Neonatal resuscitation

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Neonatal Resuscitation: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care
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http://pediatrics.aappublications.org/content/126/5/e1400.full.html
10% of newborns require some assistance to begin breathing at birth. 

<1% require extensive resuscitative measures.
Term gestation?
Breathing or crying?
Good tone?
Term gestation?  
Breathing or crying?  
Good tone?  

Yes, stay with mother

Routine care
- Provide warmth
- Clear airway if necessary
- Dry
- Ongoing evaluation
Initial steps in stabilization:

- Warm, clear airway if necessary
- Dry
- Stimulate

Yes, stay with mother

Routine care:
- Provide warmth
- Clear airway if necessary
- Dry
- Ongoing evaluation
The decision to progress beyond the initial steps is determined by *simultaneous* assessment of 2 vital characteristics:

**respirations** (apnea, gasping, or labored or unlabored breathing)

**heart rate** (whether > or < 100 bpm)
How is HR assessed?

- auscultating intermittently the precordial pulse

-- palpation of the umbilical pulse when a pulse is detectable
Once PPV or supplementary O₂ administration is begun, assessment should consist of simultaneous evaluation of 3 vital characteristics: HR, respirations, and the state of oxygenation (by a pulse oximeter).

The most sensitive indicator of a successful response to each step is an increase in HR.
Anticipation
Adequate preparation
Accurate evaluation
Prompt initiation of support

With careful consideration of risk factors, the majority of newborns who will need resuscitation can be identified before birth.
Preterm babies have

--immature lungs that may be more difficult to ventilate and are also more vulnerable to injury by PPV
--immature blood vessels in the brain that are prone to hemorrhage
--thin skin and a large surface area, which contribute to rapid heat loss
  --increased susceptibility to infection
--increased risk of hypovolemic shock related to small blood volume
**INITIAL STEPS of resuscitation**

Provide warmth by placing the baby under a radiant heat source

Positioning the head in a “sniffing” position to open the airway

Clearing the airway if necessary with a bulb syringe or suction catheter

Drying the baby

Stimulating breathing
Temperature Control

Additional warming techniques are recommended to very low-birth-weight (<1500 g) preterm babies:

-- prewarming the delivery room to 26°C
-- covering the baby in plastic wrapping (food or medical grade, heat-resistant plastic)
-- placing the baby on an exothermic mattress
-- placing the baby under radiant heat
  -- prewarming the linen
  -- drying and swaddling
-- placing the baby skin-to-skin with the mother
-- covering both with a blanket
Infants born to febrile mothers have been reported to have a higher incidence of:

--perinatal respiratory depression
--neonatal seizures
--cerebral palsy
--mortality

The goal is to achieve normothermia and avoid iatrogenic hyperthermia
Clearing the Airway

When Amniotic Fluid Is Clear

Suctioning immediately following birth (including suctioning with a bulb syringe) should be reserved for babies who have obvious obstruction to spontaneous breathing or who require PPV.

However, suctioning in the presence of secretions can decrease respiratory resistance.
When Meconium is Present

Aspiration of meconium before delivery, during birth, or during resuscitation can cause severe meconium aspiration syndrome (MAS)

Suctioning of the oropharynx before delivery of the shoulders
Elective and routine endotracheal intubation
Direct suctioning of the trachea

No value
Assessment of Oxygen Need and Administration of Oxygen

Blood oxygen levels in uncompromised babies generally do not reach extrauterine values until approximately 10 minutes following birth.

Oxyhemoglobin saturation may normally remain in the 70% to 80% range for several minutes following birth, thus resulting in the appearance of cyanosis during that time.

<table>
<thead>
<tr>
<th>Targeted Preaductal Spo₂ After Birth</th>
<th>1 min</th>
<th>60%-65%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 min</td>
<td>65%-70%</td>
<td></td>
</tr>
<tr>
<td>3 min</td>
<td>70%-75%</td>
<td></td>
</tr>
<tr>
<td>4 min</td>
<td>75%-80%</td>
<td></td>
</tr>
<tr>
<td>5 min</td>
<td>80%-85%</td>
<td></td>
</tr>
<tr>
<td>10 min</td>
<td>85%-95%</td>
<td></td>
</tr>
</tbody>
</table>
Hypoxia and ischemia are known to result in injury to multiple organs.

Conversely, adverse outcomes may result from even brief exposure to excessive oxygen during and following resuscitation.
It is recommended that oximetry be used when:

- resuscitation can be anticipated
- positive pressure is administered for more than a few breaths
- cyanosis is persistent
- supplementary oxygen is administered
Administration of Supplementary Oxygen

The goal should be an oxygen saturation value in the interquartile range of preductal saturations measured in healthy term babies following vaginal birth at sea level.

These targets may be achieved by initiating resuscitation with air or a blended oxygen and titrating the oxygen concentration to achieve an SpO2 in the target range using pulse oximetry.
If the baby is bradycardic (HR 60 per minute) after 90 seconds of resuscitation with a lower concentration of oxygen, oxygen concentration should be increased to 100% until recovery of a normal heart rate.

If the infant remains apneic or gasping, or if the HR remains 100 per minute after administering the initial steps, start PPV.
Initial Breaths and Assisted Ventilation

Preterm lungs are easily injured by large-volume inflations immediately after birth.

Assisted ventilation rates of 40 to 60 bpm are commonly used.

The primary measure of adequate initial ventilation is prompt improvement in heart rate.

Chest wall movement should be assessed if heart rate does not improve.

Inflation pressure should be monitored; an initial inflation pressure of 20 cm H2O may be effective, but 30 to 40 cm H2O may be required in some term babies without spontaneous ventilation.
Assisted ventilation should be delivered at a rate of 40 to 60 bpm to promptly achieve or maintain a HR of 100 per minute.

The use of colorimetric CO2 detectors during mask ventilation of small numbers of preterm infants in the intensive care unit and in the delivery room may help to identify airway obstruction.
Starting infants on CPAP reduces the rates of intubation and mechanical ventilation, surfactant use, and duration of ventilation, but increases the rate of pneumothorax.

Spontaneously breathing preterm infants who have respiratory distress may be supported with CPAP or with intubation and mechanical ventilation.
Laryngeal mask airways are effective for ventilating newborns weighing >2 kgs or delivered >34 w GA.

A laryngeal mask should be considered during resuscitation if facemask ventilation is unsuccessful and tracheal intubation is unsuccessful or not feasible.
Endotracheal Tube Placement
Indications

--Initial endotracheal suctioning of nonvigorous meconium-stained newborns
--If bag-mask ventilation is ineffective or prolonged
--When chest compressions are performed
--For special resuscitation circumstances, such as congenital diaphragmatic hernia or extremely low birth weight
After endotracheal intubation and administration of intermittent positive pressure, a prompt increase in heart rate is the best indicator that the tube is in the tracheobronchial tree and providing effective ventilation.

Exhaled CO2 detection is the recommended method of confirmation of endotracheal tube placement.

However, poor or absent pulmonary blood flow may give false negative results (no CO2 detected despite tube placement in the trachea).
Chest Compressions

Chest compressions are indicated for a heart rate that is 60 per minute despite adequate ventilation with supplementary oxygen for 30 seconds.

Because ventilation is the most effective action in neonatal resuscitation, rescuers should ensure that assisted ventilation is being delivered optimally before starting chest compressions.

Compressions should be delivered on the lower third of the sternum to a depth of approximately one third of the anterior-posterior diameter of the chest.
Two techniques have been described: compression with 2 thumbs with fingers encircling the chest and supporting the back (the 2 thumb–encircling hands technique) or compression with 2 fingers with a second hand supporting the back.
Because the 2 thumb–encircling hands technique may generate higher peak systolic and coronary perfusion pressure than the 2-finger technique, the 2 thumb–encircling hands technique is recommended for performing chest compressions in newly born infants
Compressions and ventilations should be coordinated to avoid simultaneous delivery.

It is recommended that a 3:1 compression to ventilation ratio be used for neonatal resuscitation where compromise of ventilation is nearly always the primary cause, but rescuers should consider using higher ratios (15:2) if the arrest is believed to be of cardiac origin.
Medications

Drugs are rarely indicated in resuscitation of the newly born infant

However, if the heart rate remains 60 per minute despite adequate ventilation (usually with endotracheal intubation) with 100% oxygen and chest compressions, administration of epinephrine or volume expansion, or both, may be indicated
Epinephrine is recommended to be administered intravenously.

The recommended IV dose is 0.01 to 0.03 mg/kg per dose.

While access is being obtained, administration of a higher dose (0.05 to 0.1 mg/kg) through the endotracheal tube may be considered.

The concentration of epinephrine for either route should be 1:10,000 (0.1 mg/mL).
Term gestation? Breathing or crying? Good tone?
Yes, stay with mother

No
Warm, clear airway if necessary, dry, stimulate

30 sec

60 sec

HR below 100, gasping, or apnea?

Yes
Labored breathing or persistent cyanosis?

No

Targeted Postnatal \( \text{SpO}_2 \) After Birth
1 min 60%-65%
2 min 65%-70%
3 min 70%-75%
4 min 75%-80%
5 min 80%-85%
10 min 85%-95%

Clear airway \( \text{SpO}_2 \) monitoring Consider CPAP

HR below 100?

Yes
Take ventilation corrective steps

No
HR below 60?

Yes
Consider intubation Chest compressions Coordinate with PPV

No
Take ventilation corrective steps

Intubate if no chest rise!

No

Consider:
- Hypovolemia
- Pneumothorax

HR below 60?

Yes
IV epinephrine

No
Postresuscitation care

Routine care
- Provide warmth
- Clear airway if necessary
- Dry
- Ongoing evaluation