Cardiopulmonary Resuscitation (CPR), One-Person: Infant (Age 1 Month to 1 Year) – Performing

What is One-Person Cardiopulmonary Resuscitation (CPR) for Infants?

- Cardiopulmonary resuscitation (CPR) for infants (i.e., babies, from one month in age to 1 year of age [12 months]) is an emergency procedure used to maintain tissue perfusion during cardiopulmonary arrest (no pulse) or, despite oxygenation and ventilation, if the patient’s heart rate is < 60 beats per minute (BPM) with signs of poor perfusion. The subject of this topic is one-person infant CPR, which refers to the administration of CPR by a single rescuer—chest compressions, rescue breathing, and the use of a manual defibrillator or an automated external defibrillator with pediatric dose attenuator (AED). Infants younger than 1 month are considered newborns and should be treated according to Neonatal Resuscitation Program (NRP) guidelines issued by the American Academy of Pediatrics (AAP) in collaboration with the American Heart Association (AHA). One-person CPR should transition to two-person CPR upon the arrival of a second qualified rescuer. For information about how to perform two-person CPR for infants, see Nursing Practice & Skill: Cardiopulmonary Resuscitation (CPR), Two-Person: Infant (Age 1 Month to 1 Year) – Performing. The information contained in this Nursing Practice & Skill is intended to present an overview of how to perform one-person CPR on an infant.

- What: The most recently released guidelines from the AHA were published in 2010 and continue to maintain that prompt initiation and proper technique during CPR are the most important factors in improving survival following cardiopulmonary arrest. In keeping with best evidence, the focus of infant, child, and adult CPR has shifted from the sequence of A-B-C (Airway, Breathing, Circulation) to C-A-B (Circulation, Airway, Breathing) to emphasize the priority of administering high-quality chest compressions (for infants this is defined as pushing against the center of the infant’s sternum, just below the nipple line, at least ⅓ of the depth of the chest [approximately 1½ in/4 cm] at a rate of at least 100 compressions per minute); AHA guidelines state “the foundation of CPR is chest compressions.” The fourth component of BLS is “D,” representing defibrillation for shockable rhythms (e.g., ventricular fibrillation [VF] and pulseless ventricular tachycardia [pVT]) using a manual defibrillator/AED. (Note: For infants, a manual defibrillator is preferred to an AED because the electrical charge can be more precisely controlled). Note: Beginning in 2016, the minimum rate for compressions per minute is 120.

- How: Performing CPR involves assessing for responsiveness and breathing, then progressing through the C-A-B and D steps of the Pediatric BLS Algorithm (AHA, 2011a; AHA, 2011b). If the arrest was not witnessed, the rescuer should check for pulse to confirm cardiopulmonary arrest and perform two minutes of CPR (chest compressions and rescue breaths) before leaving the infant to activate the emergency response system (ERS) and retrieve a manual defibrillator/AED. If the arrest was sudden and witnessed, the rescuer should leave the infant to activate the ERS and obtain a manual defibrillator/AED.
AED return to the infant check for pulse analyze the infant’s rhythm defibrillate, if appropriate begin chest compressions. AHA guidelines require that when a single rescuer is present, continuous cycles of infant CPR are performed using a ratio of 30 chest compressions to two rescue breaths over a two-minute period (approximately 5 cycles of CPR), alternating CPR with analysis and defibrillation (if appropriate) until care of the infant is turned over to a pediatric advanced life support (PALS)-trained clinician.

- Where: CPR is performed in both healthcare and community settings. In the community setting, where rescue supplies and equipment are not readily available, basic CPR is performed until ERS personnel arrive with equipment. In acute care facilities and other healthcare settings, basic CPR is performed by healthcare professionals trained in BLS until the arrival of PALS-trained clinicians.
- Who: The one-person rescuer method is rarely used in the healthcare setting because of the availability of trained staff. CPR can be performed by trained healthcare professionals and by appropriately trained nonprofessionals. Family members are often present during CPR interventions that occur outside of the hospital, and can be present during in-hospital intervention if their presence does not impede resuscitation efforts. Family members can be valuable sources of information for any relevant events that preceded cardiopulmonary arrest.

**What is the Desired Outcome of Performing One-Person Cardiopulmonary Resuscitation (CPR) for Infants?**

The desired outcome of performing CPR is to maintain tissue perfusion to vital organs during cardiopulmonary arrest. In the case of infants, the desired outcome is expanded beyond the basic goal in adult CPR (i.e., return of spontaneous circulation [ROSC]) to a more specific result: maintaining blood oxygenation and tissue perfusion until the patient has resumed normal breathing and his/her pulse is > 60 bpm with signs of adequate perfusion.

**Why is One-Person Cardiopulmonary Resuscitation (CPR) for Infants Important?**

CPR is the initial emergency measure used to treat individuals in cardiopulmonary arrest. CPR cannot restore normal myocardial electrical activity in a patient who has no electrical activity (e.g., asystole), or in patients with uncoordinated electrical activity between the ventricles (e.g., VF and pVT). However, administering high-quality chest compressions and rescue breaths can “buy time” until defibrillation is possible by promoting adequate oxygenation and tissue perfusion to reduce the risk of brain injury and death.

**Facts and Figures**

- More than 50% of children who require CPR are < 1 year old; the majority are < 6 months old (O’Connor, 2013).
- Respiratory failure precedes cardiac arrest for the majority of infants and children so that, unlike adults, oxygen content in the blood is reduced before the onset of arrest. Therefore, chest compressions alone are often insufficient to deliver adequate oxygen to vital organs. Because the etiology of cardiopulmonary arrest often cannot be immediately identified, it is critical to administer both compressions and rescue breaths to infants and children during CPR (AHA, 2011a; AHA, 2011b).
- Although compression-only CPR (i.e., CPR performed without rescue breathing) is unsuccessful in children with asphyxia or other non-cardiac arrest (71% of arrest victims), investigators report that compression-only CPR can be effective in the 29% of children whose arrest has a cardiac etiology (Berg et al., 2010; Hüpfl et al., 2010; Kitamura et al., 2010).
- Despite the use of CPR, the mortality rate in infants and children who experience cardiac arrest is 73–97%, depending if arrest occurs in-hospital and if the arrest is witnessed. Children and infants who survive are often severely neurologically compromised (O’Connor, 2013).
- The survival rate for infants and children who experience in-hospital cardiac arrest is 27%, which is significantly higher than the survival rate for infants and children who experience out-of-hospital cardiac arrest, which is 3% and 9%, respectively (Kleinman et al., 2010).
- Researchers who reviewed patient registries of > 300 U.S. and Canadian hospitals reported the following pediatric patient outcomes based on the duration of CPR following in-hospital cardiac arrest (Matos et al., 2013):
  - The survival-to-discharge rate for all patients was roughly 28%, with only 19% of all patients demonstrating favorable neurological outcomes.
  - The adjusted probability of survival for patients who required CPR for ≤ 15 minutes was 41%.
  - The adjusted probability of survival decreased to 12% for patients who required CPR for > 35 minutes.
  - Among survivors, 70% of those who required CPR for < 15 minutes and 60% of those who required CPR for > 35 minutes had favorable neurological outcomes.
Researchers, who evaluated the quality of chest compressions after providers practiced on infant manikins, reported chest compression effectiveness improved from < 1% (without real-time feedback) to 75–80% (with real-time feedback) (Martin et al., 2013)

What You Need to Know Before Performing One-Person Cardiopulmonary Resuscitation (CPR) for Infants

Prior to performing one-person CPR of an infant, the nurse clinician should be knowledgeable about
• current AHA guidelines for infant CPR for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care, which discuss
  – preliminary steps, such as
    - checking Do Not Resuscitate (DNR) status—look for an armband or other easily-spotted indication. Before initiating CPR in the healthcare setting, quickly check for a DNR armband or other indicator that designates the family/caregiver instructions regarding the desired extent of response efforts
    - assessing scene safety. Confirm the scene is safe for the rescuer and the patient
    - assessing the patient, which involves
      - checking the patient for a conscious response. Sharply tap the sole of the infant’s bare foot while speaking loudly to the infant
      - observing for normal breathing—agonal, gasping breaths are not recognized as normal breathing. Some instructors encourage rescuers to wave a hand over the patient’s chest (the “magic wand” approach) to focus attention for 5–10 seconds while observing for breathing/chest rise
    - activating the ERS. If the patient is not conscious or breathing normally, shout “I need help! Bring a manual defibrillator/AED” and activate “Code Blue” response (i.e., pushing a wall button with a direct connection from the patient’s room to a central alarm that activates a code response). Note: The code call for infants and pediatric patients (e.g., Code White) is often designated differently from the code call for adults to alert the code team to bring the pediatric-equipped emergency resuscitation cart (crash cart). A key difference between adult and infant CPR is when the ERS system is activated
      - If the arrest is not witnessed, check for a pulse to confirm cardiopulmonary arrest, and provide 5 cycles of CPR (approximately two minutes) before leaving the infant to activate the ERS and obtain a manual defibrillator/AED
      - If the arrest is sudden and witnessed, leave the infant to activate the ERS and retrieve a manual defibrillator/AED, then return to the infant to perform pulse check and begin chest compressions
    - palpating for a pulse. Palpate for the brachial pulse at least 5 seconds, but no more than 10 seconds. Locate the brachial pulse by gently pressing the index and middle fingers on the inside of the infant’s upper arm between the elbow and shoulder. Begin chest compressions if a distinct pulse cannot be palpated within 10 seconds
      - If a pulse is detected, but the patient is not breathing, perform rescue breathing by delivering 12–20 breaths/minute (approximately 1 breath every 3–5 seconds) and checking the brachial pulse every two minutes
      - Except for the pulse check during the initial assessment, AHA guidelines continue to deemphasize the importance of pulse check during CPR, “Because of the difficulties with pulse assessments, interruptions for a pulse check should be minimized during resuscitation, even to determine if ROSC has occurred” (Berg et al., 2010). Pulse check should be performed every two minutes during reassessment, when the patient’s breathing and cardiac rhythm is assessed—“C” for circulation. Perform chest compressions on a firm, flat surface. In infants, chest compressions should be delivered at a minimum rate of 100 compressions per minute at least 1½ in/4 cm (⅓ the anterior-posterior [AP] depth) of the infant’s chest
      - Compressor body and hand position: The chest compression technique recommended for one-person infant CPR is the two-finger method in which the rescuer places two fingers against the middle of the patient’s chest, just below the nipple line. Avoid pressing against the xiphoid process located at the very tip of the sternum
      - Chest compression technique: High-quality chest compressions for one-person infant CPR are performed using the two-finger method with the fingertips pressed against the center of the infant’s chest, just below the nipple line. The fingertips are pressed downward, approximately ⅓ the AP depth of the infant’s chest (approximately 1½ in/4 cm) at a minimum rate of 100 compressions per minute. Allow the chest to recoil (re-expand) completely to permit blood to flow back into the heart. Compression and recoil times should be approximately equivalent
      - Chest compression rate/cycle: The universal compression-ventilation ratio for a single rescuer of patients of all ages is 30 compressions to 2 breaths. This 30:2 compression/ventilation cycle is repeated for two minutes (approximately 5 cycles) at which time the infant is reassessed for breathing and pulse. It is critical to minimize interruption to chest compressions when delivering rescue breaths (10 seconds)
- A key difference between adult and infant CPR is the CPR endpoint. In adults, CPR is continued until ROSC. In infants, CPR is continued until the pulse rate is 60 bpm with signs of adequate perfusion

- “A” for airway, opening the airway, use of barrier device (e.g., face mask and bag-valve-mask device [BVM]), and advanced airway devices to support delivering rescue breaths

- Airway techniques include the head tilt-chin lift method and the jaw thrust method. The head tilt-chin lift method is the preferred method for opening the airway unless a head or neck injury is suspected

- Perform the head tilt-chin lift method as follows:
  - Standing at the side of the patient’s head, place the open palm of the hand nearest the patient’s forehead against the forehead and tilt the head back. To avoid airway obstruction, do not hyperextend the neck. Be aware that extending an infant’s head beyond the neutral “sniffing” position (i.e., when supine, the external ear canal is level with the top of the infant’s shoulder) can block the soft tissues of the airway
  - Simultaneously, position the fingertips of the opposite hand under the bony part of the lower jaw to lift the jaw forward. This action lifts the tongue from the airway. Do not use the soft underside of the jaw to lift the chin

- The jaw thrust method is presented for information purposes only because this airway technique requires two rescuers: one to maintain the jaw thrust position and a second rescuer to hold the barrier device and deliver rescue breaths. (The head tilt-chin lift method can be used if the jaw thrust does not open the patient’s airway)

- The first rescuer, standing at the patient’s head,
  - places both hands on opposite sides of the patient’s face, resting his/her elbows on a firm surface next to the patient’s head and
  - places both thumbs at the corners of the patient’s mouth (below the lower lip), then
  - positions fingers under the mandibular angles of the patient’s lower jaw and lifts the jaw with fingers, displacing the jaw forward
  - If the patient’s lips close, pushes thumbs downward against the patient’s chin to open the mouth
  - The second rescuer, standing at the patient’s side (opposite from the compressor) next to the patient’s face, delivers rescue breaths

- Barrier devices include the face mask and the BVM. The “barrier” refers to the mask itself and the built-in one-way valve that diverts exhaled air, body fluids, or blood away from the rescuer. When using the mask, the rescuer should be positioned at the side of the patient, adjacent to the patient’s face. When using the BVM, the rescuer should be positioned above the patient’s head (unless the jaw thrust method was used to open the patient’s airway). Note: The BVM is the least effective method a single rescuer can use for providing rescue breaths because of the need to move back and forth between the patient’s side (for chest compressions) and the patient’s head (for effective BVM use). Use of the BVM is more appropriate for two-rescuer situations

- If using the face mask without the BVM,
  - stand at the patient’s side, next to his/her face
  - position the narrow portion of the mask over the patient’s face using the bridge of the nose as a guide; the wide portion of the mask should be positioned so that it rests beneath the lower lip, against the patient’s chin
  - position the index finger and thumb of the hand closest to the top of the patient’s head along the top edge of the mask (the last three fingers will rest against the patient’s forehead)
  - place the thumb of the second hand along the lower edge of the mask and the fingers along the bony margin of the patient’s jaw. Avoid pressing against the soft underside of the patient’s jaw to reduce the risk of airway blockage
  - once the mask is in position, press the cushioned/inflated edge of the mask firmly (not tightly) against the face so no air escapes during rescue breathing
  - perform the head tilt-chin lift to open the patient’s airway

- If working with the BVM, use the “E-C” clamp technique to hold the mask in place while lifting the jaw to open the airway

  - Stand above the patient’s head
  - Position the mask over the patient’s face using the bridge of the nose as a guide. The BVM should be connected to supplemental oxygen. If supplemental oxygen is not available, the BVM can still be used; however, it will deliver an oxygen concentration equivalent to the ambient room air (approximately 21%)
  - Place the thumb and forefinger around the “nozzle” or valve stem of the mask (forming a “C”), while using the 3rd, 4th, and 5th fingers against the bony margin of the patient’s jaw to form an “E.” If a tighter grip is needed, encircle the valve stem of the mask with the thumb and forefinger and use the remaining fingers to grasp the underside of the mandible—this grasp is called the “O.K.” sign because of the way the hand is configured
- Once the mask is in position, press the cushioned/inflated edge of the mask firmly (not tightly) against the patient’s face to prevent air from escaping during rescue breathing
- Perform a head tilt-chin lift to open the patient’s airway
- Typically, advanced airway devices such as the laryngeal mask airway (LMA), endotracheal tubes (ETT), and the Combitube are not used by lone rescuers. See the series of Nursing Practice & Skill topics for more information about using or assisting with placement of these devices
- “B” for rescue breathing. The goal of rescue breathing is to introduce oxygen into the patient’s blood for delivery to critical organs. The rescuer must be careful to deliver effective rescue breaths—each breath should last one second and the time required to deliver two rescue breaths should not exceed 10 seconds. Adequate ventilation is assumed if the patient’s chest is seen to rise during each rescue breath. Do not administer more than two breaths with each round of 30 compressions to avoid unnecessary delay in delivering chest compressions and the risk of over-ventilation, which can lead to gastric distension and cardiopulmonary compromise if excess air becomes trapped in the lungs and prevents cardiac expansion
- The “one second rule” (i.e., delivering breaths over one second) is followed when administering rescue breaths for all methods of oxygen delivery (e.g., mouth-to-mouth breaths, when using a face mask, when squeezing supplemental oxygen through a BVM, and when using an advanced airway)
- The rate of delivering rescue breaths changes depending on whether the patient has an advanced airway in place and if the patient is in cardiac or respiratory arrest:
- For cardiac arrest in infants without an airway adjunct, rescuers must pause chest compressions to provide rescue breaths
- For cardiac arrest in patients with an airway adjunct, rescuers do not pause compressions to administer rescue breaths; breaths are administered over one second every 6–8 seconds (8–10 breaths per minute)—do not stop chest compressions to deliver rescue breaths. This situation requires two-rescuer CPR, one to continue compressions and the second rescuer to provide continuous rescue breaths
- For respiratory arrest in infants with or without an airway adjunct, rescue breaths are administered over one second every 3–5 seconds (12–20 breaths per minute)
- Use care to deliver an adequate volume of air (just enough to see the chest rise). Be mindful of the infant’s smaller lung capacity and do not over-ventilate the infant
- “D” for Defibrillation. For infants, a manual defibrillator is preferred to an AED; however, if a manual defibrillator is not available, use an AED that has been modified to deliver a shock dose appropriate for an infant (e.g., pediatric-capable AED or AED with pediatric attenuator). If the patient’s heart requires defibrillation, an unmodified AED can be used if neither is available—a non-ideal shock is better than no shock. Use of an AED without a pediatric attenuator is better than no defibrillation. The manual defibrillator/AED should be used as soon as the device becomes available. Note: Use of a manual defibrillator requires knowledge of EKG rhythms and the ability to recognize shockable rhythms (e.g., VF and pVT), which is beyond the scope of BLS
- Power on the manual defibrillator/AED
- Place the adhesive side of pediatric-sized electrode pads over the proper locations against patient’s bare chest—one pad is positioned on the upper-right side of the chest (just below the collarbone) and the second pad is positioned to the lateral side of the left nipple several inches/centimeters below the left armpit (most electrode pads include a diagram identifying correct chest placement). Adult pads can be used if infant-sized pads are unavailable; confirm the pads do not touch or overlap
- Avoid placing the electrode pad over any implanted device or medication patch. Note: Chest compressions should not be stopped during electrode pad placement—it is prudent to remove the patient’s shirt/top/gown during the initial assessment to better assess the patient’s chest for rise and fall and to avoid having to stop chest compressions to remove the clothing for electrode pad placement
- Attach the electrode cables to the manual defibrillator/AED
- Defibrillator/AED use:
  - Manual defibrillator: If the monitor displays a shockable rhythm (e.g., VF or pVT), charge the machine to the appropriate energy level. (See the series of Nursing Practice & Skill topics about cardiac rhythms for more information regarding the types of cardiac rhythms that require defibrillation/shock.) An initial dose of two joules/kg is advised, increasing to 4 joules/kg for subsequent shocks, if necessary. Doses higher than 4 joules/kg, if delivered with a biphasic manual defibrillator, can be safe and effective (Kleinman et al., 2010; O’Connor, 2013). (Note: The preceding information regarding use of a manual defibrillator is provided for information purposes only because rhythm analysis using a defibrillator monitor, required before administering a shock, is beyond the scope of BLS practice)
- If electrode pads are not available, recall that manual defibrillator paddles can be altered for pediatric patients by removing the adult-size surfaces covering the smaller, pediatric/infant-size paddle surface. Paddles are more difficult to use because it is necessary to apply approximately 35 lb of pressure against the patient’s chest while simultaneously pressing the shock buttons on both paddles and avoiding any direct contact with the patient and the patient’s bed.

- AED use: If using an AED with a pediatric attenuator, turn the key or switch that allows delivery of a child-shock dose. Initiate machine analysis of the rhythm by pushing the appropriate button or monitor dial. Analysis can require 5–15 seconds—DO NOT PERMIT ANYONE TO TOUCH THE PATIENT DURING RHYTHM ANALYSIS—electrical activity from rescuers can impede accurate analysis. The machine will advise if a shock/defibrillation is needed. Note: An AED with pediatric cables (i.e., maximum biphasic shock of 50 joules) is preferred for children between 1 and 8 years of age. There is insufficient evidence to recommend for or against use of AEDs in infants < 1 year of age (Kleinman et al., 2010; O'Connor, 2013).

- Warn all persons to step away from the patient by announcing, “Clear the patient,” and confirming everyone is away from the patient and the patient’s crib/surface by observing the patient and surrounding area as you state, “I’m clear. You’re clear. We’re all clear.” Be mindful that the clinician administering the shock is responsible for the safety of everyone, including the infant.

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- Press the shock/defibrillate button or panel on the device—observe for a sudden contraction of the patient’s muscles. Note: “stacked shocks” (i.e., shocks with increasing levels of energy administered without pause) are no longer advocated because they have not been shown to improve rhythm conversion.

- Chest compressions should be resumed immediately after the shock is delivered, followed by rescue breaths in a 30:2 ratio per cycle for two minutes.

- Reassess. After approximately two minutes of CPR administered in 5 cycles of 30 compressions and two rescue breaths, the AED will prompt a rhythm check. Patient reassessment (i.e., breathing and pulse check) should be performed every two minutes. Pulse check is critical—recall that electrical activity on the monitor does not confirm the presence of a pulse; pulseless electrical activity [PEA] will produce a rhythm on the defibrillator/AED monitor but will not yield a pulse.

- Shock if indicated (following the above steps), or if no shock is indicated, continue CPR beginning with chest compressions.

- Continue to alternate the delivery of shocks every two minutes with the delivery of 5 cycles of CPR (30 compressions to 2 rescue breaths per cycle) until the patient’s heart rate > 60 bpm with adequate perfusion, a second rescuer arrives, or care of the patient is turned over to a PALS-trained clinician.

Preliminary steps that should be taken prior to performing two-person CPR include the following:

- Become BLS-certified through the AHA. The BLS designation must be renewed every two years to remain current.

- Review the facility/unit-specific protocol for responding to cardiopulmonary arrest, including the procedure for notifying the ERS, as appropriate.

- Healthcare organizations develop their own resuscitation protocols based on current guidelines published by expert organizations such as the AHA. It is essential to adhere to your specific facility/unit-specific protocol, which can vary from other protocols. For example, each facility/unit-specific protocol will specify how to notify the appropriate ERS (e.g., notify facility “Code Blue/White” or “Rapid Response” teams).

- Although CPR can be performed with no equipment, as is often the case in the community setting, a barrier device (e.g., face mask, BVM) is strongly recommended. Note: Typically, most hospitals equip each patient area with a face mask, a BVM and tubing for connection to supplemental oxygen via wall outlet or oxygen gas cylinder with flow meter attachment, and suction equipment. Additional supplies to consider include the following:

  - Nonsterile gloves. Personal protective equipment (PPE; e.g., gloves, mask) should be worn to minimize exposure to blood and body fluids; however, CPR should not be delayed to locate PPE.

  - Manual defibrillator or an AED equipped with a pediatric attenuator.

  - Advanced airway supplies (e.g., LMA, ETT, Combitube) in pediatric sizes.

  - Backboard or other hard surface.

**How to Perform One-Person Cardiopulmonary Resuscitation (CPR) for Infants**

- Parent or caregiver consent is implied because CPR is a universally accepted standard of care.

- Don gloves, if readily available, to comply with standard precautions. DO NOT DELAY CPR TO LOCATE PPE.

- Initiate one-person CPR for infants CRPAs follows:

  - Confirm the patient’s resuscitation status—quickly look for a DNR armband.
• Assess the area to verify it is safe for the rescuer and the patient
• Check the patient for level of consciousness and for breathing—gasing breaths are not considered adequate breaths
  – Establish the patient is unresponsive. Sharply tap the sole of the infant’s bare foot while speaking loudly to the infant
  – Scan for breathing—observe for chest rise and fall for at least 5 seconds but no more than 10 seconds. If the patient is
    unresponsive but still breathing (not gasing), do not initiate CPR and notify the treating clinician immediately
• If the rescuer is alone and the attack is not witnessed, check the brachial pulse for at least 5 seconds, but no more than 10
  seconds. If the patient is pulseless, providetwo minutes of CPR before leaving the infant to activate the ERS and retrieving
  the manual defibrillator/AED
  – Check for a brachial pulse, taking at least 5 seconds but no more than 10 seconds
    - If a pulse is detected, but the patient is not breathing, perform rescue breathing by delivering 12–20 breaths/minute
      (approximately one breath every 3–5 seconds) and checking the brachial pulse everytwo minutes
    - If no pulse is felt or you are unsure of the pulse, begin two minutes of CPR (30 chest compressions followed by
      2 rescue breaths) using the two-finger technique; complete approximately 5 cycles of CPR. (If possible to be
      completed quickly, it is prudent to remove clothing from the infant’s chest at this time so it will not be necessary to
      stop compressions during application of the electrode pads when the manual defibrillator/AED arrives. Clothing
      removal can be performed by a bystander, if one is available. Do not delay chest compressions to remove clothing)
  - “C”: Administer 30 high-quality chest compressions against the center of the infant’s chest, just below the nipple line,
    using a smooth, hard, and fast motion, pushing straight down against the sternum (at least ¼ the AP depth of
    the infant’s chest or approximately 1½ in./4 cm) at a minimum rate of 100 compressions per minute. Allow the chest to
    recoil completely—chest compression and recoil times should be equivalent
  - “A”: Airway. Place a face mask over the infant’s mouth and nose with the narrow part of the mask over the bridge of the
    patient’s nose. Open the patient’s airway using either the head tilt-chinlift method or, if head injury is suspected, with
    the jaw thrust method (the jaw thrust method typically requires two people). The time needed to open the patient’s
    airway, place the barrier device, and administer two rescue breaths should not exceed 10 seconds
  - “B”: Rescue breaths. Deliver two rescue breaths, observing for chest rise. Do not over-ventilate the infant
    – After delivering two rescue breaths, resume chest compressions and complete a total of 5 CPR cycles, each cycle
      composed of 30 chest compressions and two rescue breaths (approximately two minutes)
    – Leave the infant to activate the ERS and retrieve the manual defibrillator/AED
    – Return to the infant and perform a pulse check
• If you are rescuer alone and the attack is sudden and witnessed, leave the infant to activate the ERS and retrieve the
  manual defibrillator/AED; return to the infant and perform a pulse check
• If the infant remains pulseless, set up the manual defibrillator/AED. Do not administer a shock if the patient has a pulse
  (see Red Flags, below). If appropriate, defibrillation should be performed as soon as it becomes available
  – Power on the manual defibrillator/AED
    – If using an AED without a pediatric attenuator, set the energy level to the appropriate level for an infant
    – Attach pediatric-sized electrode pads on the infant’s chest—do not place the electrode pads over wet skin (quickly dry
      the skin), implanted medical devices, or medicine patches (remove the patch and wipe the skin dry). Adult-sized electrode
      pads can be used if pediatric-sized pads are not available—confirm the pads do not touch/overlap
    – Attach the connecting cables to the manual defibrillator/AED. Note: The previous three steps (e.g., opening and powering
      on the defibrillator/AED, attaching the pads, and connecting the cables) should be performed within 30 seconds after
      defibrillator/AED arrival
  – Prepare to analyze the infant’s cardiac rhythm
    - If using a manual defibrillator, a person trained in EKG rhythm analysis is needed to interpret the rhythm and deliver a
      shock at the appropriate energy level. (Note: Rhythm analysis is beyond the scope of BLS)
    - If using an AED, “clear” all people from the patient; it is important for all rescuers to step away from the patient during
      machine analysis so the sensing element does not mistakenly analyze rescuer cardiac rhythms
    - Press the “Analyze” button; The AED will advise if a shock is needed and will automatically charge for the shock
  – Prepare and administer a shock
    - Loudly state a warning such as, “Everybody clear!” and confirm visually that all persons are physically separate from
      the infant and the infant’s bed
    - Press the “Shock” button/panel and observe the patient for a sudden muscular contraction
• Resume chest compressions immediately following delivery of the shock using the ratio for one-person infant CPR (30
  compressions to 2 rescue breaths)
• Reassess the patient (i.e., check the infant for pulse, breathing, and rhythm) after two minutes (approximately 5 CPR cycles). In the event the infant is experiencing PEA, always check the pulse after rhythm check even if the monitor shows a perfusing rhythm.

• Continue to alternate delivery of 5 cycles of CPR (30 compressions to 2 rescue breaths—approximately every two minutes with reassessment/analysis/shock until
  – the infant’s heart rate is > 60 bpm with adequate perfusion. Post-resuscitation care will be directed by the treating clinician to optimize cardiopulmonary function and vital organ perfusion
  – a second rescuer arrives, at which time the CPR cycle changes to 15 compressions to 2 rescue breaths (10 cycles every two minutes) and the two-thumbs-encircling hands technique is used to provide chest compressions
  – a PALS-trained clinician arrives and assumes the role of team leader following PALS protocol

› If additional staff members arrive, request assistance with setting up suctioning equipment—ventilation with a BVM can cause air to enter the stomach leading to distension and vomiting
› Provide report to the clinician assuming care of the patient; assist as needed
› Discard PPE and other used supplies per facility protocol; return crash cart to central services/pharmacy for resupply if the seal on the cart was opened during the CPR intervention
› Perform hand hygiene

› Update the patient’s plan of care, if appropriate, and document the following information in the patient’s medical record using facility-designated forms for CPR:
  • Time the patient was found unresponsive and not breathing
  • Time CPR was initiated
    – Indicate the type of barrier device used
    – Indicate the type of artificial airway inserted, if any
    – Indicate if supplemental oxygen was utilized
  • Time of arrival of manual defibrillator/AED and PALS-trained clinicians
    – Include EKG rhythm strips if available
  • The patient’s response to CPR and his/her current condition, including post-resuscitation disposition
  • Time the treating clinician (if not present during the resuscitation efforts) and family/caregivers were contacted to advise of CPR event
  • Family/caregiver education, including topics presented, response to education provided/discussed and details regarding any barriers to communication and/or techniques that promoted successful communication

Other Tests, Treatments, or Procedures That Can Be Necessary Before or After Performing Cardiopulmonary Resuscitation (CPR) for Infants

› Depending on the outcome of CPR, in accordance with the treating clinician’s orders,
  • post-resuscitation efforts will be initiated
    – If CPR is successful and the individual has suspected neurological, organ, or bone damage, diagnostic and treatment procedures can be ordered (e.g., 12-lead EKG, CAT scan)
    – Continue to monitor the patient’s vital signs, with special attention to respiratory rate, heart rate, and heart rhythm, per the facility protocol, and assist with transfer of the patient to the pediatric intensive care unit
  • autopsy can be conducted to determine the cause of cardiopulmonary arrest

What to Expect After Performing Cardiopulmonary Resuscitation (CPR) for Infants

› A perfusing heart rhythm > 60 bpm and normal respirations will be reinstated. If the patient does not regain normal respiratory and heart function, the medical team in charge of the patient’s care can attempt other more invasive resuscitation measures if these technologies are available and advisable based on the patient’s medical condition
› Emotional support will be provided for the patient and family, as needed

Red Flags

› The manual defibrillator/AED should be used only if the patient is in cardiac arrest (i.e., does not have a pulse)—do not defibrillate if the patient has a pulse. The operator must check the pulse manually because a manual defibrillator/AED is not capable of this function
› If the patient vomits during CPR, turn the head to one side to prevent aspiration and attempt to wipe or suction vomitus if equipment is available—ventilation with a BVM can cause air to enter the stomach leading to distension and vomiting
Rib and sternal fractures can occur with chest compressions, potentially resulting in
• pneumothorax or hemothorax. Signs/symptoms include: chest pain, dyspnea, decreased breath sounds, and/or hyper-resonance over the one lung, tracheal deviation from midline, hypotension, and/or shoulder pain
• injury to the heart and/or great vessels. Check formuffled heart sounds, pulsusparadoxus (i.e., abnormally large decrease in systolic blood pressure and pulse wave amplitude during inspiration), electrocardiographic abnormalities, hypotension
• organ laceration, particularly among patients with increased abdominal girth or abdominal tenderness
• flail chest. Flail chest is suspected with paradoxical chest movement, palpable movement of bone fragments over the sternum, and/or chest pain

Superficial burns and worsening arrhythmia can occur as a result of defibrillation

What Do I Need to Tell the Patient’s Family?
Educate the patient and family, as appropriate, about the CPR event and the need for additional testing and interventions, if required

References