

Resuscitation of the Newly Born

What You'll Cover

- Preparation for out-of-hospital delivery
- Focused history and assessment findings that indicate potential complications
- Steps to prevent hypothermia in the newly born
- Indications for resuscitative measures
- Special intervention techniques for the newly born

Glossary

The following specialized terms are used in this chapter:

abruptio placentae—premature detachment of the placenta

acidosis—abnormally low bicarbonate or increased hydrogen ion concentration in the blood

acrocyanosis—cyanosis that is limited to the hands and feet, a normal finding in a newly born infant

anemia—a condition in which oxygen-transporting material in the blood (erythrocytes and hemoglobin) is abnormally low

asphyxia—impaired ventilatory exchange resulting in severe hypoxia or anoxia (frequently associated with hypercarbia)

atelectasis—collapsed lung tissue

atony—lack of muscle tone; flaccidity

atresia—congenital absence of a normal opening or normally patent lumen

circumoral—around the mouth

fetus—term for a baby *in utero* from the eighth week of pregnancy until the moment of birth

germinal matrix—a portion of the brain tissue that contains fragile blood vessels

hypoplasia—underdevelopment of tissue or an organ

lumen—the interior space of a tubular structure

meconium—greenish fecal material that may be discharged by a fetus into amniotic fluid at or near birth, usually in response to fetal distress

neonate—term used to describe an infant from birth through the first 28 days of life

newborn, newly born—terms used to describe an infant during the first few hours after birth

placenta previa—a condition in which the placenta is abnormally implanted in the uterus so that it impinges on or occludes the opening of the uterine cervix

polycythemia—an abnormal increase in erythrocytes and hemoglobin in the blood

pubic symphysis—the firm fibrocartilaginous joint between the 2 pubic bones

scaphoid abdomen—a condition in which the anterior wall of the abdomen is sunken, presenting a flat or concave appearance

shoulder dystocia—arrest of normal labor after delivery of the head due to impaction of the infant's shoulders against the maternal pubic symphysis

Interventions described in this chapter are recommendations based on the medical literature, national pediatric prehospital protocols, and expert opinion. They are not intended to serve as a standard of care. Interventions for individual patients must adhere to regional protocols and medical direction.

Learning Objectives and Key Points

The following learning objectives are covered in this chapter. Key points are discussed in more detail within the chapter text.

describe 6 steps performed during an uncomplicated out-of-hospital delivery

If an uncomplicated delivery is anticipated, prepare the environment so that it is as warm and clean as possible. Guide the baby out of the birth canal to prevent undue trauma to the mother and infant. Once the infant's head is delivered, provide suctioning before delivery progresses. Clamp and cut the umbilical cord, then dry and warm the baby using clean blankets or towels. Position the baby's airway and provide additional suctioning as necessary. In some cases, you may need to provide stimulation to initiate respiration.

describe 2 steps that are occasionally needed during an out-of-hospital delivery

In some cases, you may need to provide high-concentration oxygen and assisted ventilation if the baby does not breathe promptly. Occasionally, chest compressions, endotracheal intubation, vascular access, and fluid and/or medication administration may be necessary.

explain the importance of having a delivery kit assembled

It is difficult to remember all the equipment that may be needed during an out-of-hospital delivery. Make sure a delivery kit has been prepared and is appropriately stocked.

describe 2 complications that may arise if the infant experiences hypothermia

Hypothermia is the most common complication in out-of-hospital deliveries. A low body temperature can cause bradycardia, hypoxia, apnea, and respiratory distress, thereby interfering with effective resuscitation. Hypothermia can also lead to hypoglycemia, which can cause acidosis and convulsions. Therefore, keeping the baby warm and dry is a priority.

describe 3 steps to prevent hypothermia

Babies are born wet, which greatly accelerates heat loss. Thoroughly drying the baby immediately after delivery is the most important step in preserving body heat. Replace any damp towels or blankets with clean, dry ones and keep the baby wrapped for warmth. Place a cap or other covering over the baby's head. Prewarm the dry towels or blankets if possible, using a microwave, IV warmer, or the heater in the ambulance or another vehicle. If possible, keep the temperature around 32°C to 38°C (90°F to 100°F) in both the delivery area and the ambulance.

describe 4 risk factors that may lead to complications in a delivery

Be alert for major risk factors that may indicate the need for additional interventions during

delivery and follow-up management of the infant. The most important indicators of risk are multiple births, the presence of meconium in the amniotic fluid, a history of maternal drug use, and premature birth. Additional risk factors include maternal diabetes and breech presentation. A mnemonic that can help you remember these factors is *4 M's Plus 2*: *multiple* births; *meconium*; *maternal* drug use; *maturity* of the fetus; *diabetes*; and *breech* position.

describe 2 measures to alleviate shoulder dystocia

If the baby's shoulders do not deliver despite steady downward pressure on the head, try raising the mother's legs into a knee-to-chest position. If this maneuver does not free the baby, place a fist immediately *superior* to the mother's pubic bone and exert downward pressure. This may push the shoulder down and under the pubic bone.

describe 3 steps in clamping and cutting the umbilical cord

When the baby has delivered, clamp the cord 4-6 inches (10 to 15 cm) from the infant's abdomen. Place a second clamp slightly distal to the first. Cut between the 2 clamps with sterile scissors.

describe 3 precautions to observe during routine suctioning after birth

Before suctioning, turn the baby's head slightly to the side so that any secretions pool in the baby's cheek to avoid stimulating the gag reflex and causing aspiration. Suction the mouth first, then the nares. Do not suction continuously. Monitor the heart rate and respiratory rate; if either slows during suctioning, stop and allow the infant time to recover.

describe appropriate management actions when meconium is present

Suctioning as described above should take place as soon as the baby's head has delivered and before the rest of the baby has delivered. If meconium is present, additional suctioning should be performed after the baby is completely free of the birth canal. If thick meconium is present and the infant exhibits atony, bradycardia, or depressed respiration, perform endotracheal intubation for tracheal suctioning as permitted by regional protocols. Consider the infant at risk for respiratory complications and notify the hospital.

describe the indication for administering blow-by oxygen in the newly born

Administer blow-by oxygen to the infant if circumoral cyanosis persists despite regular, deep, spontaneous respiration. While acrocyanosis is common immediately after delivery and is not an indication for supplemental oxygen, many system protocols provide supplemental oxygen for newly born children delivered outside of the hospital.

describe the indication and 2 methods for gentle stimulation of the newly born

Indications for gentle stimulation include a failure of the infant to breathe spontaneously after drying, warming and suctioning have been performed. Appropriate methods for stimulation include flicking of the soles of the feet, gentle rubbing of the back. More vigorous methods should be avoided.

describe 2 indications for initiating bag-mask ventilation

If the baby does not begin to breathe spontaneously after you have applied gentle stimulation, or if respirations are intermittent and gasping, begin bag-mask ventilation with high-concentration oxygen. Also perform this step if the newly born infant is breathing but the heart rate is slower than 100 beats per minute.

describe the indication for placing an orogastric catheter

Bag-mask ventilation can cause gastric distention. This may interfere with diaphragmatic excursion, preventing the infant from fully expanding the lungs. If you observe abdominal distention, consider placing an orogastric catheter to decompress the stomach.

describe 3 indications for endotracheal intubation of the newly born

Endotracheal intubation may be indicated to provide more efficient assisted ventilation if bag-mask ventilation is ineffective; for tracheal suctioning if meconium is present; if diaphragmatic hernia is suspected to avoid esophageal insufflation, gastric distention and lung compression; or if medications must be delivered by tracheal tube. In some systems, intubation may be permitted when a prolonged transport time is expected.

explain the significance of heart rate in assessment of the newly born

Heart rate provides the best indication of adequate oxygenation and circulation in the newly born.

describe 2 sites for assessing heart rate in the newly born

Generally, the easiest way to assess the heart rate in the newly born infant is to palpate the umbilical cord at its base, as the 2 umbilical arteries will continue to pulsate for several minutes after birth. Alternatively, palpate the brachial pulse or auscultate the left side of the chest.

describe the indication for beginning chest compressions

Initiate chest compressions if the infant's heart rate is slower than 60.

describe the indication for administering epinephrine

After 30 seconds of chest compressions with assisted ventilation, reassess the infant's heart rate. If the heart rate remains slower than 60 beats per minute, continue compressions and administer epinephrine via the intravenous, intraosseous, umbilical, or tracheal route.

describe 2 conditions that indicate the need for vascular access in a newly born infant

If the infant does not respond to assisted ventilation, chest compressions, and initial epinephrine administration and you have not already done so, obtain vascular access to allow delivery of additional epinephrine, fluids, and dextrose as directed by medical control. If you cannot establish peripheral access, attempt intraosseous access. Umbilical catheterization may be attempted by those specially trained in this technique after attempts at IV and IO access prove unsuccessful.

describe appropriate management actions during transport

Keep the ambulance passenger compartment warm during transport. Reassess the baby's airway, breathing, and circulation frequently on the way to the hospital. Continually monitor the baby for warmth throughout transport.

describe the Apgar scoring system and its use

The Apgar scoring system provides important documentation of the infant's condition immediately after delivery. The system assigns a score for each of 5 assessment findings. If possible, assess the baby's Apgar score 1 minute after birth and again 5 minutes after birth. *Any necessary resuscitation measures take priority over assessing the baby's Apgar score.*

NSC Objectives

Information in this chapter supports the following objectives from the paramedic *National Standard Curriculum*:

- 6-1.4 Identify important antepartum factors that can affect childbirth. (C-1)
- 6-1.9 Identify the primary signs utilized for evaluating a newborn during resuscitation. (C-1)
- 6-1.10 Formulate an appropriate treatment plan for providing initial care to a newborn. (C-3)
- 6-1.13 Determine when ventilatory assistance is appropriate for a newborn. (C-1)
- 6-1.15 Determine when chest compressions are appropriate for a newborn. (C-1)
- 6-1.18 Determine when endotracheal intubation is appropriate for a newborn. (C-1)
- 6-1.22 Determine when vascular access is indicated for a newborn. (C-1)
- 6-1.23 Discuss the routes of medication administration for a newborn. (C-1)
- 6-1.24 Determine when blow-by oxygen delivery is appropriate for a newborn. (C-1)
- 6-1.29 Discuss the initial steps in resuscitation of a newborn. (C-1)
- 6-1.31 Discuss the effects maternal narcotic usage has on the newborn. (C-1)
- 6-1.35 Describe the epidemiology, including the incidence, morbidity/mortality, risk factors and prevention strategies for meconium aspiration. (C-1)
- 6-1.37 Discuss the assessment findings associated with meconium aspiration. (C-1)
- 6-1.38 Discuss the management/treatment plan for meconium aspiration. (C-1)
- 6-1.40 Discuss the pathophysiology of apnea in the neonate. (C-1)
- 6-1.41 Discuss the assessment findings associated with apnea in the neonate. (C-1)
- 6-1.42 Discuss the management/treatment plan for apnea in the neonate. (C-1)
- 6-1.43 Describe the epidemiology, pathophysiology, assessment findings, management/treatment plan for diaphragmatic hernia. (C-1)
- 6-1.44 Describe the epidemiology, including the incidence, morbidity/mortality and risk factors for bradycardia in the neonate. (C-1)
- 6-1.45 Discuss the pathophysiology of bradycardia in the neonate. (C-1)
- 6-1.46 Discuss the assessment findings associated with bradycardia in the neonate. (C-1)
- 6-1.47 Discuss the management/treatment plan for bradycardia in the neonate. (C-1)
- 6-1.52 Describe the epidemiology, including the incidence, morbidity/mortality and risk factors

- for respiratory distress/cyanosis in the neonate. (C-1)
- 6-1.54 Discuss the assessment findings associated with respiratory distress/cyanosis in the neonate. (C-1)
- 6-1.55 Discuss the management/treatment plan for respiratory distress/cyanosis in the neonate.(C-1)
- 6-1.64 Describe the epidemiology, including the incidence, morbidity/mortality and risk factors for hypothermia in the neonate. (C-1)

Introduction

In most cases, infants delivered out of the hospital do well. However, since out-of-hospital birth involves an increased risk of complications, you should arrive prepared to perform special resuscitative measures as necessary. Both standard actions and resuscitative measures are summarized in the *PALS Newborn Resuscitation Pyramid*, which appears in the *Illustrations* appendix (see *Figure B66*).

Although the approach to assessment and management of the newly born infant is patterned after the normal sequence of ABCs, you must also attend to several factors unique to an out-of-hospital delivery. Prepare the environment so that it is as warm and clean as possible. Manually guide the baby out of the birth canal to prevent undue trauma to the mother and infant. As soon as the infant's head has delivered, provide suctioning before delivery progresses. In all cases, clamp and cut the umbilical cord, dry and warm the baby using clean blankets or towels, position the baby's airway, and provide additional suctioning as necessary. In some cases, you may need to provide gentle stimulation to initiate respiration. Occasionally, when the infant's respirations and heart rate are insufficient to maintain adequate perfusion, you may need to provide high-concentration oxygen, assisted ventilation, chest compressions, and medications.

Preparation for Delivery

Equipment

To expedite your preparations for out-of-hospital delivery, keep an obstetrics kit stocked and ready in the ambulance. Table 1 lists appropriate equipment and supplies to include in the kit. If multiple births are anticipated, bring an obstetrics kit for each infant expected.

Table 1. Obstetrics Kit for Out-of-hospital Deliveries

<p>Delivery and Initial Management</p> <ul style="list-style-type: none"> • Sterile gloves • Two sterile clamps • Sterile scissors • Gauze sponges (5 cm by 25 cm) • 2-L plastic bag or container with lid • Four or more clean, dry towels • Two or more baby blankets • Bulb syringe <p>Resuscitation Equipment</p> <p><i>For suctioning particulate meconium</i></p> <ul style="list-style-type: none"> • Suction source • Suction catheters in sizes 5F, 6F, or 8F and 10F or 12F • Meconium aspirator <p><i>For bag-mask ventilation</i></p> <ul style="list-style-type: none"> • Oxygen source and tubing • Resuscitation bag not exceeding 750 mL • Transparent facemask with soft inflatable rim (sizes for premature and term babies) <p><i>For endotracheal intubation</i></p> <ul style="list-style-type: none"> • Straight laryngoscope blades in sizes 0 and 1 with extra bulbs • Pediatric laryngoscope handle with extra batteries 	<ul style="list-style-type: none"> • Tracheal tubes in sizes 2.5, 3, 3.5, and 4 mm • Tracheal tube stylets • Sterile adhesive tape • Laryngeal mask airway (optional) • Exhaled carbon monoxide detector <p><i>For orogastric intubation</i></p> <ul style="list-style-type: none"> • 8F feeding catheter • 20-mL syringe <p><i>For intraosseous access</i></p> <ul style="list-style-type: none"> • 18-gauge IO needle and syringe • Normal saline <p><i>Additional items for umbilical venous catheterization</i></p> <ul style="list-style-type: none"> • Iodine-povidone solution • Scalpel with blade • Sterile gauze sponges, 5 cm or 10 cm square • Size 5F umbilical catheter • Three-way stopcock • Mosquito clamp • Fine forceps without teeth • Umbilical tape <p><i>Additional supplies</i></p> <ul style="list-style-type: none"> • Epinephrine 1:10 000 solution
---	--

Scene Safety

On arrival, ensure scene safety, then lay out the delivery items so that they are within easy reach.

Environmental Temperature

Hypothermia is the most common cause of complications in out-of-hospital deliveries. A low body temperature can cause bradycardia, hypoxia, apnea, and respiratory distress, thereby interfering with effective resuscitation. Hypothermia can also lead to hypoglycemia, which can cause acidosis and convulsions. Keeping the baby warm and dry is a priority.

Infants have limited ability to maintain their body temperature during the first few hours after birth, so you should raise the environmental temperature where the delivery is to take place, if possible. A temperature of 32°C to 38°C (90°F to 100°F) is ideal. To be warm enough for the newly born, the room or ambulance should feel uncomfortably warm to you. Warm the baby blankets and towels if possible, using a microwave oven, the heater in the ambulance, or an IV warmer.

Maternal Focused History

As part of the preparation for delivery, try to gather focused history information from the mother. At minimum, ask about 6 maternal risk factors that may indicate the need for additional interventions during delivery and follow-up management of the infant. These factors are

- multiple births
- evidence of meconium in the amniotic fluid
- history of maternal drug use
- premature birth occurring more than 4 weeks in advance of the due date
- maternal diabetes
- breech presentation

To help you remember these risk factors, recall the mnemonic *4 M's Plus 2*: *multiple* births; *meconium*; *maternal* drug use; *maturity* of the fetus; *diabetes*; and *breech* position.

To determine if one or more risk factors are present, ask the following questions during the interview:

- How many babies are you carrying? (*If she doesn't know, ask her whether she has had twins in the past. This increases the likelihood of multiple births.*)
- When is the baby due? (*If she isn't sure, ask her how many months she has been pregnant.*)
- Did your water break? What color was the fluid?
- Have you used any prescribed medicines or other drugs recently? Which ones?
- Do you have high blood sugar or diabetes?
- Has your doctor told you whether the baby is coming head first or feet first?

Deliveries involving any of the described risk factors should take place in the hospital if possible; therefore, you should initiate transport if time permits. If immediate transport is not possible, be prepared to provide additional interventions, which may include deep suctioning, endotracheal intubation, assisted ventilation, and medication administration.

If there is time, also ask whether the mother has had regular checkups during her pregnancy and whether she has experienced any medical complications involving her own health, the pregnancy, or the fetus. Note significant findings on the patient care record and relay them to medical control.

Delivery

Observe body substance isolation procedures (universal precautions) before performing any action that may involve contact with blood, emesis, or secretions.

Delivery and Initial Suctioning

Positioning the mother

There are 3 options for positioning the mother for delivery:

- Supine with good support for her head and a firm, stable surface under her lower body.
- Recumbent on her left side with her back toward you and her knees drawn up to her chest (Sims position).
- Supine with her buttocks at the edge of the bed or stretcher, her legs spread, and her feet supported on chairs positioned at either side of her body.

The second and third positions provide easier access to the infant's mouth and nares for suctioning; however, the third position provides less support for the mother and increases the risk that you could drop the infant as delivery progresses.

When the mother is settled, drape a clean towel over your arm. The newly born infant will be very slippery. During delivery, you can use this towel to maintain a better grip on the infant.

Controlling the head

In a normal vaginal delivery, the baby presents head first. When you observe crowning, control the head to prevent a rapid expulsion that could tear the mother's posterior vaginal wall.

As the infant's head is delivered, watch to make sure that the umbilical cord is not wrapped around the baby's neck. If it is, try to free it by gently pushing it over the baby's head. If you cannot loosen the cord, clamp it in 2 places, then cut the cord between the clamps with sterile scissors.

If the cord is *not* wrapped around the baby's neck, or if it can be freed easily, do not cut it until the baby is fully delivered.

Suctioning the mouth and nares

As soon as the infant's head is fully delivered, quickly suction the mouth 2 to 3 times until it is clear of fluid, then suction each naris. Practice squeezing the bulb syringe a few times before suctioning. Squeeze the air out of the bulb before placing the tip in the infant's mouth (*see Figure B47*).

Place a 4-inch (10-cm) square gauze over the bulb of the syringe. This will help you control it if it becomes slippery.

If the fluid from the bulb syringe is stained with meconium (as indicated by a greenish or brownish color), take 5 seconds to repeat suctioning of the mouth to the level of the posterior pharynx, then superficially suction each naris. About 90% of the time, meconium is thin and watery, so that the bulb syringe provides adequate suctioning. Thicker meconium may be managed with a 10F suction catheter (an 8F catheter may be more suitable for premature babies). If you cannot insert the suction catheter into the infant's mouth within 10 seconds, abandon the attempt and continue delivery.

Shoulder dystocia

In rare cases, a potentially fatal complication called shoulder dystocia may occur after the baby's head has delivered. In this case, the baby's shoulders becomes wedged under the mother's pubic bone. If delivery does not progress despite steady downward pressure on the infant's head, attempt the following procedures:

- With the mother supine, position 1 rescuer or assistant at each of the mother's legs and help her raise her legs into a knee-to-chest position.
- If this maneuver does not free the infant's shoulders, place your fist immediately *superior* to the mother's pubic bone and exert steady downward pressure. This may push the infant's shoulder down and under the pubic bone.

If both methods fail, place the mother in a knee-to-chest position and initiate emergency transport.

Breech birth

Every effort should be made to deliver a breech birth in the hospital, particularly if it will be the mother's first baby. Breech presentations carry a much greater risk of the baby's head becoming wedged in the birth canal after the body is delivered, resulting in profound asphyxia or infant mortality.

If a breech delivery is imminent, the following steps should be taken:

- Provide supplemental oxygen and obtain IV access in the mother.
- Allow the baby to deliver buttocks or legs up to the umbilicus.
- Support the baby's legs and body, and gently extract a 4-6 inch segment of umbilical cord.
- Rotate the body to align the shoulders in an anterior-posterior position.

- Guide the baby upward to allow delivery of the posterior shoulder.
- Guide the baby downward to allow delivery of the anterior shoulder.
- Position the baby's face/abdomen away from the mother's pubis.
- Deliver the baby's head.
- If the head does not deliver, the baby may become asphyxiated as the cord is compressed between the head and the birth canal.
- To avoid asphyxiation place a gloved hand in the vagina, with the palm towards the baby's face forming a V with the index and middle finger on opposite sides of the nose. Push the vaginal wall away from the baby's nose and mouth.

Immediate Postpartum Care

Immediately after delivery, place the infant at the same level as the mother's abdomen. The baby should remain at this height until you have clamped and cut the umbilical cord. Placing the infant higher can cause the baby to lose blood into the placenta; placing the infant lower can result in excessive transfusion of blood from the placenta to the baby.

Basic care of all newly born infants includes drying, warming, positioning, suctioning, stimulation, and clamping and cutting of the umbilical cord. Perform all of these steps with the baby at the level of the mother's abdomen.

Drying

As soon as the baby is lying next to the mother, dry the infant briefly but thoroughly to prevent hypothermia. Do this before beginning any other interventions.

Warming

After drying, replace damp towels with clean, dry towels or pre-warmed blankets. You can warm the blankets with an IV warmer, car heater, microwave oven, or clothes dryer, depending on where you are and what is available. Pay special attention to drying and covering the head and hair, as infants lose a large percentage of their body heat through this area. If possible, place a cap over the infant's head. Do not obstruct the mouth and nose.

Positioning

Place the wrapped infant supine on a firm surface.

Suctioning

Suction the mouth until it is clear of fluid, then suction each naris. Suctioning the nares may

stimulate the newly born infant to inhale; this is why the mouth must be suctioned first, so that the newly born infant does not aspirate fluids or secretions that are in the mouth. Practice squeezing the bulb syringe a few times before you begin suctioning. Squeeze the air out of the bulb before placing the tip in the infant's mouth.

Cutting the umbilical cord

If you did not cut the umbilical cord during delivery, do it now. Pull the blankets or towels away from the baby's abdomen. Clamp the cord at least 4 to 6 inches (10 to 15 cm) from the baby's abdomen (about 1 to 1.5 times the width of your palm). Place a second clamp slightly distal to the first. Cut the cord between the clamps with sterile scissors. Inspect the umbilical cord for hemorrhage. If present, place a second clamp and make sure hemorrhage stops.

Keeping the newly born infant warm

It is essential to keep the baby warm throughout subsequent assessment and interventions. Make sure the baby's head remains covered throughout transport. Additional measures include positioning a hot water bottle wrapped in a towel near the infant or placing the infant on the mother's abdomen, covering both the mother and baby with a warmed blanket. Before placing any heated object on an infant, test it first against your inner wrist or the back of your hand to ensure that it will not burn the infant's sensitive skin. The object should feel lukewarm, not hot. If the object feels uncomfortably warm to you, it is too warm for the baby.

Postpartum Assessment and Management

Airway Assessment and Management

After the baby is warm and dry, proceed directly with airway management.

Position the infant either supine or laterally with the head slightly lower than the body. Extend the neck only slightly to open the airway. It is easy to hyperextend or flex a newly born infant's neck, which will obstruct the airway. To preclude this problem, place a 1-inch (2.5-cm) pad, such as a blanket or towel, under the infant's shoulders to achieve and maintain a patent airway. This maneuver will place the child in a sniffing position.

Turn the baby's head slightly to the side so that secretions pool in the infant's cheek and not in the hypopharynx. This helps prevent stimulation of the gag reflex and aspiration of fluids.

Suction the mouth first, then each naris. If the amniotic fluid is clear, a quick bulb suctioning is sufficient. Suction for no longer than 10 to 15 seconds. Do not place the tip of the bulb syringe too deeply within either the mouth or naris. Deep or prolonged suctioning can stimulate the vagal nerve, causing bradycardia. It can also stimulate the baby to breathe in any remaining fluids. If vagal stimulation occurs, allow time for the infant's heart rate and respiratory rate to recover before proceeding with thorough suctioning.

If meconium is present, repeat the suctioning process. Look for thick fluid or particulate matter (*pea-soup* consistency), which can obstruct the baby's airway if aspirated. Particulate meconium may be observed in the amniotic fluid that passed during delivery and clinging to the umbilical cord and body once the baby is fully delivered.

Indications for endotracheal intubation and tracheal suctioning

If meconium is present in an infant who has good muscle tone, normal respirations, and a heart rate exceeding 100 beats per minute, it is unnecessary to intubate the child to perform tracheal suctioning. There is no evidence that tracheal suctioning improves outcome or decreases meconium aspiration syndrome under these circumstances.

Perform endotracheal intubation *only* if *all* of the following findings are present:

- the amniotic fluid contains thick, particulate meconium
- the infant exhibits apnea or depressed respiration
- the infant's heart rate is slower than 100 beats per minute

Intubation should be performed under direct laryngoscopy (see *Task Analysis* appendix). It is usually impossible to suction thick meconium by passing the suction catheter directly into the tracheal tube due to the small diameter; therefore, you must connect a meconium aspirator between the tracheal tube and the suction tubing, and provide suctioning through the tracheal tube (see *Figure A37*).

Once the child is intubated, suction the trachea inferior to the vocal cords. Continue to suction as you withdraw the tracheal tube. Repeat the process up to 2 or 3 times until no further meconium is aspirated. If the heart rate slows to less than 100 beats per minute during the process, discontinue suctioning and allow the infant to recover.

If regional protocols do not permit endotracheal intubation, remove as much meconium as possible with a suction catheter to minimize aspiration.

Any infant with thick, particulate meconium should be considered at risk for complications. Notify the hospital of this finding.

Breathing Assessment and Management

After airway positioning and suctioning, assess the baby's breathing.

Most newly born infants will readily begin to breathe or cry during drying, warming, positioning, and suctioning. If the baby has not yet breathed after initial airway management, apply gentle stimulation by lightly slapping the sole of the infant's foot, flicking your finger against the infant's heel (see *Figure B48*), or rubbing the infant's back. Any of these maneuvers should stimulate the infant to take a first breath.

NEVER attempt to stimulate breathing by holding the baby upside down, slapping the buttocks or back, squeezing the ribs, forcing the thighs onto the abdomen, dilating the anal sphincter, applying hot or cold compresses, blowing cold oxygen onto the infant's face or body, or putting the infant into a hot or cold bath. *Any of these actions can cause serious injury.*

If the infant does not immediately respond to appropriate stimulation, repeat the action for no more than 10 to 15 seconds, then quickly reassess the infant.

If you observe central cyanosis in an infant who is breathing spontaneously, give blow-by oxygen (*see Figure B49*). (Acrocyanosis is common immediately after delivery and does not necessitate supplemental oxygen.) Many regional protocols recommend delivery of supplemental oxygen to all newly born infants. Hold the oxygen tubing about ½ to 2 inches (1 to 2 cm) from the infant's mouth and nose. Set the flow rate to 5 liters per minute. The closer the oxygen tubing, the higher percent oxygen delivered to the lungs. Continue oxygen delivery while proceeding with assessment until color improves.

Begin bag-mask ventilation if the infant exhibits any of the following:

- apnea
- gasping, irregular respirations
- heart rate slower than 100 beats per minute

Select a properly sized facemask and a resuscitation bag with a minimum volume of 450 to 500 mL. Disable the pop-off valve, if present; pressures of 30 to 40 cm H₂O may be needed to open the alveoli in a newly born infant during the first few ventilations. After the first few breaths, pressure requirements drop to 20 to 30 cm H₂O.

Place the mask using the E-C clamp technique to ensure a good seal (*see Task Analysis appendix*). Squeeze the bag slowly and steadily until visible chest rise occurs. If there is no visible chest movement, try the following measures:

- reposition the airway
- reapply the mask for a better seal
- apply more pressure when squeezing the bag
- open the mouth further
- suction the pharynx with a 10F suction catheter

Once chest rise is observed, provide assisted ventilation with high-concentration oxygen at a rate of at least 40 breaths per minute.

If you observe abdominal distention due to gastric inflation, consider orogastric intubation (*see*

Task Analysis appendix).

Consider endotracheal intubation if assisted ventilation appears ineffective. In some systems, endotracheal intubation may also be permitted when a long transport time is anticipated.

Circulation Assessment and Management

Assess the heart rate after the infant is either breathing spontaneously or has been receiving assisted ventilation for 30 seconds. **The heart rate is the best indicator of oxygenation and circulation in the newly born infant.**

The easiest way to measure the heart rate is by palpating the umbilical cord at its base; the umbilical arteries will continue to pulsate for several minutes after birth. Alternatively, auscultate the chest or palpate the brachial pulse.

Count the heart rate for 6 seconds and multiply by 10 to estimate the beats per minute. The heart rate in a healthy newly born infant can range from 100 to 180 beats per minute. The average is about 140 beats per minute. Since it can be difficult to count such rapid rates, you may find it helpful to tap out the rate with 1 hand while palpating the pulse with the other. This way, another rescuer can help listen for changes in the rate.

If the heart rate is faster than 100 beats per minute, discontinue bag-mask ventilation and reassess breathing before proceeding. The infant should be able to breathe unaided at a rate of 40 to 60 breaths per minute with good chest excursion.

If after 30 seconds of assisted ventilation the heart rate is slower than 100 beats per minute, take the following actions based on rate:

- If the heart rate is between 60 and 100 beats per minute, resume assisted ventilation until the heart rate reaches 100 beats per minute. This step is necessary even if the infant is able to breathe spontaneously.
- If the heart rate is slower than 60 beats per minute, begin chest compressions in addition to assisted ventilation.

The ratio for cardiopulmonary resuscitation is 3 compressions to 1 ventilation at a combined rate of 120 per minute; that is, 90 compressions and 30 ventilations per minute. Each action should be allotted about one-half second. Exhalation will occur during the first compression after each ventilation. You may find that it helps you to coordinate compressions with ventilations if you count out loud (“...1 and 2 and 3 and breathe and 1 and 2 and 3 and breathe...”).

Reassess the heart rate in 30 seconds, proceeding as described below.

- If the heart rate is between 60 and 100 beats per minute, discontinue compressions; continue assisted ventilation until the rate is faster than 100 beats per minute.
- If the heart rate remains slower than 60 beats per minute, continue compressions and administer epinephrine 1:10 000 solution at 0.01 to 0.03 mg/kg (0.1 to 0.3 mL/kg). Epinephrine may be administered through the tracheal tube, intravenously, intraosseously, or through the umbilical vein as available.

Continue to reassess heart rate and respiratory rate every few minutes.

If the infant does not respond to resuscitation measures and you have not already done so, obtain vascular access to allow delivery of additional epinephrine, fluids, and dextrose as directed by medical control. If you cannot establish peripheral access, attempt intraosseous access. Umbilical catheterization (*see Figure A36*) may be attempted by those who are specially trained in this technique after attempts at IV and IO access prove unsuccessful (*see Task Analysis appendix*).

In infants with adequate perfusion (strong central pulse and a normal heart rate), the central skin color should steadily improve until the lips and tongue are pink. Do not be alarmed if acrocyanosis persists; this is a common finding in newly born infants, particularly if the environment is cool. By itself, it does not indicate a problem.

Table 2 summarizes initial resuscitative measures for newly born infants.

TABLE 2. Resuscitation Measures for Newly Born Infants

Assessment Findings	Action
• All cases	Dry, warm, position, suction, and stimulate
• Central cyanosis	Blow-by supplemental oxygen
• Apnea or gasping respirations • Heart rate <100 beats/min	Assisted ventilation with high-concentration oxygen at 40–60 breaths/min
• Heart rate 0–60 beats/min	Chest compressions with assisted ventilation at combined rate of 120/min (90 compressions/30 ventilations)
• Heart rate <60 beats/min despite CPR	Epinephrine and endotracheal intubation

CUPS Assessment

Table 3 summarizes assessment findings that help determine the newly born infant’s CUPS status.

Table 3. CUPS Assessment of the Newly Born

Category	Assessment	Actions
Critical	Absent airway, breathing, or circulation; requires continuing assisted ventilation, chest compressions, or epinephrine	Perform rapid initial interventions and transport simultaneously
Unstable	Compromised airway, breathing, or circulation; requires assisted ventilation	Perform rapid initial interventions; transport promptly
Potentially unstable	Normal airway, breathing, and circulation; requires blow-by oxygen; additional risk factors present	Perform initial assessment with interventions; transport promptly; assess Apgar score if time allows
Stable	Infants delivered outside the hospital should not be considered stable	

Based on CUPS Assessment Table © 1997 N. D. Sanddal, et al. *Critical Trauma Care by the Basic EMT, 4th ed.*

Further Treatment

Hypoglycemia

The following factors increase the risk for hypoglycemia in the newly born:

- maternal diabetes
- premature birth
- hypoxia or hypothermia

Infants with any of these risk factors should be tested for hypoglycemia as time allows. Do not delay transport for this procedure.

If blood glucose levels are lower than 20 mg/dL, obtain vascular access and administer 10% dextrose solution at 2 to 5 mL/kg. Do not administer a more concentrated dextrose solution, as this could cause osmotic stress and hemorrhage within the germinal matrix and CSF ventricles. A vigorous infant may simply be fed a solution of 10% glucose in water.

Hypovolemia

In most cases, a newly born infant will not require additional volume expansion. Unnecessary fluid resuscitation may cause pulmonary edema, complicating treatment of pneumonia or respiratory distress syndrome. Fluid administration is generally indicated only if the infant has clearly suffered volume loss. This may occur in placenta previa if the umbilical cord tears, causing fetal-side hemorrhage.

Give normal saline or Ringer's lactate if the infant is hypovolemic, as indicated by persistent central cyanosis, weak central pulses, and decreasing blood pressure despite resuscitative measures. Administer 10 mL/kg over a 5- to 10-minute period.

Table 4 summarizes appropriate the dosage for dextrose, saline, and epinephrine in newly born infants.

Table 4. Medications for Newly born infant Resuscitation

Medication	Dose	Route	Indications/Comments	Complications
Epinephrine (1:10 000)	0.01–0.03 mg/kg (0.1– 0.3 mL/kg)	TT, IV, IO	Give by rapid infusion when infant is unresponsive to other resuscitative efforts; dilute with NS to volume of 1 to 3 mL for tracheal administration	Tachycardia, vasoconstriction
Normal saline	10 mL/kg	IV, IO	For volume expansion when there is evidence of fetal blood loss; administer over a 5- to 10-min period	Pulmonary edema, worsening respiratory distress
Dextrose 10%	200–500 mg/kg (2–5 mL/kg)	IV, IO	For blood glucose level <20 mg/dL or for newly born infants unresponsive to other resuscitation medications	Higher concentrations can cause CNS bleeding

Table 5 lists estimated weights, tracheal tube sizes, and resuscitation fluid volumes based on length for infants of different gestational ages.

Table 5. Resuscitation Equipment and Dosage for Newly Born Infants

Length (50th percentile)	Weight (50th percentile)	Approximate gestation	Approximate tracheal tube size	Saline for shock	Glucose <i>D</i> ₁₀ <i>W</i>
34 cm (13.4")	0.85 kg	25 weeks	2.5 mm	10 mL	2–5 mL
39.5 cm (15.5")	1.3 kg	30 weeks	3 mm	10 mL	2–5 mL
46 cm (18")	2 kg	35 weeks	3–3.5 mm	20 mL	4–10 mL
49 cm (19.3")	3.2 kg	40 weeks/term	3.5–4 mm	30 mL	6–15 mL

Source: Babson SG, et al: J Ped, 1976; 89: 815.

Vaginal Hemorrhage

Once the infant is stable, assess the mother for vaginal trauma and excessive hemorrhage. Performing external uterine massage for 3 to 5 minutes can help control postpartum hemorrhage. Place 1 hand just superior to the mother’s pubic bone and the other hand at the level of the umbilicus. Press down into the abdomen to gently massage the uterus until it becomes firm (it should become approximately the size of a softball). Allowing the mother to breast-feed the infant also increases uterine muscle tone, which may decrease hemorrhage. If vaginal hemorrhage persists despite these measures, administer intravenous oxytocin. Consult medical control for dosage.

Reassessment and Transport

Warm the ambulance passenger compartment in advance and transport the mother and infant as

soon as possible. Maintain maximum heat throughout transport. Reassess the baby’s airway, breathing, circulation, and body temperature frequently on the way to the hospital.

Do not wait for the placenta to deliver before initiating transport. If it delivers spontaneously, place it in a 2-L plastic container or plastic bag, cover or seal it, and bring it to the hospital with the mother and infant.

Documentation

In the patient care record, note any past medical history you were able to gather from the mother and describe the progression of labor and delivery, including any complications that arose. Note the infant’s initial appearance and assessment findings and changes that developed over time. List interventions and the infant’s response. Also make a note of the baby’s Apgar score, if performed.

Apgar scoring

The Apgar scoring system provides important documentation of the baby’s condition immediately after delivery. If possible, assess the baby’s Apgar score 1 minute after birth and again 5 minutes after birth. *Any necessary resuscitation measures should take precedence over assessing the baby’s Apgar score.*

The system assigns a score for each of 5 assessment findings (see Table 6). With practice, you can learn to calculate the Apgar score as part of your routine assessment: Observe muscle tone and color while drying the infant, irritability during suctioning or gentle stimulation, and respiration while palpating the pulse.

Table 6. Apgar Score

Assessment	0	1	2
Heart rate	Absent	<100	>100
Respirations	Absent	Slow, irregular	Normal, crying
Muscle tone	Atony	Some flexion	Active; good flexion
Irritability	No response	Some grimace	Cough, sneeze, or cry
Color	Cyanotic or pale	Acrocyanosis	Completely pink

The Apgar scoring system is named for Virginia Apgar, the pediatrician who developed it. The name can also be used as a mnemonic to help you remember the categories of the score:

- A – appearance (color)
- P – pulse rate
- G – grimace (irritability)

- A – activity (muscle tone)
- R – respiration

The Apgar Score was developed as a prognostic indicator. Do not use the Apgar Score to guide resuscitation decisions; these should be based on assessment of the infant's ABCs as previously described. Detailed information on the elements used in determining Apgar scores appears in the *Explanatory Text* section.

Explanatory Text

Oxygen Delivery and the Newly Born Infant

Some paramedics hesitate to deliver high-concentration oxygen to a newly born infant due to a misunderstanding about the potential effects of oxygen on an infant's vision. Excess oxygen can cause blood vessels in a newly born baby's eyes to grow at an accelerated rate, eventually leading to blindness if left untreated. However, this condition, called retrolental fibroplasia or retinopathy of prematurity, is associated with inappropriately high concentrations of oxygen delivered in an intensive care setting over an extended period, not with emergency resuscitation. Always use high-concentration oxygen when a newly born infant requires resuscitation. Your first priority is to correct hypoxia, the primary cause of bradycardia in the newly born, and high-concentration oxygen provides the best means to accomplish this.

Primary and Secondary Apnea in the Newly Born

A newly born infant will respond to hypoxia by breathing faster in an attempt to increase oxygenation. If oxygen levels do not improve, the infant stops breathing. This is called *primary apnea*.

After an episode of primary apnea, the infant may begin to breathe again in an abnormal pattern with gasping, irregular respirations. If oxygen levels do not improve during this period, the infant once again stops breathing. This is called *secondary apnea*.

Infants who are experiencing primary apnea usually have fairly good muscle tone and good blood pressure (as indicated by a strong central pulse at the base of the umbilical cord). These infants generally respond to blow-by oxygen and gentle stimulation with a return of spontaneous respiration.

Infants with secondary apnea, however, generally require bag-mask ventilation with high-concentration oxygen. The longer the infant has been hypoxic during secondary apnea, the longer you will need to provide assisted ventilation before the infant recovers spontaneous respiration.

Some medical complications can deprive the baby of oxygen while still *in utero*, so that the infant can experience both primary and secondary apnea *before birth*. There is no definitive way

to tell these conditions apart in the field, so you should assume that any baby who doesn't respond immediately to gentle stimulation and blow-by oxygen is experiencing secondary apnea. Assisted ventilation with high-concentration oxygen must be initiated promptly.

Complications in Out-of-hospital Deliveries

Although most out-of-hospital deliveries progress without life-threatening complications, it is helpful to understand the potential risks involved. The following paragraphs examine some of the complications you may encounter when assisting with an out-of-hospital birth.

General repercussions

Out-of-hospital deliveries are associated with a greater risk of complications. These include apnea, hypoxemia, hypoglycemia, and hypothermia. Babies born out of the hospital also are more likely to deliver prematurely and to have low birth weights. A low birth weight can adversely affect respiratory function, blood glucose levels, and thermal regulation. In about 5% to 10% of out-of-hospital deliveries, the infant will require bag-mask ventilation. Traumatic birth injuries are rare.

Hypothermia

The most common complication to affect infants born outside the hospital is hypothermia, defined as a body temperature lower than 35°C (95°F). Hypothermia can lead to bradycardia, hypoxia, apnea, respiratory distress, and hypoglycemia. This complication can generally be prevented by promptly drying and warming the infant. Premature infants are at increased risk for hypothermia because of thin skin, decreased subcutaneous fat, and inadequate mechanisms to produce heat.

Anemia and polycythemia

Complications can result if the umbilical cord is not clamped promptly after the baby is fully delivered. Until the cord is clamped, blood can continue to flow between the infant and the placenta. If the infant is positioned above the level of the mother's abdomen (as when the baby is placed on the mother's abdomen or chest), blood may drain from the baby's circulation into the placenta. This may cause anemia in the infant.

If the infant is placed below the level of the mother's abdomen (for example, by placing the baby on the delivery surface next to the mother), blood may drain from the placenta into the infant's circulation. This may cause the infant to develop polycythemia, a condition characterized by an elevated hematocrit, which thickens the blood. Polycythemia can lead to stroke.

To prevent these complications, place the baby at the same level as the mother's abdomen until the cord has been clamped.

Multiple births

Multiple births should be managed in the hospital if at all possible, particularly if the fetuses may

not be aligned in the uterus to present head first. If home delivery is inevitable, additional rescuers should be called to the scene, as the second infant often needs more assistance than the first. Make sure you have additional obstetric kits on hand as well. An average of 15 to 30 minutes elapses between delivery of the first infant and the next, so transport after the first birth may be possible.

Meconium

Meconium is fecal matter from the fetus that may be released into the amniotic sac before or during delivery, usually in response to a physiologic stressor, such as hypoxia or umbilical cord compression. Meconium appears greenish or brownish. It is sometimes thick and particulate, like pea soup.

Meconium aspiration can cause severe respiratory problems, pneumonia, pneumothorax, or atelectasis. To minimize the risk, provide suctioning *before* the baby takes a first breath, immediately after the head has been delivered but before the chest appears. Always suction the infant's mouth first, then the nose.

In infants who exhibit atony, apnea, or bradycardia, deep suctioning is needed to remove thick meconium that the infant has aspirated. This requires endotracheal intubation and tracheal tube suctioning as described earlier.

Maternal drug use

If the mother is a chronic drug user, the baby will be at risk for low birth weight and its associated complications.

If the mother abuses cocaine or other stimulant drugs, the baby may exhibit withdrawal symptoms at birth, such as abnormal irritability and agitation with bradycardia. Abruptio placentae, a potentially lethal complication associated with profuse hemorrhage, may occur if the mother uses cocaine before delivery. Cocaine use does not usually affect the baby's ability to breathe.

If the mother uses narcotics (such as heroin or methadone) within several hours of delivery, the baby may exhibit respiratory depression. Be prepared to provide bag-mask ventilation in such cases. *Do NOT give naloxone to newly born infants with respiratory depression when there is any possibility of maternal narcotic use.* If the mother has a long-term history of narcotic use, naloxone can precipitate withdrawal seizures in the infant. In the field, there is generally no way to rule out this possibility.

Premature birth

Infants arriving more than 4 weeks ahead of the anticipated due date are particularly susceptible to respiratory problems, hypothermia, and hypoglycemia, and should be delivered in the hospital if this is possible. If they must be delivered at home, be prepared to initiate bag-mask ventilation,

as premature babies are more likely to have difficulty taking their first breath. Use proper techniques to achieve chest rise without hyperinflation of the lungs, which could lead to pneumothorax. Babies that are arriving more than 10 weeks ahead of their due date are likely to require endotracheal intubation upon delivery. All premature infants require extra care during warming and drying procedures.

Maternal diabetes

Mothers with diabetes often have unusually large infants. This increases the risk of the shoulder dystocia. These infants are also at risk for hypoglycemia during the first few hours after birth, and are more likely to suffer birth defects.

Diaphragmatic hernia

This rare congenital defect allows a portion of the fetus's abdominal contents to protrude through the wall of the diaphragm and into the thoracic cavity. This compresses the lungs during fetal development, resulting in pulmonary hypoplasia. In infants with diaphragmatic hernia, you will note unilateral breath sounds with no air movement on the side with the hernia, a scaphoid abdomen, and signs of respiratory distress. Bag-mask ventilation may exacerbate lung compression due to gastric inflation, particularly if the stomach is displaced, so you should perform endotracheal intubation to ensure pulmonary ventilation. Transport immediately, preferably to a hospital with a neonatal intensive care unit.

Esophageal atresia

Esophageal atresia usually involves an abnormal passageway between the trachea and the distal esophagus. Suspect this birth defect if you cannot pass the suction catheter more than a few centimeters beyond the pharynx. An infant with esophageal atresia will be unable to swallow secretions. The infant should be placed with the head down or to the side during transport. Suction the oropharynx frequently.

Changes in fetal respiration and circulation after delivery

Fetal respiration. In utero the alveoli in the lungs are collapsed and filled with fluid. After delivery, the first few breaths must inflate the lungs, clear the fluid, and provide oxygen for the newly born infant. The first breath requires inflation pressure that is 2 to 2 ½ times greater than are needed subsequently.

Fetal circulation. Blood flows from the fetus to the placenta to obtain oxygen. The blood flows through the two umbilical arteries into the placenta, and oxygenated blood returns from the placenta through the umbilical vein. From the umbilical vein the blood flows to the inferior vena cava through the ductus venosus (this structure closes and shrinks after delivery). The oxygenated blood flows from the vena cava into the right atrium and bypasses the pulmonary circulation by flowing across an opening from the right to left atrium (called the foramen ovale). From the left atrium, the oxygenated blood flows into the left ventricle and to the systemic circulation. A second pathway allowing blood to bypass the lungs is the ductus arteriosus, which

connects the pulmonary artery to the aorta. This allows blood that has not flowed from the right atrium into the left atrium across the foramen ovale, but has circulated through the right ventricle and through the pulmonary artery, to flow into the aorta and bypass the lungs. Blood flow through the lungs unnecessary as the oxygen is obtained from the placenta, and the lungs are not inflated and not functional in utero.

Changes in the newly born. The oxygenated blood no longer flows from the placenta, the foramen ovale and ductus arteriosus close, the lungs inflate, and the blood begins to flow from the right atrium and ventricle to the lungs through the pulmonary artery. Oxygenated blood flows from the lungs and pulmonary veins into the left atrium and left ventricle, and is pumped into the aorta and systemic circulation. The artery to vein pathways usually close soon after birth in the newly born. However, the foramen ovale and ductus arteriosus can remain patent, resulting in impairment of circulatory function in some children.

The Apgar Scoring System

The elements used to determine infant Apgar scores are described in more detail below.

Heart rate

- 0 Absent pulse, indicating prolonged, profound asphyxia or death.
- 1 Bradycardia (heart rate slower than 100 beats per minute).
- 2 Heart rate 100 beats per minute or faster.

Respirations

- 0 Apnea.
- 1 Respiratory distress, gasping respirations, or poor work of breathing; labored breathing with deep retractions, pauses, and poor chest rise.
- 2 Strong cry or regular ventilation with good chest rise and normal breath sounds.

Muscle tone

- 0 Atony with no muscle movement.
- 1 Some muscle tone or activity (also assign this score for active premature babies, whose posture is not as flexed as a full-term baby's).
- 2 Spontaneous movement of the limbs and a flexed posture, with hands clenched and knees drawn up.

Irritability

- 0 Infant exhibits little or no response to routine suctioning or gentle stimulation.
- 1 Infant reacts with a grimace, weak sneeze, or slight flexion of an arm or leg.
- 2 Emphatic reaction, such as a sneeze, sharp turn of the head, or swipe of the arm.

Color

0 Pallid or completely cyanotic.

1 Acrocyanosis; note that hypothermia may cause vasoconstriction and poor circulation to the extremities.

2 Pink body and extremities, indicating adequate circulation and respiration.

Barriers to Learning

Unattended out-of-hospital births make up approximately 0.3% of all births in the US (about 10 000 annually), and in most cases, out-of-hospital deliveries progress without significant complications. Therefore, few paramedics receive sufficient training or field experience in the emergency resuscitation procedures that are occasionally needed during an out-of-hospital delivery. In addition, the urgency and emotional impact experienced during an out-of-hospital birth can cause a great deal of stress.

Knowing that most deliveries proceed smoothly can help you approach the event calmly, while practice sessions involving resuscitation techniques for newly born infants can prepare you to manage an emergency skillfully.

Practice Sessions

Practice the following activities to improve your competence and confidence in resuscitation of newly born infants:

- airway positioning and suctioning with a bulb syringe using infant manikins
- endotracheal intubation of infant manikins
- chest compressions and bag-mask ventilation using infant manikins (this exercise can be particularly useful if the resuscitation bag is fitted with a pressure gauge so you can develop a sense of how much pressure should be used during initial ventilation)
- orogastric intubation and stomach decompression of infant manikins
- intraosseous access using infant manikins
- umbilical venous access using infant manikins (if this intervention is permitted by regional protocols)

If possible, arrange to spend time in both a labor-and-delivery suite and a hospital nursery as well.

References

Core

Circulation 2000; 102(Supplement I):I-343—I-357, Part 11: Neonatal Resuscitation

Dieckmann RA, Brownstein DB, Gausche M. eds. *Pediatric Education for Prehospital Professionals Student Manual*, Elk Grove Village, IL: American Academy of Pediatrics, 2000, See Emergency Delivery and Newborn Stabilization, 156-171.

Eichelberger, Martin R., Jane W. Ball, Geraldine L. Pratsch, and John R. Clark. *Pediatric Emergencies: A Manual for Prehospital Care Providers*. 2nd ed. Upper Saddle River, NJ: Prentice Hall, 1998. Newborn Management, 203–214.

Kattwinkel J, ed. *Textbook of Neonatal Resuscitation*, 4th edition. American Academy of Pediatrics and American Heart Association, 2000. Initial Steps in Resuscitation, 2-1 to 2-25.

Seidel, James. Newborn Resuscitation. In *Prehospital Care of Pediatric Emergencies*, edited by J. S. Seidel and D. P. Henderson. Sudbury, MA: Jones & Bartlett, 1997, 51–57.

EMSC Resources

Item 0793. *Illinois Prehospital Pediatric Course*. (IL) Disk Set. Instructor Manual: “Newborn Resuscitation,” 61–70.

Item 0819. *NAEMSP Model Pediatric Protocols*. (National Association of EMS Physicians)

Item 0866. *Alaska Medevac Manual*, 3rd ed. (AK) “Neonatal Resuscitation Inverted Pyramid,” 174.

Item 0871. *Emergency Medical Services for Children Pediatric Emergency Care Course*. (TN and NC) “Cardiovascular Emergencies.”

Additional Reading

Bateman, D.A., O’Brien L, Nicholas S.W., et.al. Outcome of unattended out-of-hospital births in Harlem. *Arch Peds Adol Med* 1994, 148:147-152.

Jain, L., and Vidyasagar, D. Controversies in Neonatal Resuscitation. *Pediatric Annals* 1995; 25: 540–545.

Wiswell, T.E., et.al. Meconium staining and the meconium aspiration syndrome: unresolved issues. *Ped Clin North Am* 1993; 40:955–981.

Wiswell, T.E., Meconium in the delivery room trial group: delivery room management of the apparently vigorous of the meconium-stain neonate: Results of the multi-center collaborative trial. *Pediatrics* 2000; 105:1–7.

■ HANDOUT Key Points

If an uncomplicated delivery is anticipated, prepare the environment so that it is as warm and clean as possible. Guide the baby out of the birth canal to prevent undue trauma to the mother and infant. Once the infant's head is delivered, provide suctioning before delivery progresses. Clamp and cut the umbilical cord, then dry and warm the baby using clean blankets or towels. Position the baby's airway and provide additional suctioning as necessary. In some cases, you may need to provide stimulation to initiate respiration.

In some cases, you may need to provide high-concentration oxygen and assisted ventilation if the baby does not breathe promptly. Occasionally, chest compressions, endotracheal intubation, vascular access, and fluid and/or medication administration may be necessary.

It is difficult to remember all the equipment that may be needed during an out-of-hospital delivery. Make sure a delivery kit has been prepared and is appropriately stocked.

Hypothermia is the most common complication in out-of-hospital deliveries. A low body temperature can cause bradycardia, hypoxia, apnea, and respiratory distress, thereby interfering with effective resuscitation. Hypothermia can also lead to hypoglycemia, which can cause acidosis and convulsions. Therefore, keeping the baby warm and dry is a priority.

Babies are born wet, which greatly accelerates heat loss. Thoroughly drying the baby immediately after delivery is the most important step in preserving body heat. Replace any damp towels or blankets with clean, dry ones and keep the baby wrapped for warmth. Place a cap or other covering over the baby's head. Pre-warm the dry towels or blankets if possible, using a microwave, IV warmer, or the heater in the ambulance or another vehicle. If possible, keep the temperature around 32°C to 38°C (90°F to 100°F) in both the delivery area and the ambulance.

Be alert for major risk factors that may indicate the need for additional interventions during delivery and follow-up management of the infant. The most important indicators of risk are multiple births, the presence of meconium in the amniotic fluid, a history of maternal drug use, and premature birth. Additional risk factors include maternal diabetes and breech presentation. A mnemonic that can help you remember these factors is *4 M's Plus 2*: *multiple* births; *meconium*; *maternal* drug use; *maturity* of the fetus; *diabetes*; and *breech* position.

If the baby's shoulders do not deliver despite steady downward pressure on the head, try raising the mother's legs into a knee-to-chest position. If this maneuver does not free the baby, place a fist immediately *superior* to the mother's pubic bone and exert downward pressure. This may push the shoulder down and under the pubic bone.

When the baby has delivered, clamp the cord 4-6 inches (10 to 15 cm) from the infant's abdomen. Place a second clamp slightly distal to the first. Cut between the 2 clamps with sterile scissors.

Before suctioning, turn the baby's head slightly to the side so that any secretions pool in the baby's cheek to avoid stimulating the gag reflex and causing aspiration. Suction the mouth first, then the nares. Do not suction continuously. Monitor the heart rate and respiratory rate; if either slows during suctioning, stop and allow the infant time to recover.

Suctioning as described above should take place as soon as the baby's head has delivered and before the rest of the baby has delivered. If meconium is present, additional suctioning should be performed after the baby is completely free of the birth canal. If thick meconium is present and the infant exhibits atony, bradycardia, or depressed respiration, perform endotracheal intubation for tracheal suctioning as permitted by regional protocols. Consider the infant at risk for respiratory complications and notify the hospital.

Administer blow-by oxygen to the infant if circumoral cyanosis persists despite regular, deep, spontaneous respiration. While acrocyanosis is common immediately after delivery and is not an indication for supplemental oxygen, many system protocols provide supplemental oxygen for newly born children delivered outside of the hospital.

Indications for gentle stimulation include a failure of the infant to breathe spontaneously after drying, warming and suctioning have been performed. Appropriate methods for stimulation include flicking of the soles of the feet, gentle rubbing of the back. More vigorous methods should be avoided.

If the baby does not begin to breathe spontaneously after you have applied gentle stimulation, or if respirations are

intermittent and gasping, begin bag-mask ventilation with high-concentration oxygen. Also perform this step if the newly born infant is breathing but the heart rate is slower than 100 beats per minute.

Bag-mask ventilation can cause gastric distention. This may interfere with diaphragmatic excursion, preventing the infant from fully expanding the lungs. If you observe abdominal distention, consider placing an orogastric catheter to decompress the stomach.

Endotracheal intubation may be indicated to provide more efficient assisted ventilation if bag-mask ventilation is ineffective; for tracheal suctioning if meconium is present; if diaphragmatic hernia is suspected to avoid esophageal insufflation, gastric distention and lung compression; or if medications must be delivered by tracheal tube. In some systems, intubation may be permitted when a prolonged transport time is expected.

Heart rate provides the best indication of adequate oxygenation and circulation in the newly born.

Generally, the easiest way to assess the heart rate in the newly born infant is to palpate the umbilical cord at its base, as the 2 umbilical arteries will continue to pulsate for several minutes after birth. Alternatively, palpate the brachial pulse or auscultate the left side of the chest.

Initiate chest compressions if the infant's heart rate is slower than 60.

After 30 seconds of chest compressions with assisted ventilation, reassess the infant's heart rate. If the heart rate remains slower than 60 beats per minute, continue compressions and administer epinephrine via the intravenous, intraosseous, umbilical, or tracheal route.

If the infant does not respond to assisted ventilation, chest compressions, and initial epinephrine administration and you have not already done so, obtain vascular access to allow delivery of additional epinephrine, fluids, and dextrose as directed by medical control. If you cannot establish peripheral access, attempt intraosseous access. Umbilical catheterization may be attempted by those specially trained in this technique after attempts at IV and IO access prove unsuccessful.

Keep the ambulance passenger compartment warm during transport. Reassess the baby's airway, breathing, and circulation frequently on the way to the hospital. Continually monitor the baby for warmth throughout transport.

The Apgar scoring system provides important documentation of the infant's condition immediately after delivery. The system assigns a score for each of 5 assessment findings. If possible, assess the baby's Apgar score 1 minute after birth and again 5 minutes after birth. *Any necessary resuscitation measures take priority over assessing the baby's Apgar score.*

HANDOUT

Table 1. Obstetrics Kit for Out-of-hospital Deliveries

<p>Delivery and Initial Management</p> <ul style="list-style-type: none"> • Sterile gloves • Two sterile clamps • Sterile scissors • Gauze sponges (5 cm by 25 cm) • 2-L plastic bag or container with lid • Four or more clean, dry towels • Two or more baby blankets • Bulb syringe <p>Resuscitation Equipment</p> <p><i>For suctioning particulate meconium</i></p> <ul style="list-style-type: none"> • Suction source • Suction catheters in sizes 5F, 6F, or 8F and 10F or 12F • Meconium aspirator <p><i>For bag-mask ventilation</i></p> <ul style="list-style-type: none"> • Oxygen source and tubing • Resuscitation bag not exceeding 750 mL • Transparent facemask with soft inflatable rim (sizes for premature and term babies) <p><i>For endotracheal intubation</i></p> <ul style="list-style-type: none"> • Straight laryngoscope blades in sizes 0 and 1 with extra bulbs • Pediatric laryngoscope handle with extra batteries 	<ul style="list-style-type: none"> • Tracheal tubes in sizes 2.5, 3, 3.5, and 4 mm • Tracheal tube stylets • Sterile adhesive tape • Laryngeal mask airway (optional) • Exhaled carbon monoxide detector <p><i>For orogastric intubation</i></p> <ul style="list-style-type: none"> • 8F feeding catheter • 20-mL syringe <p><i>For intraosseous access</i></p> <ul style="list-style-type: none"> • 18-gauge IO needle and syringe • Normal saline <p><i>Additional items for umbilical venous catheterization</i></p> <ul style="list-style-type: none"> • Iodine-povidone solution • Scalpel with blade • Sterile gauze sponges, 5 cm or 10 cm square • Size 5F umbilical catheter • Three-way stopcock • Mosquito clamp • Fine forceps without teeth • Umbilical tape <p><i>Additional supplies</i></p> <ul style="list-style-type: none"> • Epinephrine 1:10 000 solution
---	--

TABLE 2. Resuscitation Measures for Newly Born Infants

Assessment Findings	Action
<ul style="list-style-type: none"> • All cases 	Dry, warm, position, suction, and stimulate
<ul style="list-style-type: none"> • Central cyanosis 	Blow-by supplemental oxygen
<ul style="list-style-type: none"> • Apnea or gasping respirations • Heart rate <100 beats/min 	Assisted ventilation with high-concentration oxygen at 40–60 breaths/min
<ul style="list-style-type: none"> • Heart rate 0–60 beats/min 	Chest compressions with assisted ventilation at combined rate of 120/min (90 compressions/30 ventilations)
<ul style="list-style-type: none"> • Heart rate <60 beats/min despite CPR 	Epinephrine and endotracheal intubation

■ HANDOUT

Table 3. CUPS Assessment of the Newly Born

Category	Assessment	Actions
Critical	Absent airway, breathing, or circulation; requires continuing assisted ventilation, chest compressions, or epinephrine	Perform rapid initial interventions and transport simultaneously
Unstable	Compromised airway, breathing, or circulation; requires assisted ventilation	Perform rapid initial interventions; transport promptly
Potentially unstable	Normal airway, breathing, and circulation; requires blow-by oxygen; additional risk factors present	Perform initial assessment with interventions; transport promptly; assess Apgar score if time allows
Stable	Infants delivered outside the hospital should not be considered stable	

Based on CUPS Assessment Table © 1997 N. D. Sanddal, et al. *Critical Trauma Care by the Basic EMT, 4th ed.*

Table 4. Medications for Newly born infant Resuscitation

Medication	Dose	Route	Indications/Comments	Complications
Epinephrine (1:10 000)	0.01–0.03 mg/kg (0.1–0.3 mL/kg)	TT, IV, IO	Give by rapid infusion when infant is unresponsive to other resuscitative efforts; dilute with NS to volume of 1 to 3 mL for tracheal administration	Tachycardia, vasoconstriction
Normal saline	10 mL/kg	IV, IO	For volume expansion when there is evidence of fetal blood loss; administer over a 5- to 10-min period	Pulmonary edema, worsening respiratory distress
Dextrose 10%	200–500 mg/kg (2–5 mL/kg)	IV, IO	For blood glucose level <20 mg/dL or for newly born infants unresponsive to other resuscitation medications	Higher concentrations can cause CNS bleeding

Table 5. Resuscitation Equipment and Dosage for Newly Born Infants

Length (50th percentile)	Weight (50th percentile)	Approximate gestation	Approximate tracheal tube size	Saline for shock	Glucose D ₁₀ W
34 cm (13.4")	0.85 kg	25 weeks	2.5 mm	10 mL	2–5 mL
39.5 cm (15.5")	1.3 kg	30 weeks	3 mm	10 mL	2–5 mL
46 cm (18")	2 kg	35 weeks	3–3.5 mm	20 mL	4–10 mL
49 cm (19.3")	3.2 kg	40 weeks/term	3.5–4 mm	30 mL	6–15 mL

Source: Babson SG, et al: J Ped, 1976; 89: 815.

■ HANDOUT

Table 6. Apgar Score

Assessment	0	1	2
Heart rate	Absent	<100	>100
Respirations	Absent	Slow, irregular	Normal, crying
Muscle tone	Atony	Some flexion	Active; good flexion
Irritability	No response	Some grimace	Cough, sneeze, or cry
Color	Cyanotic or pale	Acrocyanosis	Completely pink