NEONATAL RESUSCITATION
INTRODUCTION

• Birth asphyxia is one of the leading cause of neonatal mortality in our country

• Neonatal resuscitation is a simple, effective method to decrease the mortality.
Before birth

Alveoli are filled with fluid. Blood vessels of the lungs are constricted before birth.
Blood is shunted from the pulmonary artery through the ductus arteriosus into the aorta.
After birth

The fluid in the alveoli is absorbed into lung tissue and is replaced by air.
After birth, the alveoli in the lungs fill with air and the blood vessels of the lungs relax. Gas exchange can now take place in the lungs.
As umbilicus is clamped, low resistance placental circuit is removed and systemic pressure increases. There is dramatic increase in pulmonary blood flow and a decrease in flow through the ductus arteriosus.
WHAT CAN GO WRONG DURING TRANSITION?

• Baby may not breath sufficiently.
• Meconium may block air from entering the alveoli.
• Excessive blood loss or poor cardiac contractility or bradycardia may occur resulting in systemic hypotension.
• Persistent pulmonary hypertension.
HOW THE BABY RESPONDS TO SUCH INTERRUPTION?

- Cyanosis.
- Bradycardia.
- Low blood pressure.
- Depression of respiratory drive.
- Poor muscle tone.
When newborn first becomes deprived of oxygen, an initial period of rapid breathing is followed by Primary Apnea which can be resolved by Tactile stimulation. If oxygen deprivation continues, Secondary Apnea ensues. The heart rate continues to fall, and the blood pressure falls.

If a baby does not begin breathing immediately after being stimulated, he or she is likely to be in secondary apnea and will require positive pressure ventilation. Continued stimulation will not help.
CORE KNOWLEDGE AND SKILLS

• Establish clear airway
• Support adequate ventilation and oxygenation.
• Maintain adequate cardiac output.
• Reduce heat loss.
# Resuscitation-Oriented History

**Antepartum Factors**
- Maternal diabetes
- Pregnancy-induced hypertension
- Chronic hypertension
- Anemia or isoimmunization
- Previous fetal or neonatal death
- Bleeding in second or third trimester
- Maternal infection
- Maternal cardiac, renal, or pulmonary disease
- Polyhydramnios
- Oligohydramnios
- Premature rupture of membranes
- Post-term gestation
- Multiple gestation
- Size-dates discrepancy
- Drug therapy, e.g.
  - Lithium carbonate
  - Magnesium
  - Adrenergic blocking drugs
- Maternal substance abuse
- Fetal malformation
- Diminished fetal activity
- No prenatal care
- Age <16 or > 35 years

**Intrapartum Factors**
- Emergency cesarean section
- Breech or other abnormal presentation
- Premature labor
- Precipitous labor
- Chorioamnionitis
- Prolonged rupture of membranes (more than 18 hours before delivery)
- Prolonged labor (more than 24 hours)
- Prolonged second stage of labor (more than 2 hours)
- Fetal bradycardia
- Non-reassuring heart rate patterns
- Use of general anesthesia
- Uterine tetany
- Narcotics administered to mother within 4 hours of delivery
- Meconium-stained amniotic fluid
- Prolapsed cord
- Abruptio placentae
- Placenta previa
HOW DO YOU PREPARE?

• Need for resuscitation can come as a complete surprise.
• Equipments must be in the delivery room and fully operational.
• Universal Precautions
• Resuscitation Assignments
  • Team leader (or designee): Airway
  • Second rescuer: Pulse check & chest compressions
  • Third rescuer: Medication & equipment
LIST OF EQUIPMENTS NEEDED FOR RESUSCITATION

• Laryngoscopes with straight blades
• No 0 (Preterm) & No 1 (Term) blades with extra bulbs and batteries
• Endotracheal bulbs – No 2.5, 3.0, 3.5, 4.0
• Suction equipment with suction catheters – 5F or 6F, 8F, 10F
• 5F, 8F feeding tube
• Bag and mask equipment with face masks of term and preterm sizes
• Oxygen source
• Stethoscope
• Tape or securing device
• Bulb syringe
• Drugs – Epinephrine, Normal saline, Dextrose 10%
• IV cannula 24G
• Umbilical catheters 3.5F, 5F
• Gloves
PRINCIPLES ARE THE SAME

A – Airway – Positioning and suctioning
B – Breathing – Positive pressure ventilation
C – Circulation – Chest compressions and medications
INVERTED PYRAMID

Always needed

Infrequently needed

Least needed

Most usual treatment
- Keep dry and warm; may need suction or stimulation
- Oxygen
- Establish effective ventilation
- Bag and mask
- Tracheal intubation
- Chest compressions
- Drugs

Least usual treatment
EVALUATION-DECISION-ACTION CYCLE

Evaluation -> Action -> Decision -> Evaluation
APGAR SCORE

• Objective method of quantifying the newborns condition.
• Information about overall status and response to resuscitation.
• Its not useful for determining the need for resuscitation, what resuscitation steps are necessary, or when to use them.
<table>
<thead>
<tr>
<th>Sign</th>
<th>Score</th>
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<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Heart rate</td>
<td>Absent</td>
</tr>
<tr>
<td>Respirations</td>
<td>Absent</td>
</tr>
<tr>
<td>Muscle tone</td>
<td>Limp</td>
</tr>
<tr>
<td>Reflex irritability (catheter in nares, tactile</td>
<td>No response</td>
</tr>
<tr>
<td>stimulation)</td>
<td></td>
</tr>
<tr>
<td>Color</td>
<td>Blue or pale</td>
</tr>
</tbody>
</table>
Initial steps

Chest Compressions

Drugs

Neonatal Resuscitation Algorithm—2015 Update

- Antenatal counseling
  Team briefing and equipment check

- Birth
  Term gestation? Good tone? Breathing or crying?

- Warm and maintain normal temperature, position airway, clear secretions if needed, dry, stimulate

- Apnea or gasping? HR below 100/min?

- PPV
  SpO₂ monitor
  Consider ECG monitor

- HR below 100/min?

- Check chest movement
  Ventilation corrective steps if needed
  ETT or laryngoscopy mask if needed

- Intubate if not already done
  Chest compressions
  Coordinate with PPV
  100% O₂
  ECG monitor
  Consider emergency UVC

- HR below 60/min?

- IV epinephrine
  If HR persistently below 60/min
  Consider hypovolemia
  Consider pneumothorax

- Infant stays with mother for routine care; warm and maintain normal temperature, position airway, clear secretions if needed, dry, Ongoing evaluation

- Laboring breathing or persistent cyanosis?

- Position and clear airway
  SpO₂ monitor
  Supplementary O₂ as needed
  Consider CPAP

- Postresuscitation care
  Team debriefing

Targeted Pediatric SpO₂ After Birth

- 1 min 60%-65%
- 2 min 66%-70%
- 3 min 70%-75%
- 4 min 75%-80%
- 5 min 80%-85%
- 10 min 85%-95%

© 2015 American Heart Association
The most sensitive indicator of a successful response to each step is an increase in heart rate.

- Heart rate should be calculated by counting the HR for 6 sec and then multiply it by 10.
- Auscultation of the precordium should remain the primary means of assessing HR.
- With a palpable pulse, palpation of the umbilical pulse is more accurate than palpation at other sites.
Golden Minute

Birth

Term gestation? Breathing or crying? Good tone? Yes, stay with mother

No

Warm, clear airway if necessary, dry, stimulate

No

HR below 100, gasping, or apnea?

Yes

PPV, Spo₂ monitoring

No

Labored breathing or persistent cyanosis?

Yes

Clear airway Spo₂ monitoring Consider CPAP

Routine care

- Provide warmth
- Clear airway if necessary
- Dry
- Ongoing evaluation
“Vigorous”
- Strong respiratory efforts or crying
- Good muscle tone
- HR > 100/min
- Color pink
- Clear of meconium
- Term gestation

Routine care
Routine care can be provided with the baby lying on the mother’s chest and should not require separation of mother and baby.

Cord clamping should be delayed for at least 1 minute in babies who do not require resuscitation.
INITIAL STEPS - DRYING, WARMING, POSITIONING, SUCTION, STIMULATION
Place under a radiant warmer or any external heat source - Drying, Warming
“SNIFF” POSITION

Shoulder roll for maintaining head position

Patent airway with no obstruction to airflow

Obstruction to airflow with neck hyperextended

Obstruction to airflow with neck flexed
SUCTIONING - CLEARING THE AIRWAY

- When Amniotic Fluid Is Clear
- Suctioning immediately following birth should be reserved for –
  - Babies having obvious obstruction to spontaneous breathing or
  - Who require PPV
  - Bulb syringe or Catheter attached to mechanical suction.
- When suction tube is blocked the negative pressure should be approximately 100 mm Hg

Suctioning the mouth and then nose “M” before “N”
STIMULATION

• Slapping or flicking the soles.
• Gently rubbing the newborn’s back, trunk or extremities.
• Only once or twice.
• Not of use in secondary apnea
INITIAL STEPS: MAINTAINING TEMPERATURE

• Delivery room temperatures should be at least 26°C for infants of < 28 weeks.
• Switch off fans and ACs.
• Pre-warming the linen.
• Drying and swaddling.
• Placing the baby skin-to-skin with the mother
• Covering mother-baby with a blanket.
Free flow oxygen

Central Cyanosis

Doesn't require Oxygen

Acrocyanosis
Initial steps

Chest Compressions

Drugs
INDICATIONS FOR BAG-VALVE-MASK VENTILATION

• Apnea or gasping respirations
• Heart rate < 100 bpm even if breathing
• Persistent cyanosis despite oxygen therapy
CONTRAINDICATIONS TO BAG AND MASK VENTILATION

• **Absolute contraindication**
  Diaphragmatic hernia

• **Relative contraindication**
  Meconium aspiration syndrome. Go for direct intubation with ET tube and PPV in such cases
SELF INFLATING BAG
Ventilation of lungs is the single most important and most effective step in cardiopulmonary resuscitation of the compromised newly born baby.
CORRECT SIZE AND POSITIONING OF THE MASK
• Make sure the airway is clear
• Lift the baby’s jaw into the mask
• Keep the mouth slightly open
• A noticeable rise and fall of the chest is by far the best indication that the mask is sealed and the lungs are being inflated.

• Newborn should appear to be taking a normal or easy breath.

• If blended oxygen is not available, resuscitation should be initiated with air.
HOW OFTEN TO SQUEEZE?

• 40 to 60 breaths per minute
• Breath..two..three.. breath..two..three…
• Signs of adequate ventilation
  ▪ Bilateral chest expansion
  ▪ Bilateral breath sounds
  ▪ Adequate heart rate, color
### NOT ENOUGH CHEST RISE

<table>
<thead>
<tr>
<th>Condition</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Inadequate seal</strong></td>
<td>Reapply mask to face.</td>
</tr>
<tr>
<td><strong>2. Blocked airway</strong></td>
<td>Reposition the head. Check for secretions; suction if present. Ventilate with newborn's mouth slightly open.</td>
</tr>
<tr>
<td><strong>3. Not enough pressure</strong></td>
<td>Increase pressure until there is an easy rise and fall of the chest. Consider endotracheal intubation.</td>
</tr>
</tbody>
</table>
IS THE BABY IMPROVING? – AFTER 30 SEC

• Increasing heart rate
• Improving color
• Spontaneous breathing

↓

Discontinue assisted ventilation as the rate and depth of spontaneous respirations become adequate.

Free – flow oxygen should be continued as necessary to keep the baby pink.
EXCESS GAS IN STOMACH

• Stomach distended with gas puts pressure on the diaphragm, preventing full expansion of the lungs.

• Regurgitation of gastric contents and aspiration.
INSERT AN OROGASTRIC TUBE…

• 8F feeding tube and 20 ml syringe
• Measure the length of the tube you want to insert.
• Through the mouth rather than nose.
• Remove gastric contents.
• Leave the end of the tube open.
• Tape the tube.
Neonatal Resuscitation Algorithm – 2015 Update

Initial steps
- Chest Compressions
- Drugs

You are here
WHY PERFORM CHEST COMPRESSIONS?

• At this stage babies will have very low blood oxygen levels.
• Myocardium depressed & unable to contract strongly to pump blood to the lungs to pick up oxygen.
• So, mechanically pump the heart.
• Rhythmic compressions of the sternum that Compress the heart against spine — Increase the intrathoracic pressure
• Circulate blood to vital organs of the body.
• Will also restore oxygen delivery to brain
INDICATIONS FOR CHEST COMPRESSIONS

Despite adequate effective ventilation with 100% oxygen

Hear rate < 60 bpm

or

Heart rate 60 to 80 bpm but not increasing
- Position of the baby
- Firm support for the back
- Neck slightly extended
- Compressions
  - Same location, depth and rate
  - Thumb technique is preferred
  - Less tiring
  - Control the depth of compression
- With long fingernails
- The chest should be permitted to re-expand fully during relaxation, but the rescuer’s thumbs should not leave the chest

**Thumb technique**

**2 Finger technique**
Thumb technique of chest compressions for small babies is one over the other (pictured). For large babies, use side-by-side technique.
Correct:
Fingers remain in contact with chest

Incorrect:
Fingers lose contact with chest
Depth of approx. 1/3 of the AP diameter of the chest.
NEONATAL CHEST COMPRESSIONS

• Coordinate with ventilation - 4 events in 2 sec

• 90 compressions and 30 breaths per minute

• Compression-ventilation ratio - 3:1

• One-and-two-and -three-and-breath-and-one-and-two-and-three-and-breath-and-
DANGERS

- Heart
- Lungs
- Xyphoid
- Liver
- Sternum
• After 30 sec of chest compressions and ventilation if HR is

• >60 BPM – Discontinue compressions and continue ventilation

• >100 BPM - Discontinue compressions and gradually discontinue ventilation if newborn breathing spontaneously

• <60 BPM – Intubate if not already done and give epinephrine
INDICATIONS FOR INTUBATION

• Ineffective Bag-valve-mask ventilation
• Congenital diaphragmatic hernia or ELBW
• Prolonged PPV is required
• Meconium -depressed baby
• If chest compressions are necessary- to facilitate coordination of PPV and chest compressions
• To administer drugs
LARYNGOSCOPE

- Miller O for preterm newborns
- Miller 1 for term newborns

**Suction equipment**

- 100 mm Hg
- 10F or larger to suction secretions from mouth and nose.
- Smaller suction catheters for suctioning the endotracheal tube
• Stabilize the baby’s head.

• Pre oxygenate before attempting intubation

• Free flow oxygen should be administered throughout the procedure.
3.5  >2000 gm.

3.0  1000-2000 gm.

2.5  <1000 gm.

Stylet
HOW TO HOLD THE LARYNGOSCOPE?

Handle (Contains Batteries)

Blade
Miller (Straight) Size 0

Finger left free to rest on baby’s face to provide stability
LANDMARKS PRESENT DURING INTUBATION
Preparing to insert the laryngoscope

Lifting the laryngoscope blade to expose the opening of the larynx

Correct
Incorrect

By intubator
Pressure applied to the larynx to improve visualization
By assistant
Suctioning of secretions
Vocal cords

Vocal cord guide

Stabilizing the tube

Removing the stylet

Resuming positive-pressure ventilation after endotracheal intubation
• The intubation procedure should ideally be completed within 20 sec.

• If not able to intubate within 20 sec proceed to bag and mask ventilation. When it becomes stable then you can reattempt it.
• A rise in chest with each breath
• Breath sounds over both lung fields but decreased or absent over the stomach
• No gastric distension with ventilation
• Vapor condensing on the inside of the tube during exhalation
• CO2 detectors
  ✓ Calorimetric devices
  ✓ Capnographs
IS THE TIP IN RIGHT LOCATION WITHIN THE TRACHEA?

- Equal intensity of breath sounds B/L
- If not Rt side will be louder
• Indication: Heart rate <60 bpm despite PPV and chest compressions
• Dose: 0.01 to 0.03 mg/kg IV (preferred route), ET, IO (0.1 to 0.3 ml/Kg of 1:10 000)
• If no response to ET administration, may increase ET dose to up to 0.1 mg/kg (0.1 mL/kg of 1:1000)
This baby is very pale and there was a history of Placenta Previa. Volume expansion may be required.

- **Indications**
  - Baby is pale
  - Evidence of blood loss
  - Baby is responding poorly to resuscitation.

- **NS, RL, O-ve blood cross matched with mother’s blood.**

<table>
<thead>
<tr>
<th>Recommended</th>
<th>Action</th>
</tr>
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<tbody>
<tr>
<td>Normal saline solution</td>
<td></td>
</tr>
<tr>
<td>10 mL/kg dose</td>
<td></td>
</tr>
<tr>
<td>Umbilical vein route</td>
<td></td>
</tr>
<tr>
<td>Estimated volume drawn into large syringe</td>
<td></td>
</tr>
<tr>
<td>Over 5 to 10 minutes</td>
<td></td>
</tr>
</tbody>
</table>
ROUTE OF DRUG DELIVERY

Syringe to 5F feeding tube inserted into the endotracheal tube

Syringe directly to endotracheal tube

Correct placement of umbilical venous catheter

Umbilical vein

Umbilical arteries
Umbilical vein is the most accessible vein
Temporary intraosseous access to provide fluids and medications to resuscitate critically ill neonates may be indicated following unsuccessful attempts to establish intravenous vascular access

<table>
<thead>
<tr>
<th>Medication</th>
<th>Concentration to Administer</th>
<th>Preparation</th>
<th>Dosage/Route</th>
<th>Total Dose/Infant</th>
<th>Rate/Precautions</th>
</tr>
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<tbody>
<tr>
<td>Epinephrine</td>
<td>1:10,000</td>
<td>1 mL</td>
<td>0.1±0.3 mL/kg</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>IV or IT</td>
<td></td>
<td>1 kg</td>
<td>0.1±0.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 kg</td>
<td>0.2±0.6</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3 kg</td>
<td>0.3±0.9</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>4 kg</td>
<td>0.4±1.2</td>
</tr>
<tr>
<td>Volume expanders</td>
<td>Whole blood</td>
<td>40 mL</td>
<td>10 mL/kg IV</td>
<td></td>
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<tr>
<td></td>
<td>5% albumin</td>
<td></td>
<td></td>
<td>1 kg</td>
<td>10</td>
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<tr>
<td></td>
<td>Normal saline solution</td>
<td></td>
<td></td>
<td>2 kg</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Ringer's lactate</td>
<td></td>
<td></td>
<td>3 kg</td>
<td>30</td>
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<td></td>
<td></td>
<td></td>
<td>4 kg</td>
<td>40</td>
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</table>
Buffers, a narcotic antagonist, or vasopressors may be useful after resuscitation, but these are not recommended in the delivery room

**Naloxone**

- **Indication** - Respiratory depression
- Recorded narcotic administration within 4 hours of delivery
- Dose - 0.1 mg/kg IV, IO, ET, IM, SQ
- If severe metabolic acidosis is suspected or has been proven from blood gas analysis.
- Not to be given if lungs are not adequately ventilated.
- Dose – 2 mEq/kg (4 mL/kg of 4.2% solution)
- Recommended route – Umbilical vein – Slowly not faster than 1 mEq/kg/min
MECONIUM SUCTIONING

• In a baby born through meconium and is depressed.

• Intubation and suction as necessary until meconium is recovered or until the baby’s heart rate indicates that PPV is needed.
• If attempted intubation is prolonged and unsuccessful, bag-mask ventilation should be considered, particularly if there is persistent bradycardia.
• Do not apply suction for longer than 3 – 5 secs as you withdraw the tube.
• If no meconium is recovered, don’t repeat the procedure; proceed with resuscitation.
• If baby is not depressed and is active – Routine Care. Don’t attempt for intubation.
PRETERM BABIES

- More likely to have difficulty with transition.
- Immature brain - poor respiratory drive
- Weak muscles, not able to breathe
- Deficiency of surfactant.
- More likely to lose heat.
- More likely to be born with an infection.
- Brains have very fragile capillaries that may bleed during periods of stress – IVH.
- Immature tissues, prone to oxygen toxicity
- More chances of pneumothorax
In an emergency, a pneumothorax can be detected by transillumination and treated by inserting a needle in the chest.
DIAPHRAGMATIC HERNIA

If diaphragmatic hernia is suspected (Scaphoid abdomen), void PPV with mask. Immediately intubate the trachea and insert an orogastric tube.
ARE THERE SITUATIONS IN WHICH NON INITIATION OF RESUSCITATION IS REASONABLE?

• Newborns with confirmed gestation of < 23 weeks or birth weight less than 400 grams.
• Anencephaly.
• Babies with confirmed trisomy 13 or 18
• Those with severe congenital anomalies.
• May be appropriate after 15 minutes of absent heart rate in spite of complete and adequate resuscitation efforts.
THANK YOU