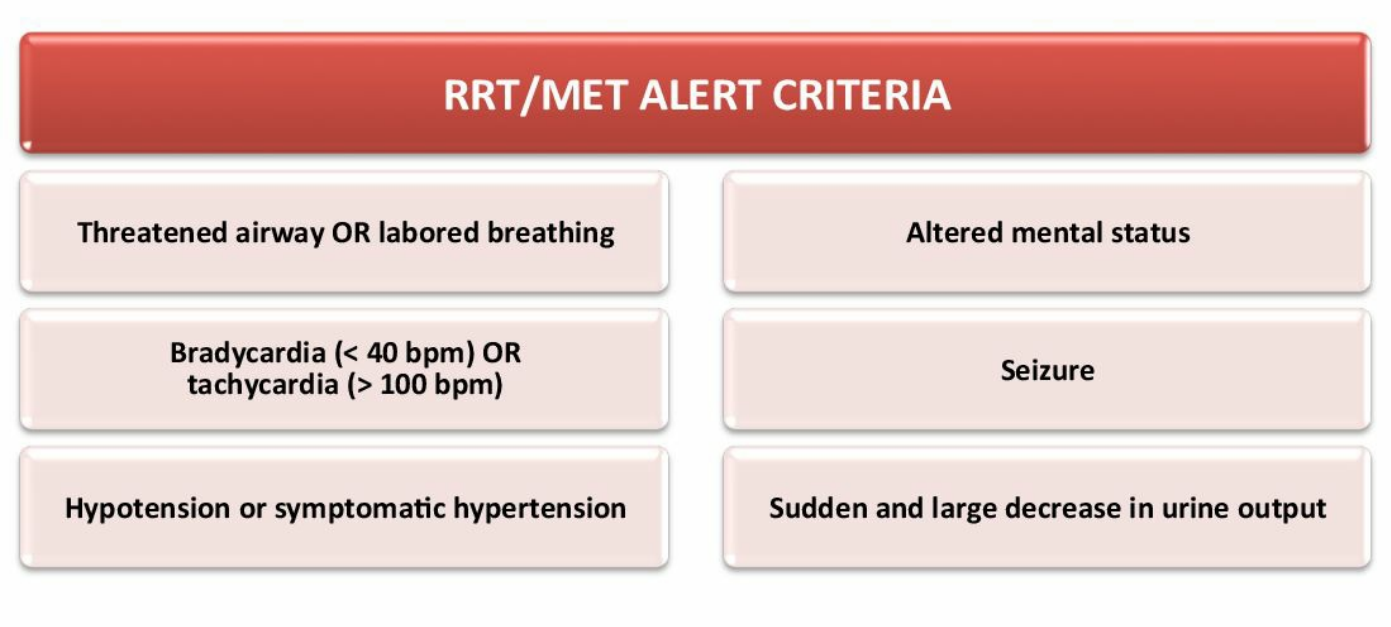


EDUCATION, IMPLEMENTATION, TEAMS

Only about 20% of people that have a cardiac arrest inside a hospital will survive. This statistic prompted the development of a Cardiac Arrest System of Care. Four out of five patients with cardiopulmonary arrest have changes in vital signs prior to the arrest. Therefore, most patients that eventually have a cardiac arrest showed signs of impending cardiac arrest. Survival rate could be improved if patients are identified and treated with ACLS protocols sooner.

Originally, specialized groups of responders within a hospital, called Cardiac Arrest Teams, attended to a patient with recognized cardiac arrest. These teams responded to a "Code Blue" after someone presumably recognized an active cardiac arrest and sought help. Many believed Cardiac Arrest Teams would improve patient survival, but studies on the subject were disappointing. The studies show survival rates were the same in hospitals with Cardiac Arrest Teams as in those without a team. As a result, hospitals are replacing Cardiac Arrest Teams with Rapid Response Teams (RRTs) or Medical Emergency Teams (METs).

Rather than waiting for loss of consciousness and full cardiopulmonary arrest, RRTs/METs closely monitor patients in order to treat patients before the cardiac arrest occurs. These teams combine the efforts of nurses, physicians, and family members to detect an impending cardiac arrest.



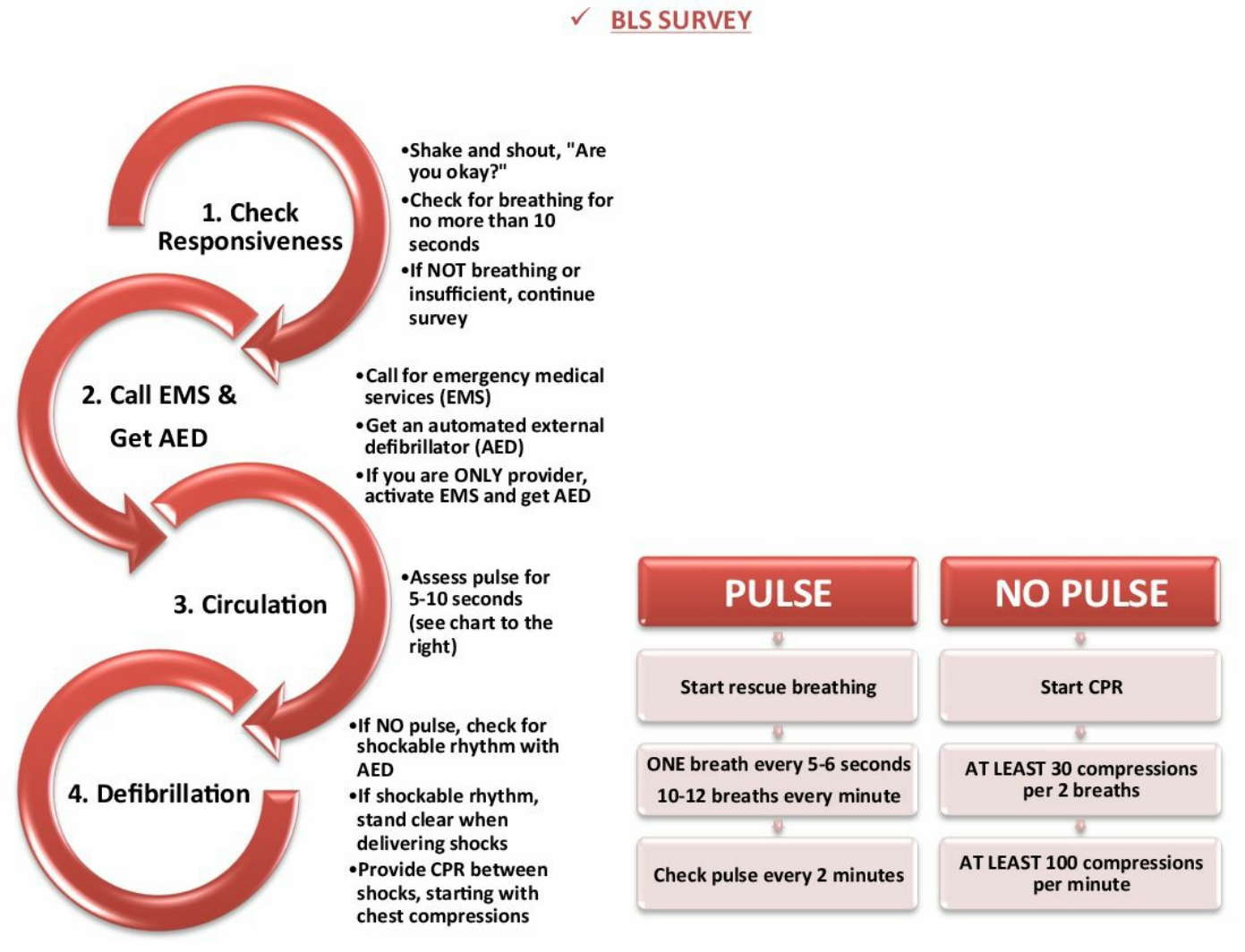
✓ ***When hospitals implement RRTs/METs, there are fewer cardiac arrests, fewer ICU transfers, improved survival rates, and shorter length of inpatient stay.***

ACLS CASES

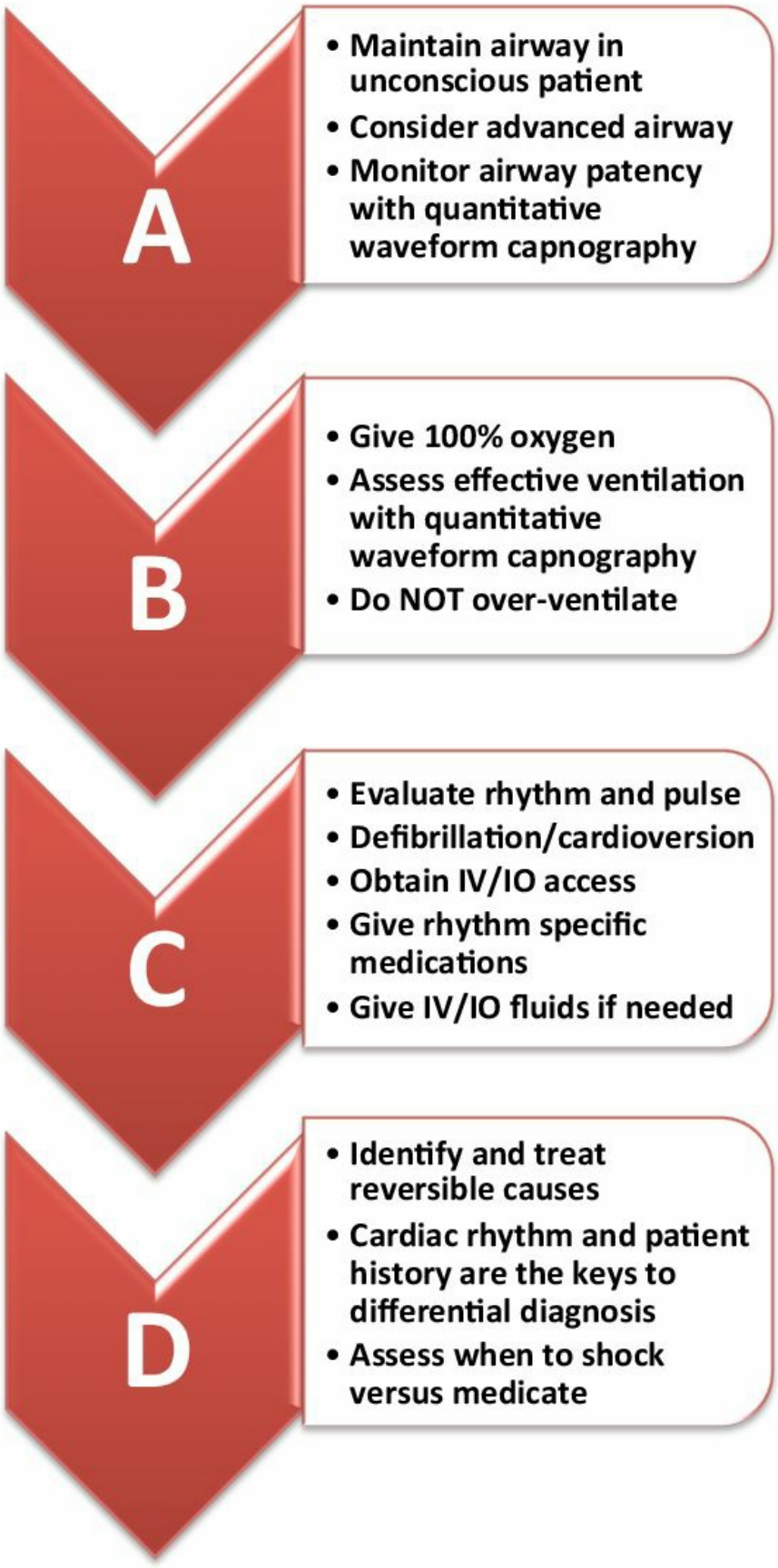
RESPIRATORY ARREST

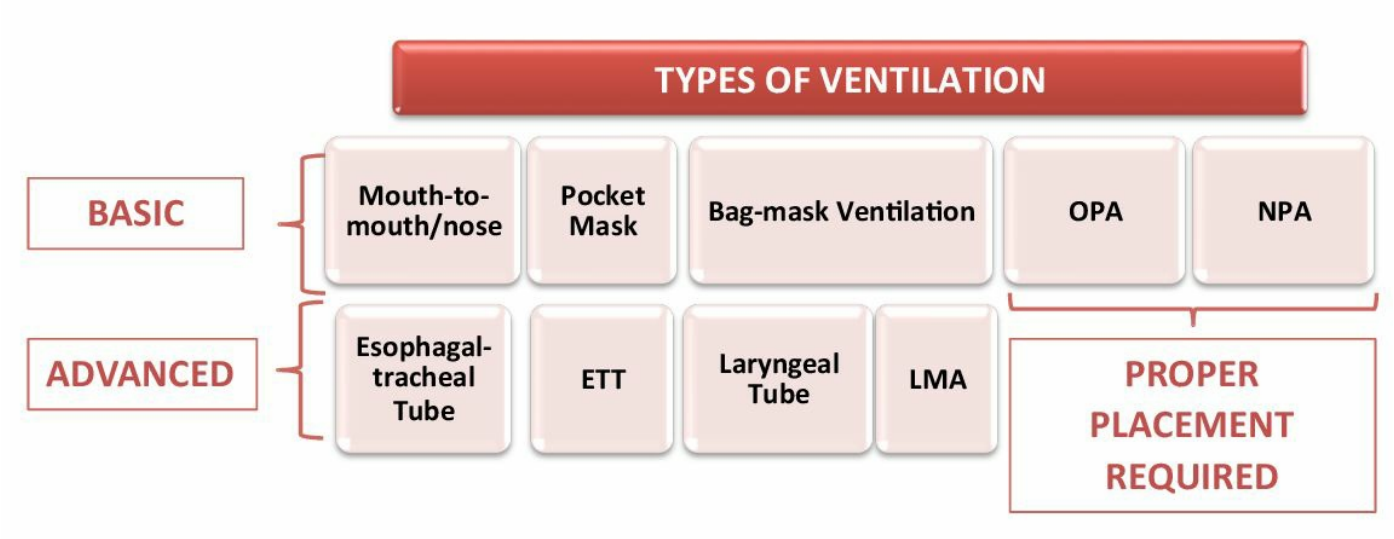
Patients with ineffective breathing patterns such as agonal or Kussmaul breathing are considered to be in respiratory arrest and require immediate attention. There are many causes of respiratory arrest, including but not limited to cardiac arrest and cardiogenic shock. Resuscitate patients in apparent respiratory arrest using either the BLS (below to left) or ACLS Survey (below to right).

✓ ***Respiratory arrest is an emergent condition in which the patient is either not breathing or is breathing ineffectively.***



ACLS SURVEY


A
• Maintain airway in unconscious patient
• Consider advanced airway
• Monitor airway patency with quantitative waveform capnography
B
• Give 100% oxygen
• Assess effective ventilation with quantitative waveform capnography
• Do NOT over-ventilate
C
• Evaluate rhythm and pulse
• Defibrillation/cardioversion
• Obtain IV/IO access
• Give rhythm specific medications
• Give IV/IO fluids if needed
D
• Identify and treat reversible causes
• Cardiac rhythm and patient history are the keys to differential diagnosis
• Assess when to shock versus medicate



The airways listed in the top row are considered basic airways, while those in the bottom row are advanced. Oropharyngeal and nasopharyngeal airways, while considered "basic," require proper placement by an experienced caregiver. Advanced airway insertion requires specialized training beyond the scope of ACLS certification. While the *placement* of advanced airways requires specialized training, all ACLS providers should know the proper use of advanced airways once they are placed. Regardless of airway type, proper airway management is an important part of ACLS.

CPR is performed with the patient laying on their back, so the jaw, tongue and tissues of the throat will follow gravity and naturally obstruct the airway. The airway, which consists of the nose, mouth, pharynx, larynx, and trachea, rarely remain open in an unconscious patient without external support.

The first step in any airway intervention is to open this airway. This usually involves lifting the chin upward while tilting the forehead back (Figure 7). The goal is to create a straight path from the nose to the trachea.

FIGURE 7

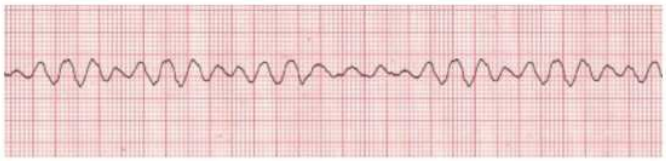
In patients with suspected neck injury, the cervical spine should be protected and a jaw thrust is used to open the airway (Figure 8). While the standard practice in a suspected neck injury is to place a cervical collar, this should not be done in BLS/ACLS. Cervical collars can compress the airway and interfere with resuscitation efforts. The provider must ensure an open airway regardless of the basic airway used.

FIGURE 8

✓ ***Do NOT over-ventilate (i.e., give too many breaths per minute or too large***

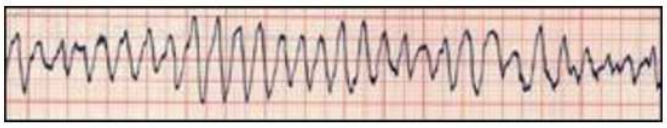
volume per breath). Both can increase intrathoracic pressure, decrease venous return to heart, diminish cardiac output, as well as predipose patients to vomiting and aspiration of gastrointestinal contents.

VENTRICULAR FIBRILLATION / PULSELESS VENTRICULAR TACHYCARDIA



RULES FOR VENTRICULAR FIBRILLATION (V-FIB)	
REGULARITY	There is no regularity to the rhythm because there are no complexes or waves present that can be analyzed.
RATE	There is no measureable rate.
P WAVE	There are no P waves present.
PRI	PRI is unable to be measured due to no P waves being present.
QRS	There are no QRS complexes present.

RULES FOR VENTRICULAR TACHYCARDIA (V-TACH) (REGULAR/RAPID WIDE COMPLEX TACHYCARDIA)	
REGULARITY	R-R intervals are usually regular but not always.
RATE	The atrial rate cannot be determined. Ventricular rate is usually between 150 and 250 beats/min.
P WAVE	QRS complexes are not preceded by P waves. There are occasionally P waves in the strip, but they are not associated with the ventricular rhythm.
PRI	PRI is not measured since this is a ventricular rhythm.
QRS	Measure more than 0.12 seconds. The ARS will usually be wide and bizarre. It is usually difficult to see a separation between the QRS complex and the T wave.



TORSADES DE POINTES
(IRREGULAR WIDE COMPLEX TACHYCARDIA)

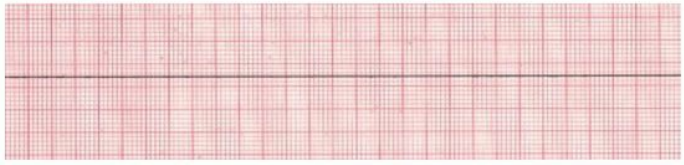
Ventricular fibrillation (V-Fib) and pulseless ventricular tachycardia (V-Tach) are life threatening cardiac rhythms that result in ineffective ventricular contractions. V-Fib (VF) is a rapid quivering of the ventricles rather than a forceful contraction. The ventricular motion of V-Fib is not synchronized with atrial contractions. V-Tach (VT) is a condition in which the ventricles contract more than 100 times per minute. The emergent condition, pulseless V- Tach, occurs when rapidly contracting ventricles are pumping blood insufficiently. Therefore, the contractions are not pumping blood, resulting in undetectable pulse. In both cases, patients are not receiving adequate blood flow to the tissues. Despite being different pathological phenomena and having different ECG rhythms, the ACLS management of V-Fib and V-Tach are essentially the same. Resuscitation for V-Fib and pulseless V-Tach starts with the BLS Survey.

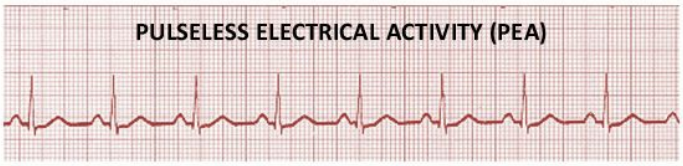
✓ ***VF and pulseless VT are both shockable rhythms. The AED cannot tell if the patient has a pulse or not.***

An AED reads and analyzes the rhythm and determines if a shock is needed. The AED is programmed to only prompt the user to shock V-Fib and V-Tach rhythms. The machine does not know if the patient has a pulse or not. This is the primary reason you should not use an AED in someone with a palpable pulse. ACLS responses to V-Fib and pulseless V-Tach within a hospital will likely be conducted using a cardiac monitor and a manual defibrillator.

Thus the ACLS provider must read and analyze the rhythm. Shocks should only be delivered for V-Fib and pulseless V-Tach. Likewise, antiarrhythmic drugs and drugs to support blood pressure may be used.

PULSELESS ELECTRICAL ACTIVITY AND ASYSTOLE



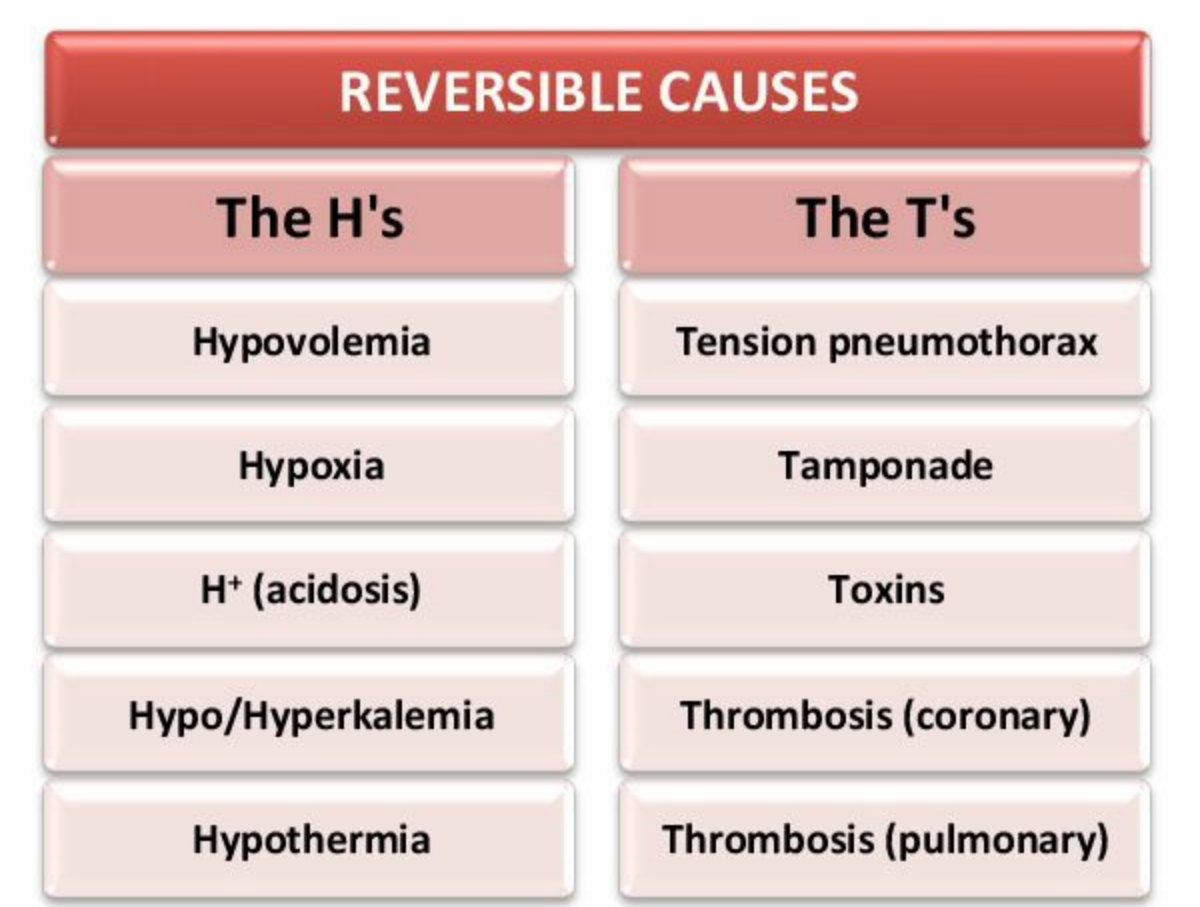


RULES FOR ASYSTOLE	
REGULARITY	The rhythm will be a flat line.
RATE	There is no rate.
P WAVE	There are no P waves.
PRI	PRI is not measurable due to no P waves being present.
QRS	There are no QRS complexes in this rhythm.

✓ ***Always ensure a reading of asystole is not a user error. Make sure leads are connected, gain is set appropriately, and the power is on.***

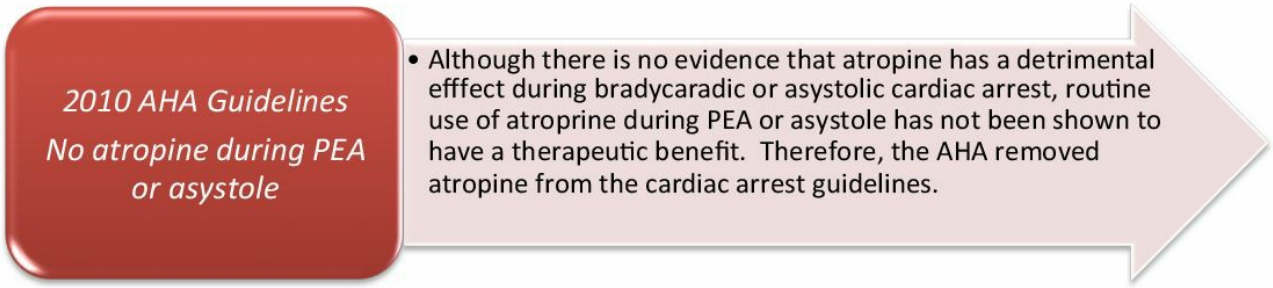
✓ ***Hypovolemia and hypoxia are easily reversed and the two most common causes of PEA.***

Pulseless electrical activity (PEA) and asystole are related cardiac rhythms in that they are both life threatening and NOT shockable. Asystole is a flat-line ECG. There may be subtle movement away from baseline (drifting flat- line) but there is no perceptible cardiac electrical activity. Always ensure a reading of asystole is not a user or technical error. Make sure leads are connected, gain is set appropriately, and the power is on. Pulseless electrical activity is one of many waveforms by ECG (including sinus rhythm), but without a detectable pulse. Pulseless electrical activity may include any pulseless waveform with the exception of V-Fib (VF), V-Tach (VT), or asystole.

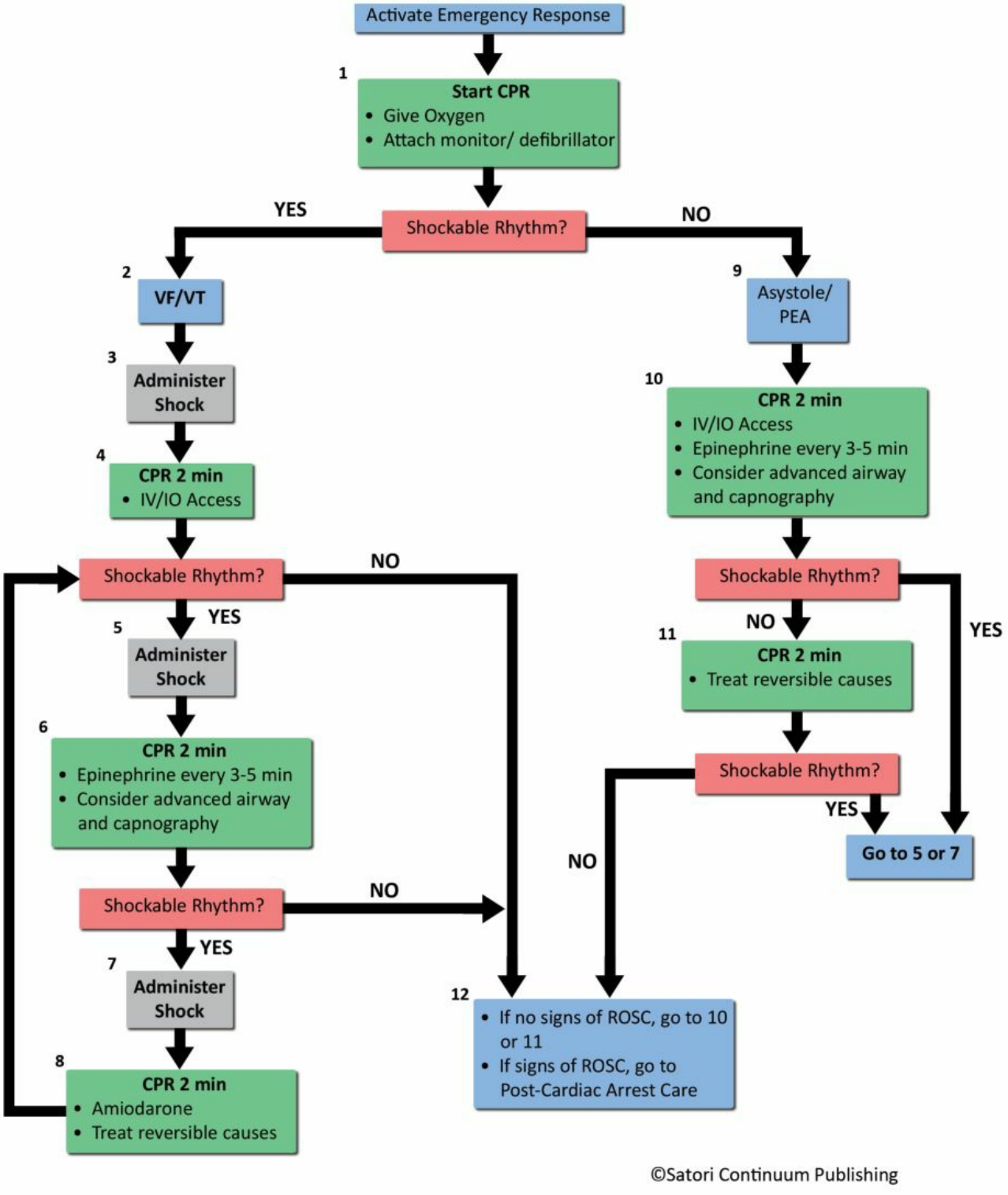


Hypovolemia and hypoxia are the two most common reversible causes of PEA. They are also the most easily reversible and should be at the top of any differential diagnosis.

If the patient has ROSC, proceed to Post-Cardiac Arrest Care. Atropine is no longer recommended in cases of PEA or asystole.


2010 AHA Guidelines
No atropine during PEA or asystole
• Although there is no evidence that atropine has a detrimental efffect during bradycaradic or asystolic cardiac arrest, routine use of atroprine during PEA or asystole has not been shown to have a therapeutic benefit. Therefore, the AHA removed atropine from the cardiac arrest guidelines.

Adult Cardiac Arrest Algorithm



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Adult Cardiac Arrest Algorithm (Cont.)

CPR Quality

- Push hard (≥ 2 inches) and fast (≥ 100 beats per min) and allow chest recoil
- Minimize interruptions
- DO NOT over-ventilate
- If no advanced airway, 30:2 compression ventilation ratio
- Quantitative waveform capnography
  - If $PETCO_2$ <10 mm Hg, attempt to improve CPR quality
- Intra-arterial pressure
  - If diastolic pressure <20 mm Hg, attempt to improve CPR Quality

Shock Energy

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

Return of Spontaneous Circulation

- Return of pulse and blood pressure
- Sudden sustained increase in $PETCO_2$ (typically ≥ 40 mm Hg)
- Spontaneous arterial pressure waves with intra-arterial monitoring

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

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.

Reversible Causes:

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

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POST-CARDIAC ARREST CARE

If a patient has a Return of Spontaneous Circulation (ROSC), start Post-Cardiac Arrest Care immediately. The initial BLS/ACLS processes were meant to save a patient's life. Post-Cardiac Arrest Care is meant to optimize ventilation and circulation, preserve heart and brain tissue/function, and maintain recommended blood glucose levels.

BLOOD PRESSURE SUPPORT AND VASOPRESSORS

- Consider blood pressure support in any patient with systolic blood pressure 90 mmHg
- Unless contraindicated, 1-2 liters of IV saline or Lactated Ringer's is the first intervention
- When blood pressure is very low, consider vasopressors (commonly referred to as "pressors")
    - Epinephrine is the pressor of choice for patients who are not in cardiac arrest
    - Dopamine, phenylephrine, and methoxamine are alternatives
    - Norepinephrine is generally reserved for severe hypotension or as a last-line agent
- Titrate the infusion rate to maintain the desired blood pressure.

HYPOTHERMIA

Hypothermia is the **ONLY** documented intervention that improves/enhances brain recovery after cardiac arrest. It can be performed in unresponsive patients (i.e., comatose) and should be continued for at least 12 to 24 hours. The goal of induced hypothermia is to reach a core body temperature between 32°C and 34°C. Hypothermia can be induced by infusing ice-cold saline or Lactated Ringer's during blood pressure support and maintained by surface cooling devices. Hypothermia should be induced and monitored by trained professionals. Induced hypothermia should not affect the decision to perform percutaneous coronary intervention (PCI), because concurrent PCI and hypothermia are reported to be feasible and safe.

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Adult Immediate Post-Cardiac Arrest Care Algorithm

Doses/Details

Ventilation/Oxygenation
Avoid excessive ventilation.
Start at 10-12 breaths/min and titrate to target $PETCO_2$ of 35-40 mm Hg.
Titrate FIO_2 to minimum necessary to achieve SpO_2 ≥94%

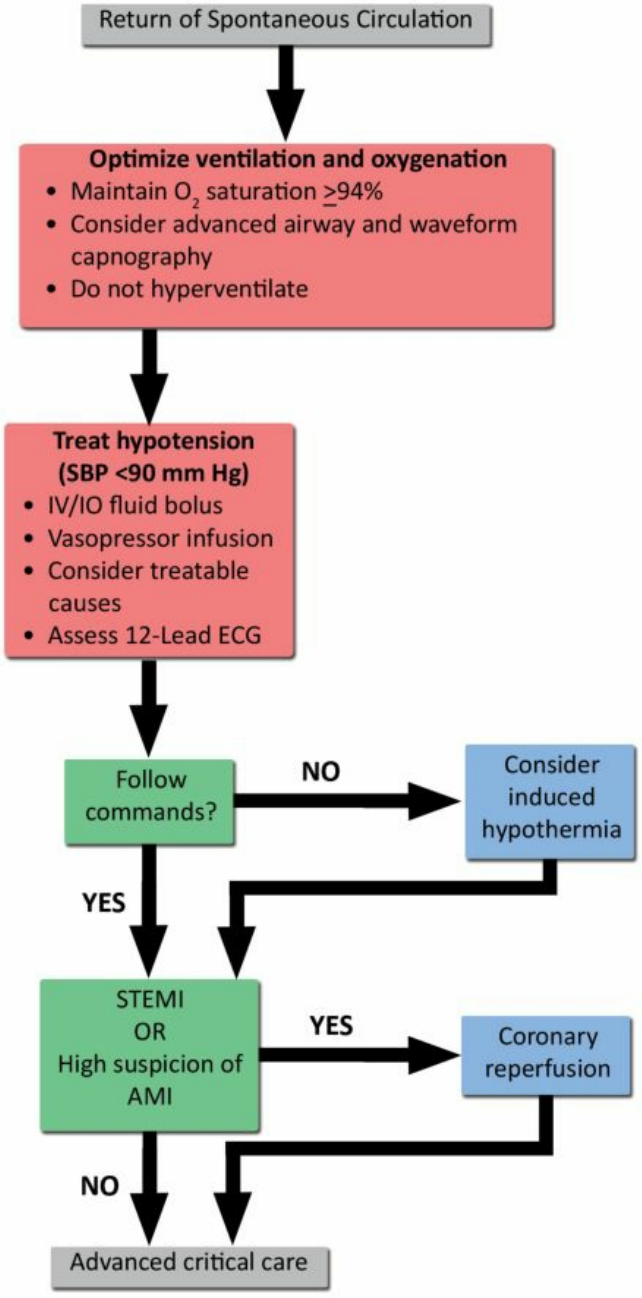
IV Bolus
1-2 liters normal saline or Lactated Ringer's. If inducing hypothermia, consider 4˚C fluid.

Epinephrine IV Infusion:
0.1-0.5 mcg/kg per minute

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

Norepinephrine IV Infusion:
0.1-0.5 mcg/kg per minute

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



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SYMPTOMATIC BRADYCARDIA

RULES FOR SINUS BRADYCARDIA	
REGULARITY	R-R intervals are regular, overall rhythm is regular.
RATE	The rate is less than 60 bpm, but usually more than 40 bpm.
P WAVE	There is one P wave in front of every QRS. The P waves appear uniform.
PRI	Measures between 0.12 and 0.20 seconds in duration. PRI is consistent.
QRS	Measures less than 0.12 seconds.

RULES FOR FIRST DEGREE AV BLOCK	
REGULARITY	R-R intervals are regular, overall rhythm is regular.
RATE	The rate depends on the underlying rhythm.
P WAVE	There is one P wave in front of every QRS. The P waves appear uniform.
PRI	Measure more than 0.20 seconds in duration. PRI is consistent.
QRS	Measures less than 0.12 seconds.

RULES FOR 2nd DEGREE TYPE I AV BLOCK (WENKEBACH)	
REGULARITY	R-R interval is irregular, but there is usually a pattern to it. The R-R interval gets longer as the PRI gets longer.
RATE	The ventricular rate is usually slightly higher than the atrial rate due to some atrial beats not being conducted. The atrial rate is usually normal.
P WAVE	P waves are upright and uniform. Most complexes will have a P wave in front of them; however there will be some that do not have a P wave.
PRI	PR interval gets progressively longer until there is a dropped QRS complex.
QRS	Measures less than 0.12 seconds.

RULES FOR 2nd DEGREE TYPE II AV BLOCK (MOBITZ II)	
REGULARITY	There is a consistent conduction ratio, then the R-R interval will be regular. If the conduction ratio is no constant, the R-R interval will be irregular.
RATE	The atrial rate will be normal. The ventricular rate will be slower, usually ½ to 1/3, than the atrial rate.
P WAVE	P waves are upright and uniform. There is not a QRS following every P wave.
PRI	PRI can only be measure on conducted beats, and it is usually constant across the strip. It may or may not be longer than a normal PRI (0.12 seconds).
QRS	Measures less than 0.12 seconds.

RULES 3rd DEGREE AV BLOCK (COMPLETE HEART BLOCK)	
REGULARITY	R-R interval will be regular. P-P interval will also be regular.
RATE	The atrial rate will be regular and normally be 60-100. Rate of QRS complexes is dependent on the focus. If the focus is ventricular, the rate will be 20-40. If the focus is junctional, the rate will be 40-60.
P WAVE	P waves are upright and uniform. There is not a QRS following every P wave.
PRI	PRI can only be measured on conducted beats, and it is usually constant across the strip. It may or may not be longer than a normal PRI (0.12 seconds).
QRS	Measures less than 0.12 seconds.

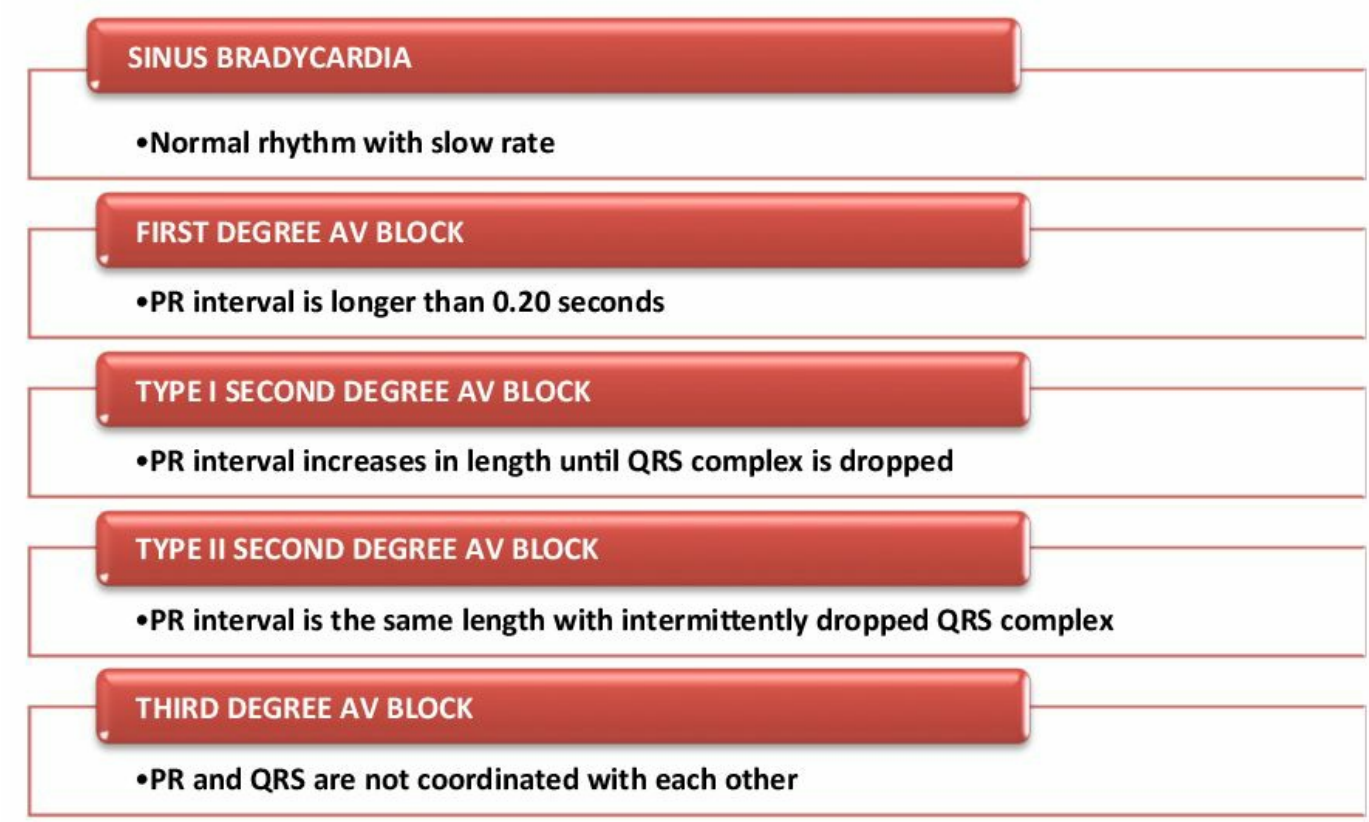
SYMPTOMS OF BRADYCARDIA

- Chest pain/discomfort
- Shortness of breath
- Altered mental status
- Hypotension (orthostatic)
- Pulmonary edema/congestion
- Weakness/dizziness/lightheadedness

✓ ***Key question is whether the bradycardia is causing the patients symptoms or some other illness is causing the bradycardia.***

Bradycardia is diagnosed as a heart rate of less than 60 beats per minute. While any heart rate less than 60 beats per minute is considered bradycardia, not every patient with bradycardia is having a pathological event. People in excellent physical shape often have sinus bradycardia. Symptomatic bradycardia may cause a number of signs and symptoms including low blood pressure, pulmonary edema/congestion, abnormal rhythm, chest discomfort, shortness of breath, lightheadedness, and/or confusion. Symptomatic bradycardia should be treated with an ACLS response. If bradycardia is

asymptomatic but occurs with an arrhythmia listed below, obtain a consultation from a cardiologist experienced in treating rhythm disorders.



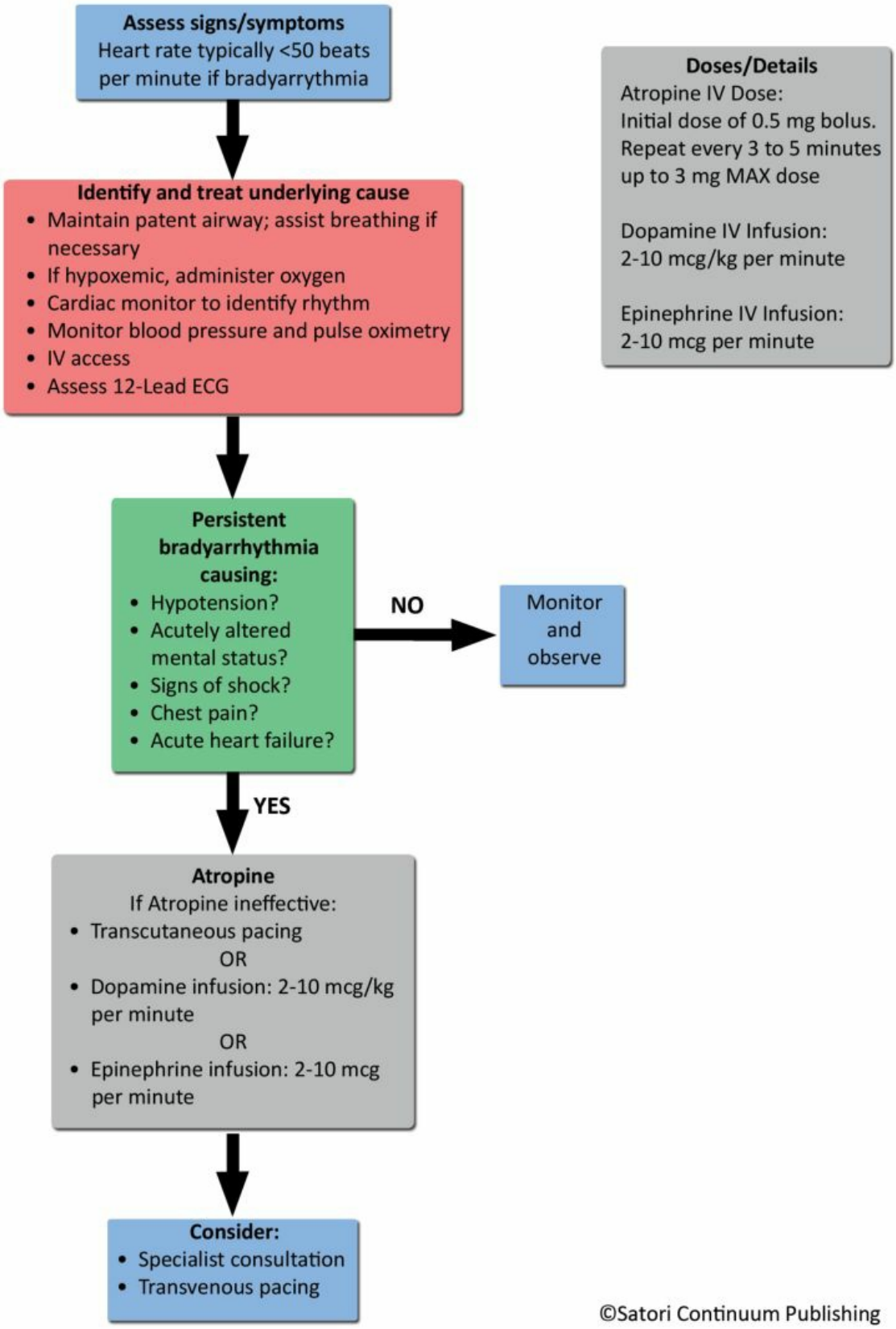
SYMPTOMATIC BRADYCARDIA
HR < 60 BPM

1. Assess patient's hemodynamic status (IV, O_2, Monitor)
2. Atropine – GIVE 0.5 mg IVP for sinus bradycardia and Type I AV Block.
   - ✓ NOT indicated for Type II and 3rd degree AV Block. Proceed to pacing.
3. Transcutaneous Pacing – USE for Type II and 3rd degree AV Block.
   - ✓ DO NOT delay pacing in symptomatic patients!
4. Dopamine – GIVE 2 – 10 mcg/kg/min if patient unresponsive to atropine/pacing.
5. Epinephrine drip – GIVE 2 – 10 mcg/min if patient unresponsive to atropine/pacing.

The primary goal of symptomatic bradycardia treatment is to make sure the heart is adequately pumping blood to the body.

Treatment is not necessarily aimed at increasing the heart rate. Treatment should continue until symptoms resolve.

Adult Bradycardia with Pulse Algorithm



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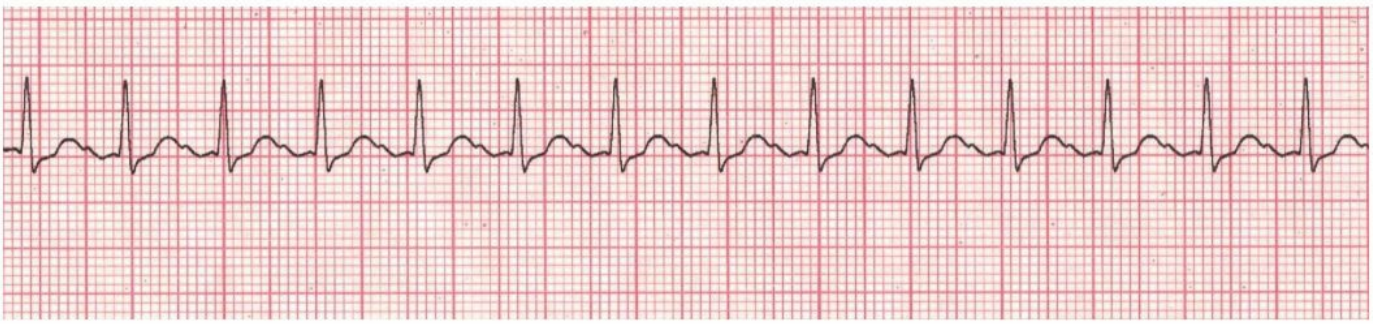
STABLE AND UNSTABLE TACHYCARDIA

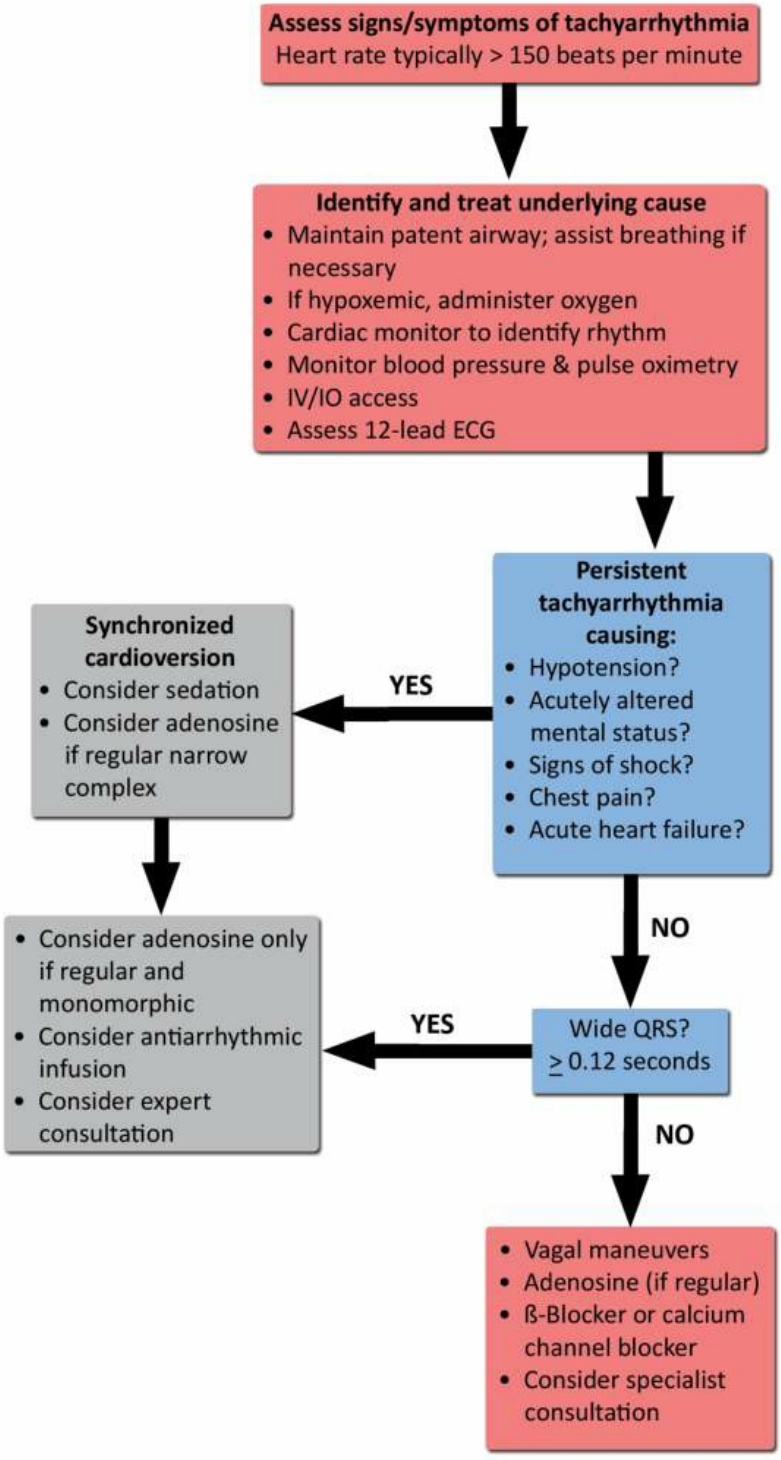


RULES FOR SINUS TACHYCARDIA	
REGULARITY	R-R intervals are regular, overall rhythm is regular.
RATE	The rate is over 100 bpm but usually less than 170 bpm.
P WAVE	There is one P wave in front of every QRS. The P waves appear uniform.
PRI	Measures between 0.12 and 0.20 seconds in duration. PRI is consistent.
QRS	Measures less than 0.12 seconds.

RULES FOR ATRIAL FLUTTER	
REGULARITY	The atrial rate is regular. The ventricular rate will usually be regular, but only if the AV node conducts the impulses in a consistent manner. Otherwise, the ventricular rate will be irregular.
RATE	The atrial rate is normally between 250-350. Ventricular rate depends on conduction through the AV node to the ventricles.
P WAVE	The P waves will be well defined and have a "sawtooth" pattern to them.
PRI	Due to the unusual configuration of P waves, the PRI is not measured with atrial flutter.
QRS	Measures less than 0.12 seconds.

RULES FOR ATRIAL FIBRILLATION (A-FIB) IRREGULAR NARROW COMPLEX TACHYCARDIA = A-FIB	
REGULARITY	The R-R intervals are irregular; therefore overall rhythm is irregularly irregular. The ventricles conduct from different atrial foci causing the irregularity.
RATE	Atrial rate usually exceeds 350. The ventricular rate is between 60 and 100 bpm. This is known as "controlled" A-Fib. If the ventricular rate is more than 100, it's consider A-Fib with Rapid Ventricular Response (RVR), also known as uncontrolled A-Fib
P WAVE	Due to the atria firing so rapidly from multiple foci, there are no obvious P waves in the rhythm. The baseline appears chaotic because the atria are fibrillating, therefore no P waves are produced.
PRI	Because there are no P waves, PRI cannot be measured.
QRS	Measures less than 0.12 seconds.

Adult Tachycardia with Pulse Algorithm



Doses/Details

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

Adenosine IV Dose:
Initial dose of 6 mg rapid IV push; follow with NS flush.
Follow with second dose of 12 mg if required

Antiarrhythmic Infusions for Stable Wide-QRS Tachycardia

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

Amiodarone IV Dose:
Initial dose: 150 mg over 10 minutes. Repeat as needed if VT recurs. Maintenance infusion: 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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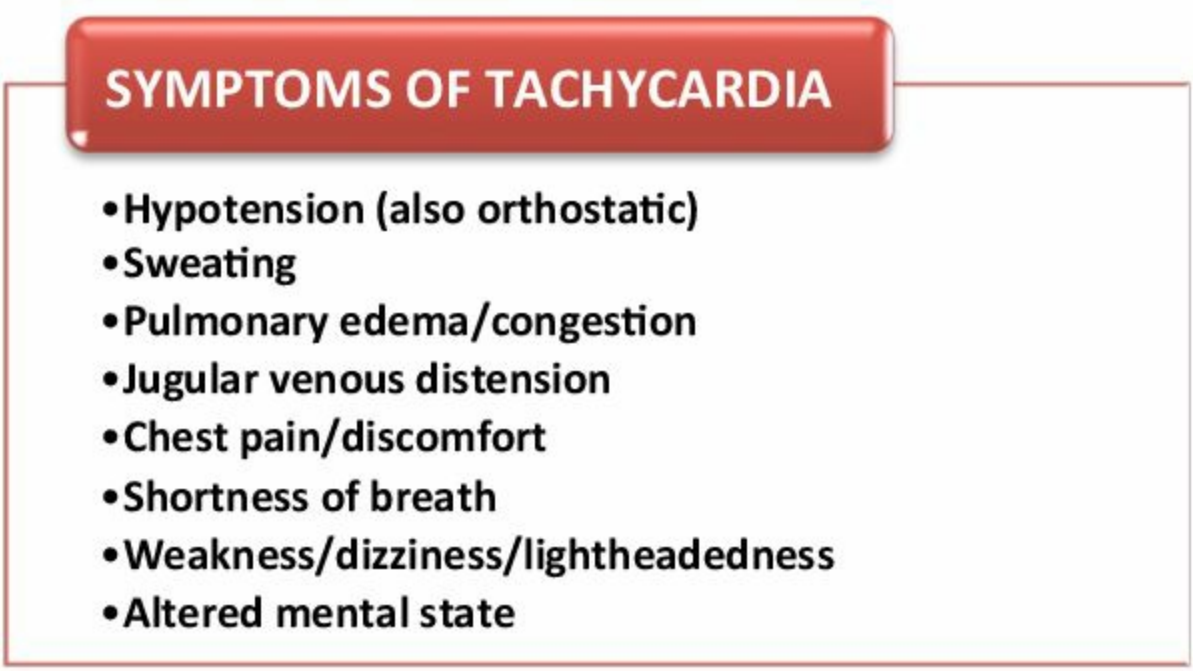


Tachycardia is a heart rate of greater than 100 beats per minute. When the heart beats too quickly, there is a shortened relaxation phase. This causes two main problems: 1) the ventricles are unable to completely fill, causing cardiac output to lower and 2) the coronary arteries receive less blood, causing supply to the heart to decrease.

- Tachycardia is evaluated whether it is considered stable or unstable
- Heart rates ≥ 150 beats per minute usually cause symptoms
- Unstable tachycardia always requires prompt attention
- Stable tachycardia can become unstable

TACHYCARDIA WITH PULSE HR > 100 BPM SYMPTOMATIC

1. Remember if the patient is UNSTABLE, provide IMMEDIATE SYNCHRONIZED CARDIOVERSION.

- Is the patient's tachycardia producing hemodynamic instability and serious symptoms?
- Are the symptoms (i.e., pain and distress of an AMI) producing the tachycardia?

If at any point you become uncertain or uncomfortable during the treatment of a stable patient, seek expert consultation. The treatment of stable patients can be potentially harmful.

2. Assess patient's hemodynamic status (IV, O_2, Monitor)

- HR 100 - 130 bpm are usually result of underlying process and often represent sinus tachycardia. In sinus tachycardia the goal is to identify and treat the underlying systemic cause.
- HR > 150 bpm may be symptomatic; the higher the rate the more likely the symptoms are due to the tachycardia.

REGULAR NARROW COMPLEX TACHYCARDIA (PROBABLE SVT)

- Attempt vagal maneuvers.
- Obtain 12-lead ECG; consider expert consultation.
- Adenosine 6 mg rapid IVP. If no conversion, give 12 mg IVP (2nd dose). May attempt 12 mg once.

Adenosine may cause bronchospasm; therefore, adenosine should be given with caution to patients with asthma.

IRREGULAR NARROW COMPLEX TACHYCARDIA (PROBABLE A-FIB)

- Obtain 12-lead ECG; consider expert consultation.
- Control rate with Diltiazem 15 - 20 mg (0.25 mg/kg) IV over 2 minutes or beta-blockers.

REGULAR WIDE COMPLEX TACHYCARDIA (PROBABLY V-TACH)

- Obtain 12-lead ECG; consider expert consultation.
- Convert rhythm using Amiodarone 150 mg IV over 10 minutes.

Synchronized cardioversion is appropriate for treating wide complex tachycardia of unknown type. Prepare for synchronized cardioversion as soon as a wide complex tachycardia is detected.

- Elective cardioversion.

IRREGULAR WIDE COMPLEX TACHYCARDIA

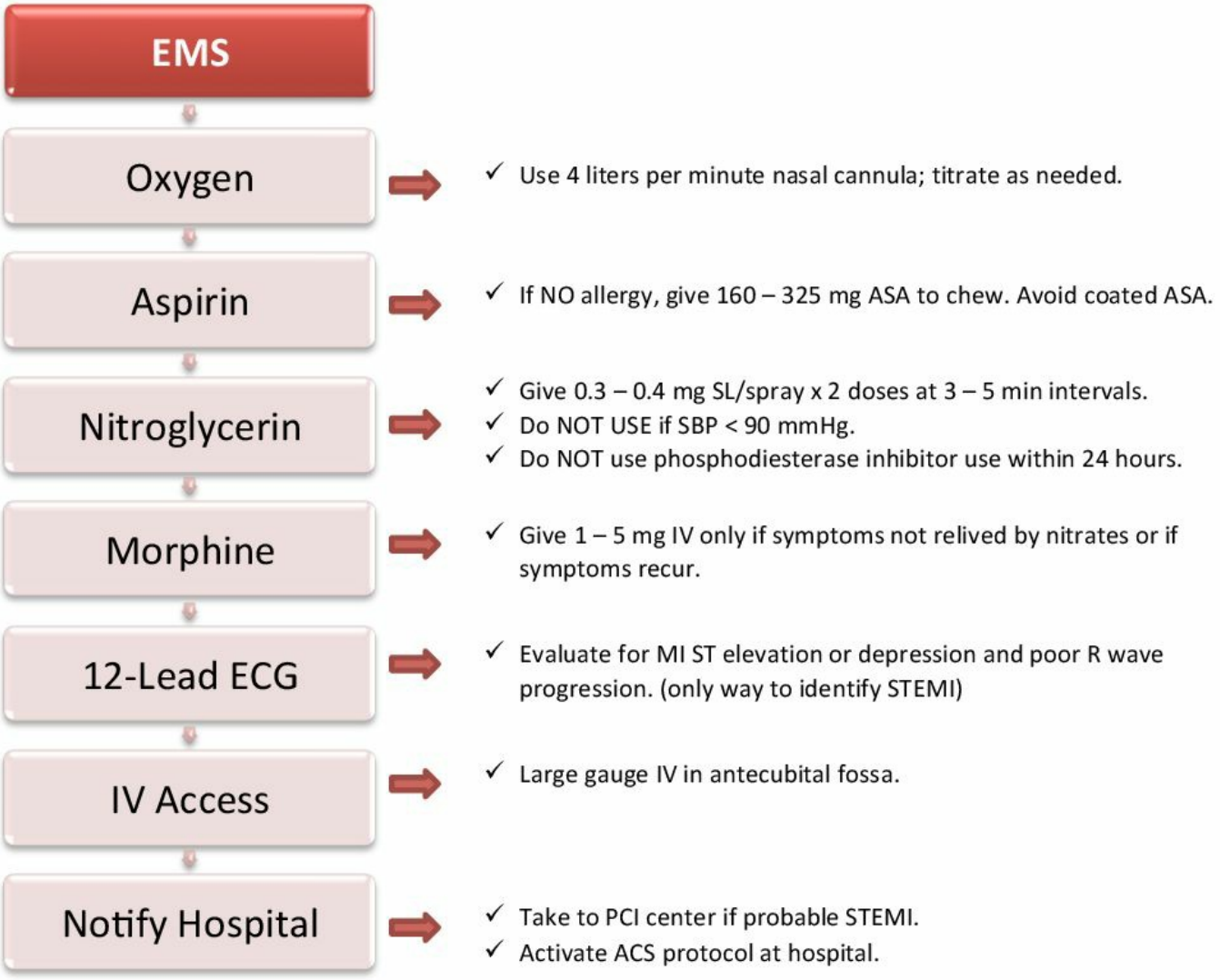
- Obtain 12-Lead ECG; consider expert consultation.
- Consider anti-arrhythmic.
- If Torsades de pointes GIVE Magnesium Sulfate 1 - 2 mg IV over 5 - 60 minutes.

ACUTE CORONARY SYNDROME

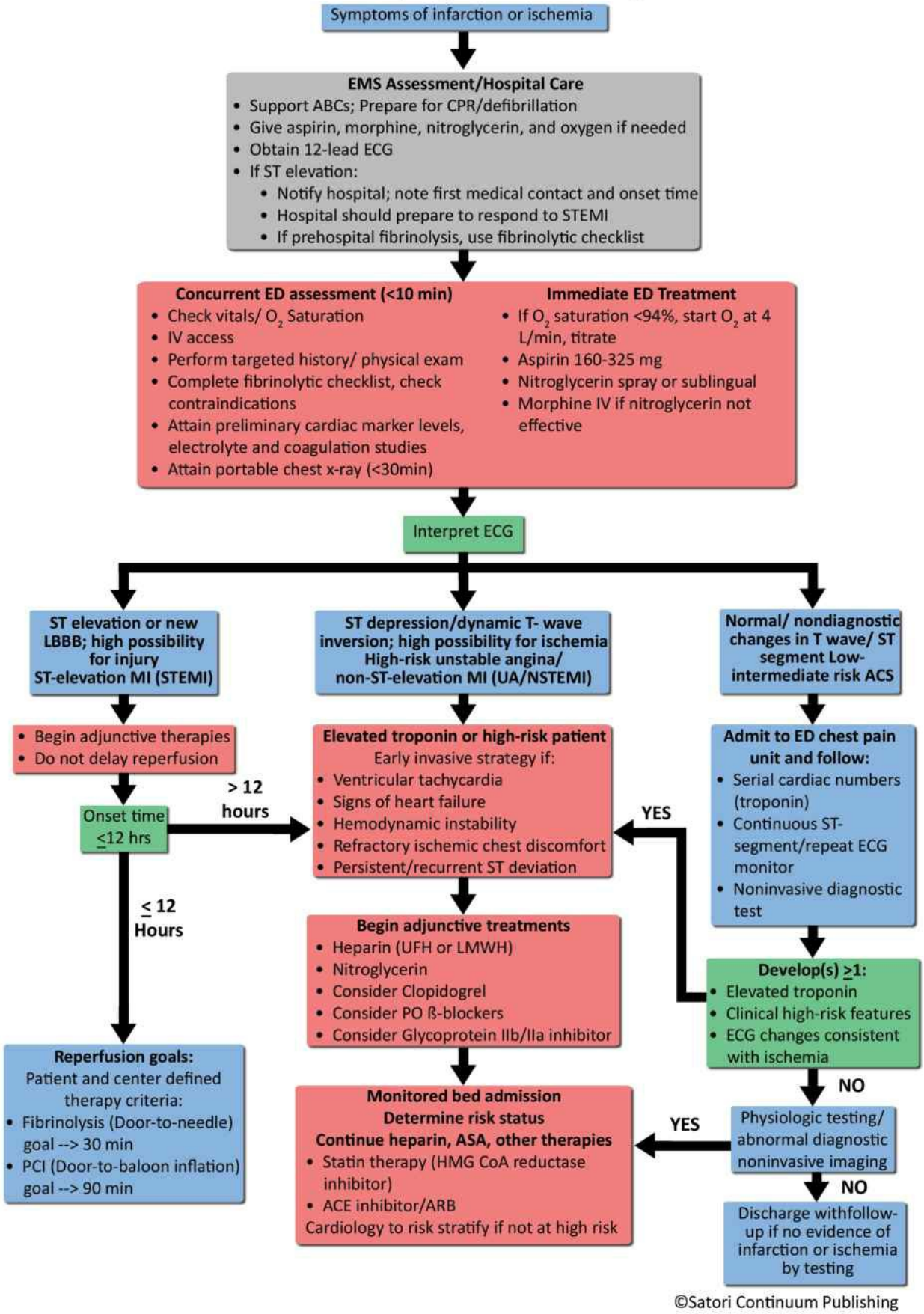
Acute coronary syndrome (ACS) is a collection of clinical presentations including unstable angina, non-ST-segment elevation myocardial infarction (NSTEMI), and ST-segment elevation myocardial infarction (STEMI). ACS is classically recognized by one or more of the following symptoms: crushing chest pain, shortness of breath, pain that radiates to the jaw, arm/shoulder, sweating, and/or nausea/vomiting. It is important to note not all individuals with ACS will present these classic findings (i.e., women and patients with longstanding diabetes mellitus). It is impossible to determine a specific cardiac event from the ACS symptoms; therefore ACS symptoms are managed in the same way.

Every patient with these symptoms should be evaluated immediately. If a patient appears to be unconscious, begin with the BLS Survey and follow the appropriate pathway for advanced care. If the patient is conscious, EMS should proceed with pathway below.

✓ ***Remember "MONA" (Morphine, Oxygen, Nitroglycerine, Morphine) in patients with suspected ACS.***


EMS
Oxygen
✓ Use 4 liters per minute nasal cannula; titrate as needed.
Aspirin
✓ If NO allergy, give 160 – 325 mg ASA to chew. Avoid coated ASA.
Nitroglycerin
✓ Give 0.3 – 0.4 mg SL/spray x 2 doses at 3 – 5 min intervals.
✓ Do NOT USE if SBP < 90 mmHg.
✓ Do NOT use phosphodiesterase inhibitor use within 24 hours.
Morphine
✓ Give 1 – 5 mg IV only if symptoms not relived by nitrates or if symptoms recur.
12-Lead ECG
✓ Evaluate for MI ST elevation or depression and poor R wave progression. (only way to identify STEMI)
IV Access
✓ Large gauge IV in antecubital fossa.
Notify Hospital
✓ Take to PCI center if probable STEMI.
✓ Activate ACS protocol at hospital.

Acute Coronary Syndromes Algorithm



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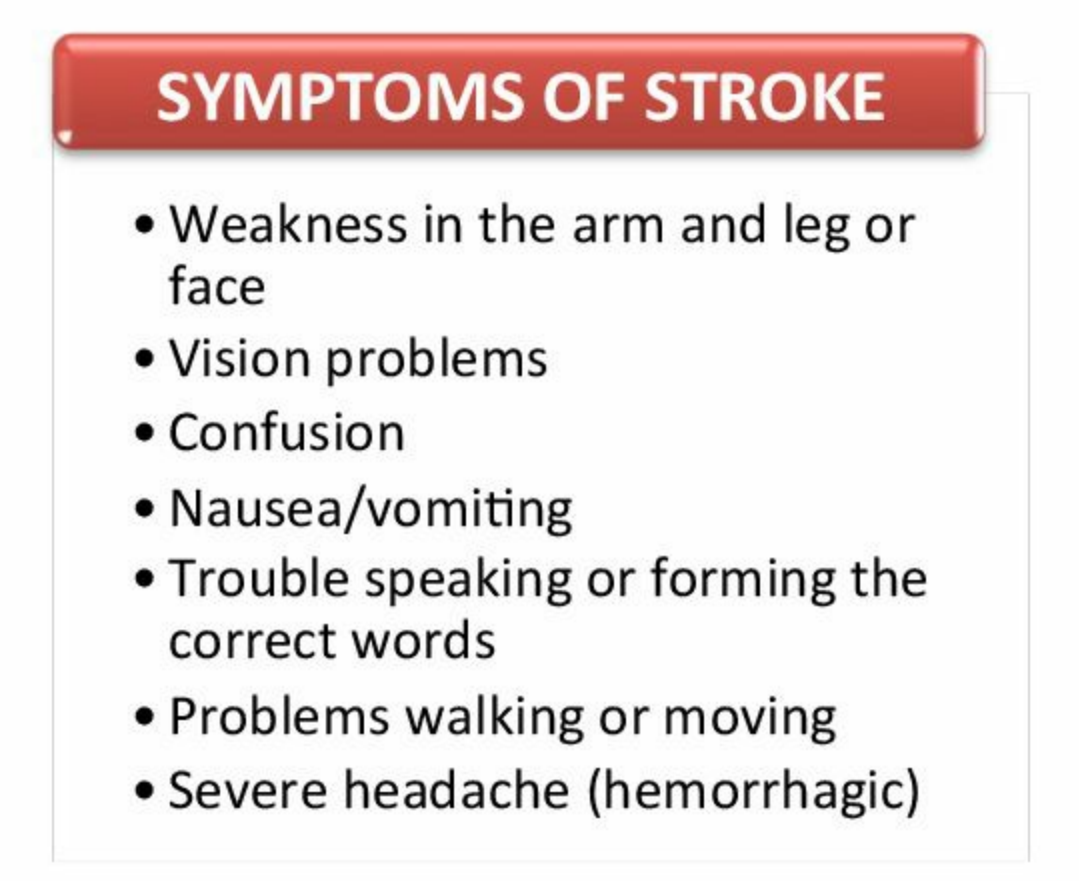
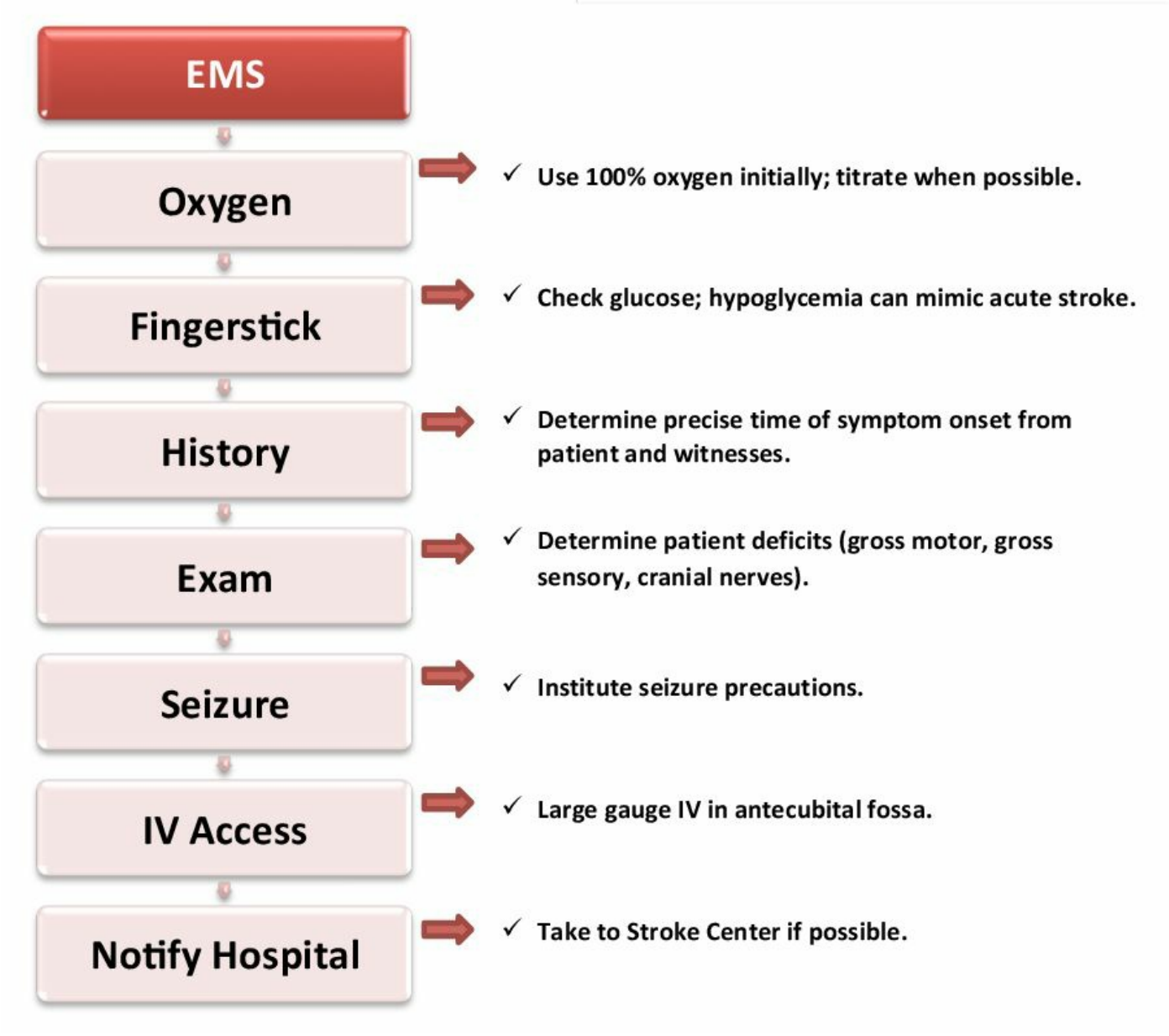
ACUTE STROKE

Stroke describes a condition in which normal blood flow to the brain is interrupted. Strokes often occur in two variations. In ischemic stroke, a clot lodges in one of the brain's blood vessels, blocking blood flow through the blood vessel. In hemorrhagic stroke, a blood vessel in the brain has ruptured, spilling blood into the brain tissue. In general, the symptoms of ischemic and hemorrhagic strokes are similar. Ischemic stroke and hemorrhagic stroke account for 87% and 13%, respectively. The treatments, however, are treated in very different ways.

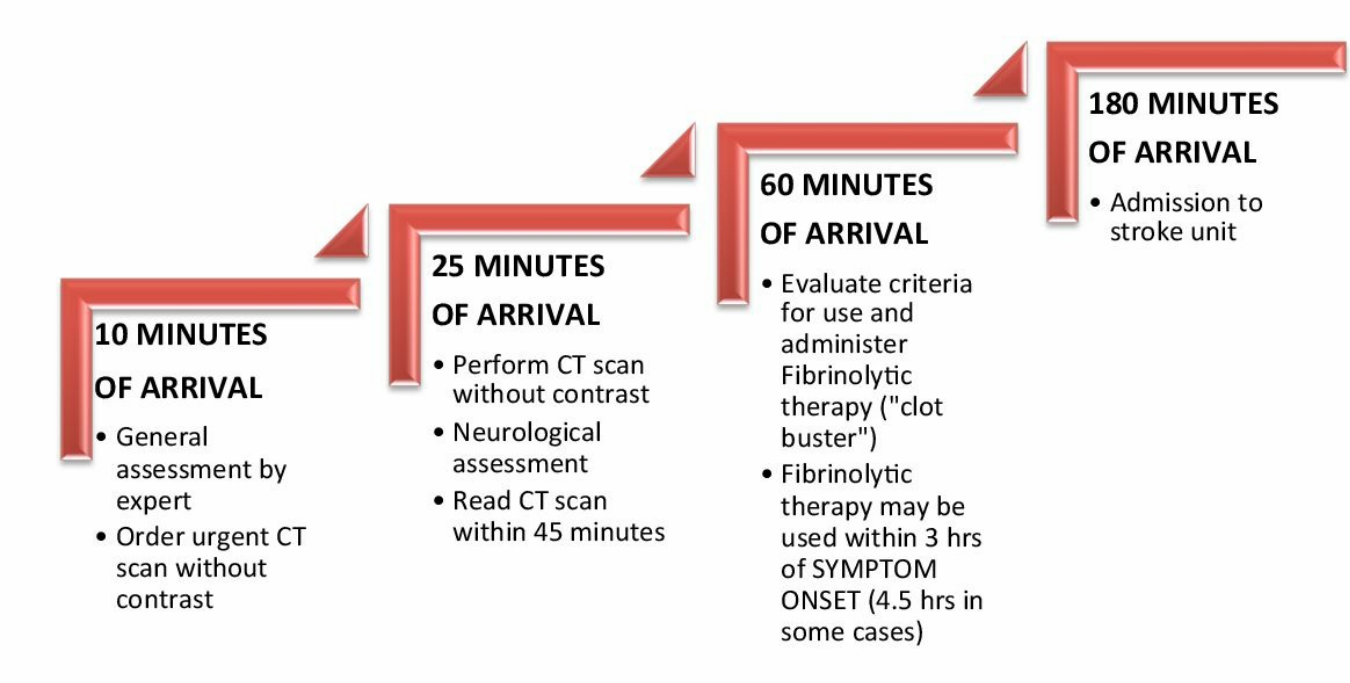




The Cincinnati Prehospital Stroke Scale (CPSS) is used to diagnose the presence of stroke in a patient if any of the following physical findings are seen: facial droop, arm drift, and abnormal speech. Patients with one of these three findings as a new event have a 72% probability of an ischemic stroke. If all three findings are present, the probability of an acute stroke is more than 85%. Patients with ischemic stroke who are not candidates for fibrinolytic therapy should receive aspirin unless contraindicated (i.e., allergy to aspirin). All patients with confirmed stroke should be admitted to Neurologic Intensive Care Unit if available. Stroke treatment includes blood pressure monitoring and regulation per protocol, seizure precautions, frequent neurological checks, airway support as needed, physical/occupational/speech therapy evaluation, body temperature, and blood glucose monitoring. Patients who received fibrinolytic therapy should be followed for signs of bleeding/hemorrhage. Certain patients (age 18-79 with mild to

moderate stroke) may be able to receive tPA up to 4.5 hours after symptom onset. Under certain circumstances, intra-arterial tPA is possible up to 6 hours after symptom onset. When the time of symptom onset is unknown, it is considered an automatic exclusion.

- ✓ ***TIME IS BRAIN!***
- ✓ ***Before giving anything (medication or food) by mouth, you MUST perform bedside swallow screening. All acute stroke patients are considered NPO on admit.***
- ✓ ***The goal of the stroke team, emergency physician, or other experts should be to assess the patient with suspected stroke within 10 minutes of arrival in ED.***
- ✓ ***The CT scan should be completed within 25 minutes of patient's arrival in the ED and should be read within 45 minutes.***



EMERGENCY DEPARTMENT STAFF

- Complete EMS care
- Targeted stroke evaluation
- Establish symptom onset time
- CT scan of brain STAT
- Obtain 12-Lead ECG
- Check glucose and lipids
- Contact Stroke Team

ISCHEMIC

- Confirm time of symptom onset
- Perform targeted neurological exam (NIH Stroke Scale)
- Complete fibrinolytic checklist

HEMORRHAGIC

- Consult Neurosurgery
- Coagulation panel, type and screen

EXCLUSION CRITERIA

- Head trauma in last three months
- Stroke in last three months
- Subarachnoid hemorrhage
- Arterial puncture in last seven days
- Previous ICH
- Active bleeding
- Heparin in last two days
- Elevated INR
- Hypoglycemia
- Very large brain infarct (multilobe)
- Platelets < 100,000/ mm^3

NO FIBRINOLYTIC

RELATIVE EXCLUSIONS

- Very minor/resolving symptoms
- Seizure may be affecting neurological exam
- Surgery or trauma in last 14 days
- Major hemorrhage in last 21 days
- Myocardial Infarction in last three months

IF BENEFIT OUTWEIGHS RISK...

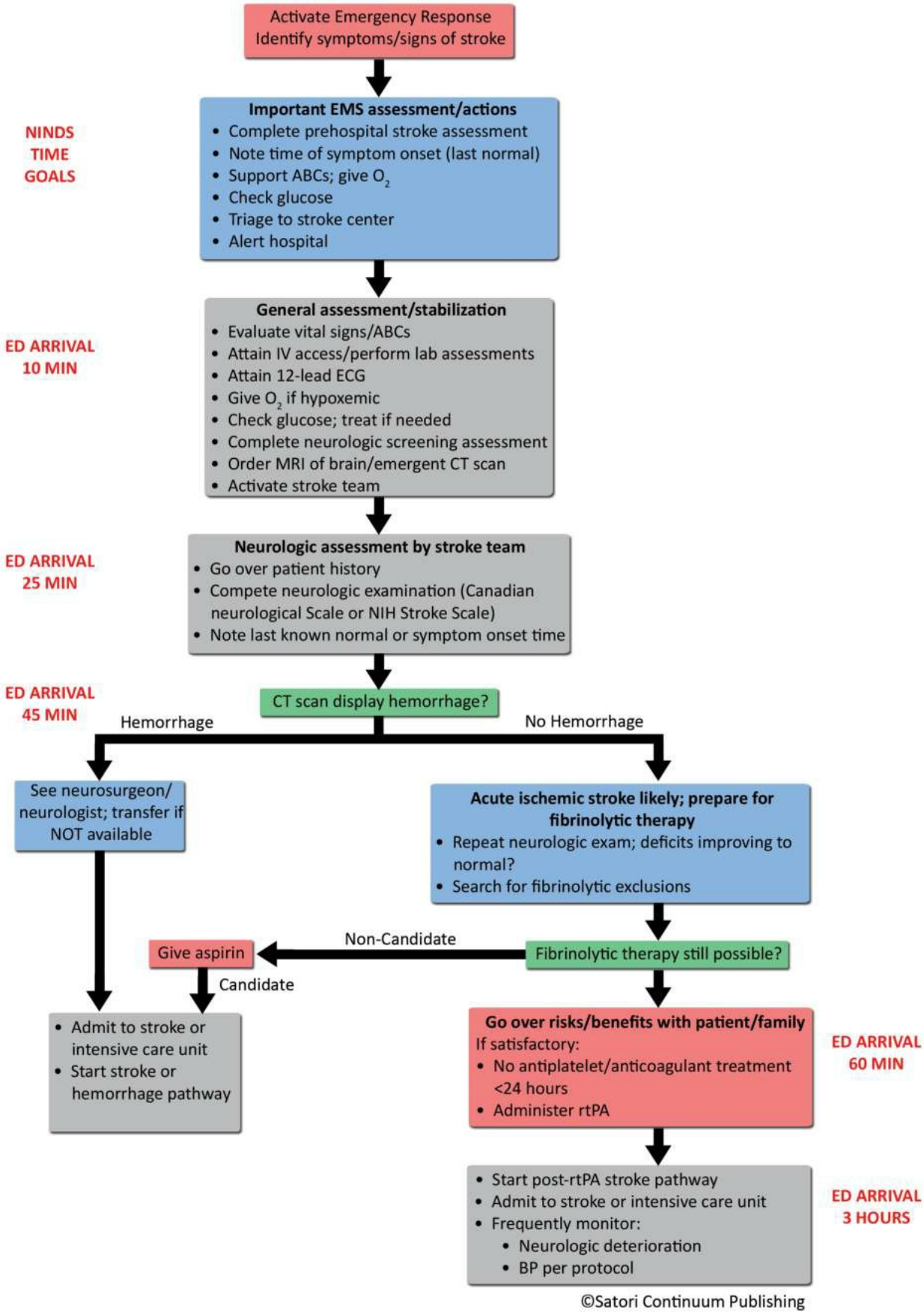
ADMINISTER FIBRINOLYTIC

INCLUSION CRITERIA

- Symptoms onset within the last three hours (unless special circumstances)
- 18 years or older
- Ischemic stroke with neurologic defect

ADMINISTER FIBRINOLYTIC

Adult Suspected Stroke Algorithm



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ADDITIONAL NHCPS TOOLS

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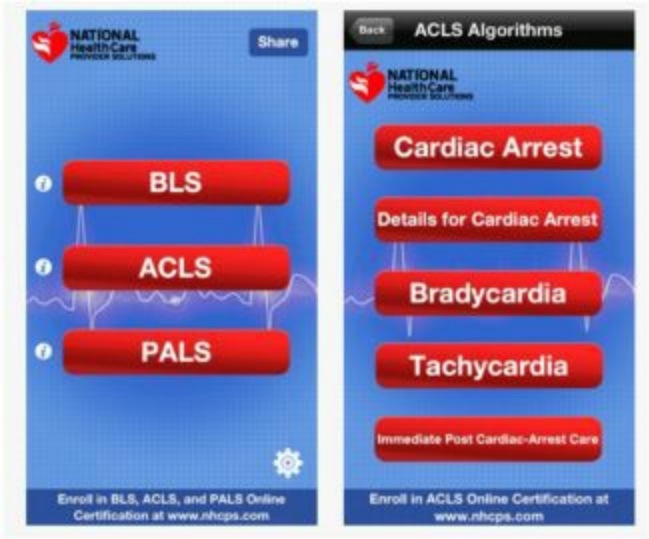
No longer will you have to carry a set of expandable cards with you at all times while at work. No longer will you waste valuable time in an emergency situation searching through multiple algorithms until you find the right one. All of the algorithms can be accessed from the palm of your hand and you'll be selecting your desired algorithm by memory in no time. Choose between multiple viewing options, and easily share algorithms with co-workers and friends through email and social media.

To improve functionality and ease getting to your desired algorithm as quickly as possible in an emergency, they have been divided between BLS, ACLS and PALS on the main screen. The individual algorithms included within this app are:



- Basic Life Support
- Advanced Cardiac Life Support
- Pediatric Advanced Life Support

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