

PEDIATRIC ADVANCED LIFE SUPPORT GUIDELINES 2005 OVERVIEW

The following represents an outline of the American Heart Association Guidelines for Pediatric Basic Cardiac Life Support and Pediatric Advanced Life Support as published in Currents in Emergency Cardiovascular Care (Winter 2005-2006) and Circulation 2005;112:IV-1-IV-5.) © American Heart Association.

It is not intended to replace the PALS or BCLS textbooks or the attendance of an approved PALS or BCLS course. It is intended to be used as a study adjunct to those textbooks.

These guidelines are based on the most extensive evidence review of CPR yet published. The guidelines have been streamlined to reduce the amount of information that rescuers need to learn and remember, and to clarify the most important skills that rescuers need to perform.

Pediatric Basic Life Support

Rapid and effective bystander CPR is associated with successful return of spontaneous circulation and neurologically intact survival in children. The greatest impact occurs in respiratory arrest, in which neurologically intact survival rates of >70% are possible.

In ventricular fibrillation in which survival rates of 30% have been documented. Only 2-10% of all children who develop out of hospital cardiac arrest survive, and most are neurologically devastated. Part of the disparity in survival numbers is that bystander CPR is provided for less than ½ of the victims.

Prevention of Cardiac Arrest

Injuries, the leading cause of death in children and young adults, cause more childhood deaths than all other causes combined.

Most common fatal injuries:

- Motor vehicle passenger injuries
- Pedestrian injuries
- Bicycle Injuries
- Drowning
- Burns
- Firearm Injuries

Motor Vehicle Injuries

- Account for nearly ½ of all pediatric deaths in the United States
 - Failure to use proper passenger restraints
 - Inexperienced adolescent drivers
 - Alcohol

Restraint Guidelines:

- Rear facing infant seats for infants <20 pounds and 1 year of age
- Child restraints for children 1 to 4 years of age
- Booster seats with seat belts for children 4 to 7 years of age

Most pediatric air bag related fatalities occur when children <1 years of age are in the vehicle's front seat or are improperly restrained for their age.

Adolescent drivers are responsible for a disproportionate number of motor vehicle related injuries; the risk is highest in the first 2 years of driving. Driving with teen passengers and driving at night dramatically increase the risk.

Pedestrian Injuries

Account for 1/3 of motor vehicle related injuries. Adequate supervision is important because injuries typically occur when a child darts out mid block, dashes across intersections, or gets off a bus.

Bicycle Injuries

200,000 injuries and nearly 150 deaths per year in children. Head injuries are a major cause of related morbidity and mortality. Helmets can reduce the severity of head injuries by 80%

Burns

80% of fire related and burn related deaths result from house fires and smoke inhalation. 70% of deaths occur in homes without functioning smoke alarms

Firearm Injuries

United States has the highest firearm related injury rate of any industrialized nation – more than twice that of any other country. Highest is in the adolescents and young adults. More likely to be fatal in young children. The presence of a gun in the home is associated with increased likelihood of adolescent and adult suicides and homicides. Remains the leading cause of death among African American adolescents and young adults.

Sudden Infant Death Syndrome

Sudden death of an infant under 1 year of age which remains unexplained after a thorough case investigation, including performance of a complete autopsy, examination of the death scene, and a review of clinical history.

- Peak incidence is 2-4 months
- Etiology unknown
- Risk factors include
 - Sleeping in the prone position
 - Sleeping on a soft surface
 - Second hand smoke

Declined 40% since the “back to sleep” education program.

Drowning

Second major cause of death from unintentional injury in children <5 years and the 3rd major cause of death in adolescents. Most drown after falling into swimming pools while unsupervised; adolescents more commonly drown in lakes and rivers while swimming or boating.

BASIC CARDIAC LIFE SUPPORT FOR INFANTS AND CHILDREN

Age: For the healthcare provider an infant is age less than 1 and child = 1 year to beginning of puberty. (armpit hair in boys and breast development in girls)

1. Check for responsiveness
 - a. Gently tap victim, look for movement.
2. If the child is unresponsive and is not moving, shout for help and start CPR. If alone, CPR for 5 cycles (about 2 minutes)
3. Chest Compression: Ventilation Ratio: 30:2
4. Activate the EMS system
5. If you are alone and no signs of trauma, carry the child with you to the phone.

Activate the EMS System and Get the AED

If the arrest is witnessed and sudden; a lone healthcare provider should activate the EMS system and get an AED before starting CPR.

1. Position the victim
2. Open the airway – lay rescuer use the head tilt, chin lift – healthcare provider if signs of trauma, the jaw thrust may be used
 - a. Approximately 2% of all victims with blunt trauma requiring spinal imaging have a spinal injury, the risk is tripled if craneiofacial injury is present, or a Glasgow Coma Scale of <8 or both.

3. Check Breathing – take no more than 10 seconds to check whether the victim is breathing – if child is breathing and no evidence of trauma, place in the trauma position.
4. Give rescue breaths – 2 breaths (the measurement of effective breaths is chest rise) It may be necessary to adjust the head a number of times to achieve effective breaths

*Note: Barrier devices have not reduced the risk of transmission of infections and some may increase resistance to airflow. If you use a barrier device, do not delay rescue breathing.

Bag Valve Mask Ventilation

- Can be as effective as Endotracheal intubation and safer when providing ventilations for short periods.
- Requires training and periodic retraining
 - Selecting the correct mask size
 - Tight seal between mask and face
- In the out of hospital setting, preferentially ventilate and oxygenate infants and children with a BVM rather than attempt intubation if transport time is short

Precautions

- Avoid hyperventilation, use only the force and tidal volume necessary to make the chest rise.
- In a victim of arrest with no advanced airway in place, pause after 30 compressions (1 rescuer) or 15 compressions (2 rescuers) to give ventilations
- During CPR for a victim with an advanced airway, the compressing rescuer should compress the chest at a rate of 100 times per minute without pauses for ventilations and ventilations should be at 8-10 breaths per minute
- If the victim has a perfusing rhythm but no breathing, 10-12 breaths/min

Healthcare providers often deliver excessive ventilation during CPR, particularly after an advanced airway is in place. Excessive ventilation is detrimental because it:

- Impedes venous return and therefore decreases cardiac output, cerebral blood flow, and coronary perfusion by increasing intrathoracic pressure
- Causes air trapping and baro trauma in patients with small airway obstruction
- Increases the risk of regurgitation and aspiration

Gastric Inflation and Cricoid Pressure

- Avoid excessive peak inspiratory pressures (ventilate slowly)
- Apply cricoid pressure.
Avoid excessive pressure so as not to obstruct the trachea.

Oxygen

Healthcare providers should use 100% oxygen during resuscitation. Once the patient is stable, wean supplementary oxygen but ensure adequate oxygen delivery by appropriate monitoring.

Pulse Check (for Healthcare Providers only)

Healthcare providers should try to palpate a pulse (brachial in the infant and carotid or femoral in a child.) Never take more than 10 seconds

If despite oxygenation and ventilation the pulse is <60 and there are signs of poor perfusion, begin chest compressions. Profound Bradycardia in the presence of poor perfusion is an indication for chest compressions because an inadequate heart rate with signs of poor perfusion indicates that cardiac arrest is imminent.

Cardiac output in infancy and childhood largely depends on heart rate.

Chest Compressions

- Compress the lower half of the sternum but do not compress the xiphoid
- Allow the chest to recoil fully because complete chest re-expansion improves blood flow into the heart
- “Push hard”: push with sufficient force to compress the chest approximately one third to one half the anterior-posterior diameter of the chest
- “Push Fast”: push at a rate of 100 per minute
- Release completely to allow the chest to fully recoil
- Minimize interruptions in chest compressions

The ideal compression-ventilation rate is unknown, but studies emphasize the following:

- It takes a number of chest compressions to raise coronary perfusion pressure, which drops with each pause.
- Long and frequent interruptions in chest compressions have been documented during CPR. This is associated with decrease in return of spontaneous circulation (ROSC)
- Ventilations are relatively less important during the first minutes of CPR for victims of sudden arrhythmic cardiac arrest than they are after asphyxia induced arrest, but even after asphyxia arrest, a minute ventilation that is lower than normal is likely to maintain an adequate ventilation-perfusion ratio because cardiac output and therefore, pulmonary blood flow produced by compressions is quite low.
- Single rescuer recommendations is 30:2. Two rescuer is 15:2 with as short a pause in compressions as possible

- Rescuer fatigue can lead to inadequate compression rate and depth and may cause the rescuer to fail to allow complete chest recoil between compressions. Deteriorates within minutes even when the rescuer denies feeling fatigued. Two rescuers should switch roles approximately every 2 minutes

Infant

In the infant compress the sternum with 2 fingers placed just below the intermammary line. The 2 thumb encircling hands technique is recommended for healthcare providers when 2 rescuers are present. This may generate higher systolic and diastolic pressures.

Compression Only CPR

Ventilation may not be essential in the first minutes of VF cardiac arrest during which periodic gasps and passive chest recoil may provide some ventilation if the airway is open. This is not true of arrests in infants and children which are more likely to be asphyxial cardiac arrest. These victims require both prompt ventilations and chest compressions for optimal resuscitation. If a rescuer is unwilling or unable to provide ventilations chest compressions alone are better than no resuscitation at all.

Defibrillation

VF can be the cause of sudden collapse or it may develop during resuscitation. Children with sudden witnessed collapse are likely to have VF or pulseless VT and need immediate CPR and rapid defibrillation.

Many AEDs have high specificity in recognizing pediatric shockable rhythms and some are equipped to decrease the delivered energy to make it suitable for children 1 to 8.

In systems and institutions that care for children and have an AED program, it is recommended that the AED have both a high specificity in recognizing pediatric shockable rhythms and a pediatric dose attenuating system to reduce the dose delivered by the device.

Foreign Body Airway Obstruction

99% of deaths from choking occur in children <5, 65% of the victims are infants. Liquids are the most common cause of choking and aspiration in infants.

Signs include: sudden onset of respiratory distress with coughing, gagging, stridor.

If symptoms are mild, do not interfere. Allow the victim to clear the airway by coughing while you observe for increase in severity.

If severe:

1. For an infant deliver 5 back blows followed by 5 chest thrusts.
2. Abdominal thrusts are not recommended for infants because they may damage the relatively large and unprotected liver
3. If the victim becomes unresponsive, begin CPR, but look in the mouth before beginning ventilations.

ADVANCED LIFE SUPPORT GUIDELINES

In contrast adults, sudden cardiac arrest in children is uncommon and cardiac arrest does not usually result from a primary cardiac cause. More often it is the terminal event of a progressive respiratory failure or shock, also called an asphyxial arrest.

Respiratory Failure

Inadequate ventilation or oxygenation is respiratory failure. Anticipate respiratory failure and possible respiratory arrest if you observe any of the following:

- An increased respiratory rate, particularly with signs of distress
- An inadequate respiratory rate, effort, or chest excursion

Shock

Results from inadequate blood flow and oxygen delivery to meet tissue metabolic demands. Shock progresses from a compensated to a decompensated state. Attempts to compensate will maintain tissue perfusion and oxygenation for a time. Signs of compensated shock include:

- Tachycardia
- Cool extremities
- Prolonged capillary refill
- Weak peripheral pulses compared with central pulses
- Normal blood pressure

As compensatory mechanisms fail, signs of inadequate tissue perfusion develop. In addition to the above, these signs include:

- Depressed mental status
- Decreased urine output
- Metabolic acidosis
- Tachypnea
- Weak central pulses
- Hypotension

The most common cause of shock in infants and children is hypovolemia. One should integrate the signs of shock because no single sign confirms diagnosis. For example:

- Capillary refill time alone is not a good indicator of circulatory volume, but a cap refill time of >2 seconds is a useful indicator of moderate dehydration when combined with decreased urine output, absent tears, dry mucous membranes and a generally ill appearance.
- Tachycardia also results from other causes such as pain, anxiety and fever.

- Pulses may be bounding in anaphylactic, neurogenic and septic shock.

Hypotension is defined as a systolic blood pressure less than the 5th percentile of normal for age:

- <60mmHg in term neonates (0-28 days)
- <70mmHg in infants (1 to 12 months)
- <70mmHg + 2x age in years (children 1 to 10 years)
- <90 in children older than 10 years

AIRWAY

Oropharyngeal and Nasopharyngeal Airways

Oral airways are reserved for the unconscious patient. Be careful of size as an airway that is too small will not keep the tongue from obstructing and one that is too large may obstruct the airway. Nasal airways are better tolerated in patients who are not deeply unconscious.

Laryngeal Mask Airway

Insufficient evidence to recommend for or against the routine use of LMA during cardiac arrest. When Endotracheal intubation is not possible, the LMA is an acceptable adjunct for experience providers, but is associated with a higher incidence of complications in young children.

Pulse Oximetry

If the patient has a perfusing rhythm, monitor saturation because clinical recognition of hypoxemia is not reliable. However pulse oximetry is unreliable with poor peripheral perfusion.

Bag Valve Mask Ventilation

Can be as effective as ventilation via an Endotracheal tube for short periods and may be safer. In the prehospital setting ventilate and oxygenate infants and children with a bag valve mask especially if transport time is short.

Precautions

Frequently overventilated during resuscitation. Excessive ventilation increases intrathoracic pressure and impedes venous return, reducing cardiac output, cerebral blood flow and coronary perfusion. Excessive ventilation also cause air trapping and barotraumas in patients with small airway obstruction and increase the risk of stomach inflation, regurgitation and aspiration. Use only the force and tidal volume needed to make the chest rise.

Gastric Inflation

- Avoid excessive peak inspiratory pressure by ventilating slowly and watching chest rise
- Apply cricoid pressure. You should do so only in an unresponsive victim. The technique may require an additional rescuer. Avoid excessive pressure so as not to obstruct the trachea.
- If you intubate the patient you must pass a nasogastric or orogastric tube **after** you intubate because a gastric tube interferes with the gastroesophageal sphincter allowing possible regurgitation

Ventilation Through an Endotracheal Tube

Endotracheal Intubation in infants and children requires special training because the pediatric airway anatomy differs from an adult. Success and low complication rates are related to the length of training, supervised experience in the operating room and in the field.

Rapid Sequence Intubation

To facilitate emergency intubation skilled experienced providers may use sedatives, neuromuscular blocking agents and other medications to rapidly sedate and paralyze the victim. Use RSI only if you are trained and have experience using these medications and are proficient in the evaluation and management of the pediatric airway. You must have a secondary plan to management airway in the event that you cannot intubate.

Cuffed Versus Uncuffed Tubes

In the hospital setting a cuffed endotracheal tube is as safe as an uncuffed tube for infants beyond the newborn period and children.

Tube Size

The internal diameter of the appropriate endotracheal tube for a child will roughly equal the size of that child's little finger, but this is an estimation and may be difficult or unreliable.

Verification of Tube Placement

There is a high risk that an endotracheal tube will be misplaced. No single confirmation technique, including clinical signs or the presence of water vapor in the tube is completely reliable.

Immediately after intubation and again after securing the tube, confirm placement with the following:

- Look for bilateral chest movement and listen for equal breath sounds over both lung fields, especially over the axillae.
- Listen for gastric insufflation sounds over the stomach (they should not be present)
- Use a device to evaluate placement. Exhaled CO₂ only if there is a perfusing rhythm present. If >20kg an esophageal detector is acceptable
- Check oxygen saturation. Following hyper oxygenation, the oxyhemoglobin saturation detected may not demonstrate a fall indicative of incorrect endotracheal tube position for as long as 3 minutes.
- If still uncertain perform direct laryngoscopy and look to see if the tube goes through the cords
- In hospital settings perform a chest x-ray to verify placement.

If an intubated patient's condition deteriorates consider the following:

D – displacement

O – obstruction

P – pneumothorax

E – equipment failure

CIRCULATION

Backboard – A firm surface that extends from the shoulders to the waist and across the full width of the bed provides optimal support for effective chest compressions. In ambulances and mobile life support units a spine board may be used.

Extracorporeal Membrane Oxygenation

Consider extracorporeal CPR for in hospital arrests refractory to initial resuscitation attempts if the condition leading to arrest is reversible or amenable to heart transplantation.

Cardiovascular Monitoring

As soon as possible monitor blood pressure. If an arterial line is present, use it to guide your compression technique.

VASCULAR ACCESS

Intraosseous Access

Venous access can be difficult. Limit the time you attempt venous access, and if you cannot achieve reliable access quickly, establish IO access. In cardiac arrest, immediate IO access is recommended if no other IV access is already in place.

Venous Access

A central line provides more secure long term access, but central drug administration does not achieve high drug levels or a substantially more rapid response than peripheral administration.

Endotracheal Drug Administration

Any vascular access (IO, IV) is preferable, but if you cannot establish vascular access you can give lipid soluble medications (LEAN – Lidocaine, epinephrine, atropine and narcan) via the endo tube. Flush with a minimum of 5cc of NSS.

Administration of ET drugs results in lower blood concentrations than the same drug given intravascular. Lower epinephrine levels achieved when given ET can result in a refractory hypotension.

EMERGENCY FLUIDS AND MEDICATIONS

Estimating Weight

Tapes with precalculated doses printed at various patient lengths have been clinically validated. Hospitalized patients should have weights and precalculated emergency drug doses recorded and readily available.

Fluids

Use isotonic crystalloid solution to treat shock. There is no benefit in using colloids. Use bolus therapy with a glucose containing solution to treat documented hypoglycemia only.

Medications

Providers are not encouraged to memorize drug doses as they change frequently by rate. The provider should rely on Tapes and drug calculation charts.

Adenosine

- Causes a temporary AV nodal conduction block and interrupts reentry circuits.
- Wide margin of safety because of short half life
- High dose may be required for peripheral administration than central venous administration

Amiodarone

- Slows AV conduction, prolongs AV refractory period and QT interval, slows ventricular conduction

- Precautions – monitor blood pressure and administer as slowly as the patient's clinical condition allows.
- May be given rapidly in arrest

Atropine

- Parasympathetic that accelerates sinus or atrial pacemakers and increases AV nodal conduction
- Precautions – small doses (<0.1mg) may produce paradoxical Bradycardia.
- Larger than recommended doses may be required in special circumstances such as organophosphate poisoning

Calcium

- Route administration of calcium does not improve outcome of cardiac arrest

Epinephrine

- Increases aortic diastolic pressure and thus coronary perfusion pressure, a critical determinant of successful resuscitation

Glucose

- Infants have high glucose requirements and low glycogen stores and develop hypoglycemia when energy requirements rise

Lidocaine

- Decreases automaticity and suppresses ventricular arrhythmias, but is not as effective as Amiodarone for improving intermediate outcome

Magnesium

- There is insufficient evidence to recommend for or against the routine administration of magnesium during cardiac arrest.
- Indicated for the treatment of documented hypomagnesemia or for torsades associated with prolonged QT.

Sodium Bicarbonate

- The routine administration of sodium bicarbonate has not been shown to improve outcome of resuscitation. During cardiac arrest or severe shock, arterial blood gases may not accurately reflect tissue and venous acidosis.

Vasopressin

- There is limited experience with vasopressin in pediatric patients and the results of its use in the treatment of adults with VF has been inconsistent. It remains indeterminate in the pediatric population.

PULSELESS ARREST

- 1) Start CPR
- 2) Send for a defibrillator
 - a. Asystole and Bradycardia with a wide QRS complex are most common in asphyxial cardiac arrest – VF and PEA are less common
- 3) Determine rhythm
 - a. VF occurs in 5% to 15% of pediatric out of hospital arrest and up to 20% of hospital arrests. The incidence increases with age

Paddle Size

- Adult paddles for children >10kg or 1 year of age
- Infant for infants weighing less than 10kg
- The electrode chest wall interface can be gel pads, electrode cream or self adhesive pads
- Apply firm pressure on the paddles placed over the right side of the upper chest and the apex of the heart.
 - Alternatively place one electrode on the front of the chest just to the left of the sternum and the other over the upper back below the scapula.

Energy Dose

- The lowest energy dose for effective defibrillation and the upper limit for safe defibrillation in infants and children are not known.
- Energy dose >4 J/kg have effectively defibrillated children with negligible adverse effects
- Biphasic shocks appear to be at least as effective and less harmful than monophasic
- 2 joules/kg doubled to 4 joules per kg

Shockable Rhythm Sequence

- 1) Attempt immediate defibrillation. The earlier you defib, the more likely the success.
- 2) Provide CPR until defib is ready and resume CPR immediately after shock
- 3) Defib is more likely to be successful after a period of CPR. After defib, begin immediate CPR. Defib results in 90% conversion the first time. Nothing supports a second or third defib before CPR
- 4) After two minutes, perform a rhythm check. If still VF/VT administer Epinephrine. Use a standard dose for all doses. High dose Epi is not supported by science. It may be indicated in special situations like beta blocker overdose. It should be repeated every 3-5 minutes.
- 5) After 2 minutes of CPR – if rhythm remains shockable – defibrillate
- 6) After two minutes of CPR Amiodarone is given
- 7) Search for reversible causes.

Asystole and Pulseless Electrical Activity

- 1) CPR with as few interruptions as possible
- 2) Search for and treat reversible causes
- 3) Use a standard dose of Epinephrine

Bradycardia

- 1) Applies to the patient who has Bradycardia that is causing cardiorespiratory compromise.
- 2) Support airway, breathing and circulation
- 3) Reassess the patient to determine if Bradycardia is still causing cardiorespiratory symptoms despite adequate oxygen and ventilation
- 4) If pulses and respiration and perfusion is normal no treatment is necessary
- 5) If heart rate is less than 60 with poor perfusion despite effective ventilation, start chest compressions
- 6) If due to vagal stimuli administer Atropine.
- 7) Pacing may be life saving if Bradycardia is due to complete heart block or sinus node dysfunction unresponsive to oxygenation and ventilation and chest compressions. This is especially true in patients with congenital or acquired heart disease
- 8) Pacing is not useful for asystole or Bradycardia post arrest or ischemic in nature

Tachycardia and Hemodynamic Instability

Narrow Complex Tachycardia

- 1) Evaluation of 12-Lead ECG and the patient's clinical presentation
- 2) Attempt vagal stimulation first unless patient is very unstable and if it does not unduly delay chemical or electrical cardioversion
- 3) Chemical cardioversion with Adenosine is very effective. Administer using the stopcock method
- 4) If patient unstable or no immediate IV access available, electrical cardioversion is indicated (0.5 joules/kg to 1 joule/kg)
- 5) Consider Amiodarone if unresponsive to vagal maneuvers and adenosine.
- 6) Do not use Verapamil in infants because it may cause refractory hypotension and cardiac arrest. Use with caution in children because it may cause hypotension and myocardial depression.

Wide Complex Tachycardia

- 1) Treat with synchronized cardioversion. If it does not delay cardioversion try a dose of Adenosine to determine if rhythm is SVT with aberrant conduction
- 2) If a second shock is unsuccessful or if the tachycardia recurs quickly consider Amiodarone before a third shock

SPECIAL RESUSCITATION SITUATIONS

TRAUMA

The following are special aspects of trauma resuscitation:

- When the mechanism of injury is compatible with spinal injury, restrict motion of the cervical spine and avoid traction or movement of the head and neck. Open and maintain airway with jaw thrust
- Do not over ventilate even in case of head injury. Intentional brief hyperventilation may be used as a temporizing rescue therapy when you observe signs of impending brain herniation
- Suspect thoracic injury in all abdominal trauma even in the absence of external injuries.
- If the patient has maxillofacial trauma or if you suspect basilar skull fracture insert an orogastric rather than nasogastric tube.
- Treat signs of shock with a bolus of 20ml/kg followed by repeated bolus to 60ml/kg.
- At 60ml/kg, switch to blood product (O negative blood)

Toxicologic Emergencies

Cocaine

Acute coronary syndrome, manifested by chest pain and cardiac rhythm disturbances (including VF and VT) is the most frequent cocaine-related reason for hospitalization

Treatment

- 1) Cool aggressively, hyperthermia is associated with an increase in toxicity
- 2) Consider Nitroglycerin for coronary vasospasm
- 3) Do not give beta blockers
- 4) For ventricular arrhythmias consider bicarbonate therapy in addition to standard treatments
- 5) To prevent ventricular arrhythmias consider prophylactic Lidocaine therapy.

POST RESUSCITATION STABILIZATION

- 1) Continue supplementary oxygen until you confirm adequate blood oxygenation and delivery
- 2) Intubate and mechanically ventilate the patient if there is significant respiratory compromise
- 3) Obtain arterial blood gases 10-15 minutes after establishing initial ventilatory settings

- 4) Control pain and discomfort with analgesics and sedatives
- 5) Maintain blood pressure with vasopressor if necessary
- 6) Ideally post resuscitation care should be provided by a trained team in a pediatric intensive care facility.

NEONATAL RESUSCITATION

These recommendations are applicable to neonates who have completed perinatal transition and require resuscitation during the first few weeks to months following birth. The terms *newborn and neonate* are intended to apply to any infant during the initial hospitalization. The term *newly born* is intended to apply specifically to an infant at the time of birth.

Approximately 10% of newborns require some assistance to begin breathing. About 1% require extensive resuscitative measures. Those infants who do not require resuscitation can generally be identified by a rapid assessment of the following 4 characteristics:

- Was the baby born after a full term gestation?
- Is the amniotic fluid clear of meconium and evidence of infection?
- Is the baby breathing or crying?
- Does the baby have good muscle tone?

If the answer to all 4 questions is “yes”, the baby does not need resuscitation and should not be separated from the mother. If the answer to any of these assessment questions is “no”, there is a general agreement that the infant should receive one or more of the following 4 categories of action in sequence:

- A. Initial steps in stabilization (provide warmth, position, clear airway, dry, stimulate, reposition)
- B. Ventilation
- C. Chest Compressions
- D. Administration of epinephrine and/or volume expansion

The decision to progress from one category to the next is determined by the simultaneous assessment of 3 vital signs: respirations, heart rate and color. Approximately 30 seconds is allotted to complete each step, reevaluate, and decide whether to progress to the next step.

Anticipation of Need for Resuscitation

At every delivery there should be at least one person whose primary responsibility is the newly born. Either that person or someone else who is immediately available should have the skills required to perform a complete resuscitation including endotracheal intubation and administration of medications.

The majority of newborns who will require resuscitation can be identified before birth.

- 1) <37 weeks gestation
 - a. Preterm babies have immature lungs that may be more difficult to ventilate and are also more vulnerable to injury by positive pressure ventilation
 - b. Preterm babies also have immature blood vessels in the brain that are prone to hemorrhage
 - c. Thin skin, large surface area which contribute to heat loss
 - d. Increased susceptibility to infection
 - e. Increased risk of hypovolemic shock caused by small blood volume

Initial Steps

The initial steps of resuscitation are to provide warmth by placing the baby under a radiant heat source, position the head in a “sniffing” position to open the airway, clear the airway with a bulb syringe or suction catheter, and dry the baby and stimulate breathing.

Temperature Control

Very low birth weight (<1500 grams) preterm babies are likely to become hypothermic despite the use of traditional techniques for decreasing heat loss. Additional warming techniques should be used such as covering the baby in plastic wrapping and placing him under radiant heat. Temp must be monitored closely.

All resuscitation procedures, including intubation, chest compressions and insertion of lines can be performed with these temperature controlling interventions in place. Infants born to febrile mothers have been reported to have a higher incidence of perinatal respiratory depression, neonatal seizures, and cerebral palsy and increased risk of mortality.

Clearing the Airway of Meconium

Aspiration of meconium before delivery, during birth or during resuscitation can cause severe aspiration pneumonia. The prior recommendation was to attempt intubation when the head (but before the body) delivered. Evidence from a large multicenter randomized trial no longer recommend this approach. Therefore, current recommendations no longer advise routing intrapartum oropharyngeal and nasopharyngeal suctioning for infants born to mothers with meconium staining of amniotic fluid.

The recommendation is that infants be intubated immediately following birth and that suction be applied to the tube as it is withdrawn. A vigorous infant should not have endotracheal suction performed.

Periodic Evaluation at 30-second Intervals

Gasping and apnea indicate the need for assisted ventilation. Increasing or decreasing heart rate can also provide evidence of improvement or deterioration.

A newly born infant who is uncompromised will achieve and maintain pink mucous membranes without administration of oxygen. Blue color of the hands and feet alone is usually a normal finding at birth and is not a reliable indicator of hypoxemia but may indicate other conditions such as cold stress. Central cyanosis, pallor or mottling may be a sign of decreased cardiac output, severe anemia, hypovolemia, hypothermia or acidosis.

Administration of Oxygen

There are concerns about the potential adverse effects of 100% oxygen on respiratory physiology and cerebral circulation and the potential tissue damage from oxygen free radicals. It is reasonable to begin the resuscitation with room air. Free flow oxygen should be administered to patients with central cyanosis with breathing.

Positive Pressure Ventilation

If the infant remains apneic or gasping, if the heart rate remains <100 30 seconds after administering the initial steps or if the infant continues to have central cyanosis despite administration of supplementary oxygen, start positive pressure ventilation.

Assisted Ventilation of the Preterm Infant

Evidence indicates that preterm lungs are easily injured by large volume inflations immediately after birth. When ventilating preterm infants after birth excessive chest wall movement may indicate large volume lung inflations which should be avoided.

Endotracheal Intubation

Indicated when:

- 1) tracheal suctioning for meconium is required
- 2) if bag mask ventilation is ineffective or prolonged
- 3) chest compressions are performed
- 4) endotracheal administration of medications is required
- 5) for special resuscitation such as congenital diaphragmatic hernia or extremely low birth weight

The timing of endotracheal intubation may also depend on the skill and experience of the available providers.

Chest Compression

Indicated for a heart rate that is <60 despite adequate ventilation with supplementary oxygen for 30 seconds. Because chest compressions are likely to compete with effective ventilations, rescuers should ensure that assisted ventilation is being delivered optimally before starting compressions. The thumbs should encircle the newborn for compressions.

Medications

Drugs are rarely indicated in resuscitation of the newly born infant. Bradycardia in the newborn infant is usually the result of inadequate lung inflation or profound hypoxemia and establishing adequate ventilation is the most important step to correct it. Given the lack of data on ET Epinephrine it should be given IV if at all possible.

Volume Expansion

Consider volume expansion when blood loss is suspected or the infant appears to be in shock and has not responded adequately to other resuscitation measures. The recommended dose is 10ml/kg which may be repeated.

Naloxone

Is no longer recommended as part of initial resuscitative efforts in the delivery room for newborns with respiratory depression. If considered, heart rate and color must first be restored by supporting ventilation.