Indian Academy of Pediatrics (IAP)

STANDARD TREATMENT GUIDELINES 2022

Neonatal Resuscitation Program

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Neonatal Resuscitation Program

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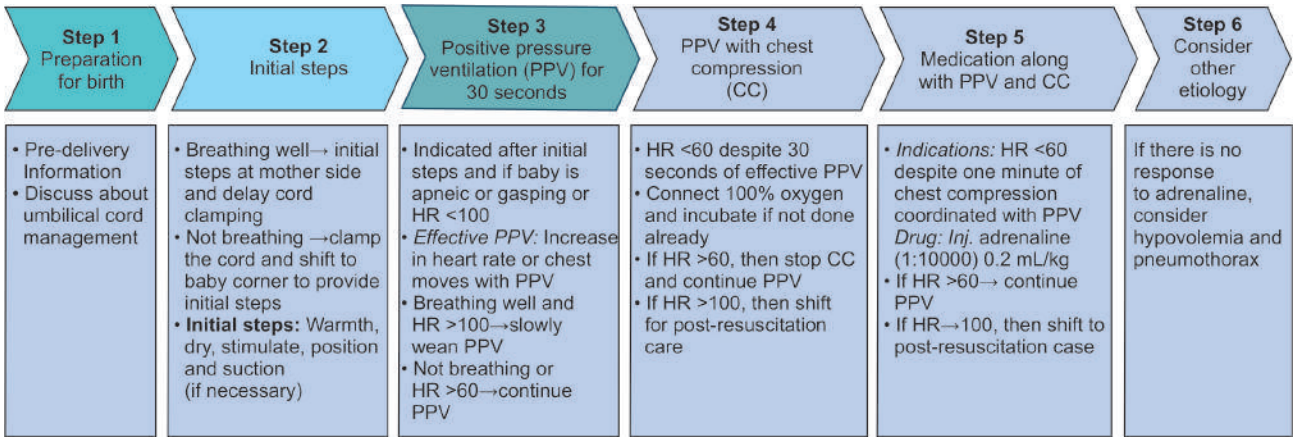
Introduction

- ☑ Perinatal asphyxia is an important preventable cause of neonatal mortality and morbidity, and contributes around 20% of neonatal mortality.
- ☑ Neonatal Resuscitation Program (NRP) is the most effective tool to reduce perinatal asphyxia. NRP is a standardized, structured program which brings in updated evidence-based practice.
- ☑ Indian Academy of Pediatrics (IAP) and National Neonatology Forum (NNF) are aiming at one NRP trained personnel at all deliveries through IAP-NNF-NRP-FGM program.

Overview of Neonatal Resuscitation Program



The key to successful neonatal resuscitation is anticipation and preparedness.

	Assessment	Action and possible outcome	Points to remember
PREPARE	*Pre-delivery questions regarding:* ☑ Gestational age ☑ Meconium-stained amniotic fluid (MSAF) ☑ Additional risk factors Discussion about umbilical cord management with obstetrician before delivery	Prepare team and team briefing *Check equipment and supplies:* Functioning of Ambu bag **(Video link 1)**, laryngoscope and availability of endotracheal (ET) tubes, suction catheter, and pulse oximeter with target saturation table.	☑ Cord clamping should be delayed at least 60 seconds if baby is breathing well ☑ Functioning of Ambu bag (self-inflating bag) is assessed by squeezing bag with palm covering the mask ☑ With air-tight seal around the mask, pop-off valve opens and makes hissing sound ☑ Feel for the air or pressure against the palm. This ensures opening of the fish mouth valve. ☑ Bag should recoil instantly when pressure is released
INITIAL STEPS	Assess for breathing or crying	☑ *Breathing well (routine care):* Deliver to mother's abdomen in skin-to-skin contact (SSC) → dry the baby and remove wet linen and cover the baby with warm towel → DCC → initiate breastfeeding → baby and mother to be in SSC (zero separation) ☑ *Baby not breathing (initial steps):* Clamp cord immediately → shift to the warmer → dry and replace wet linen with another pre-warmed towel → stimulate → place the baby in sniffing position → suction the mouth followed by the nose	 *Positioning the head and neck using shoulder roll* ***(Video link 2)***
	After initial steps, assess breathing and heart rate (HR)	☑ Baby breathing and HR >100 but appears cyanosed, check for saturation → saturation below target → provide free flow oxygen ☑ If baby has labored breathing—nasal continuous positive airway pressure (CPAP) should be considered ☑ Baby not breathing or if breathing but HR <100—provide positive pressure ventilation	*Target oxygen saturation table:* ☑ *1 minute*: 60–65% ☑ *2 minutes*: 65–70% ☑ *3 minutes*: 70–75% ☑ *4 minutes*: 75–80% ☑ *5 minutes*: 80–85% ☑ *10 minutes*: >85% **MSAF does not influence the resuscitation. Intubation for tracheal suction in non-vigorous baby born through MSAF is not recommended.**

Positive pressure ventilation (PPV) is the most important step in neonatal resuscitation. 99% of apneic babies can be revived if PPV is provided in the correct manner at appropriate time *(within the first golden minute)*.

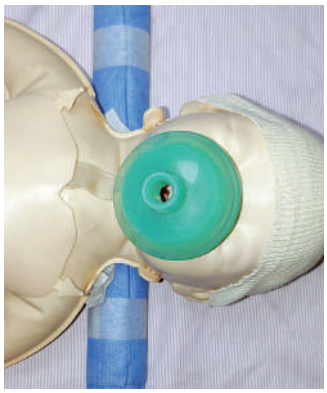
Indications for PPV after initial steps

- When baby is apneic or gasping
- Heart rate is <100

Steps to Provide Effective Positive Pressure Ventilation

Initiating PPV	Role of assistant	Ineffective PPV– HR not increasing and also chest is not moving	After PPV	After care
With self-inflating bag • Choose appropriate size mask (size 0 & 1, for preterm and term, respectively) • Place the mask covering the chin to bridge of the nose but avoiding eyes • Provide air-tight seal • PPV for 30 seconds in room air for babies ≥35 weeks of gestational age and 21–30% for preterm <35 weeks • *Rate of PPV:* 40–60 per minute by reciting breath—2–3 and synchronizing the squeeze with "breath" and releasing the bag with "–2–3"	**Effective PPV** • Increasing HR • If HR is not increasing, then chest should move with PPV • Assistant connects pulse oximeter to the right hand • After 15 seconds, looks for effectiveness of PPV by primarily assessing for increasing heart rate (HR) by auscultation and if not increasing, then looks for chest movement with PPV	**Corrective action** • MR SO P A • Five rescue breaths with each step to assess chest movement with PPV **MR**– **M**ask readjustment **R**eposition the head and neck **SO**– **S**uction the mouth and nose. Open the mouth **P**– Increase the delivered **P**ressure by squeezing the bag harder **A**–**A**lternate airway like intubation Provide PPV that moves the chest for 30 seconds	**Duration** • Effective PPV for 30 seconds • Assess for breathing and HR • Breathing well—slowly wean-off PPV and titrate oxygen for target SpO_2 • HR >100 but not breathing well, continue PPV and add oxygen if saturation below target. If prolonged, consider intubation • HR <100, continue PPV, ensure effective ventilation by intubation and add oxygen if saturation below target	Type of care depends on duration of PPV • Effective PPV for 30 seconds only then provide **observational care** Observational care includes monitoring vitals, feeding and activity every 15 minutes in the first hour and then every 30 minutes in the second hour at mother side • Effective PPV for more than 30 seconds than provide **post-resuscitation care** in a nursery

Effective PPV given for 30 seconds

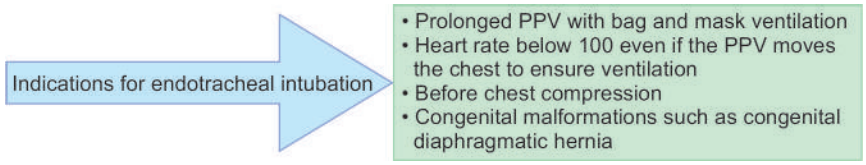


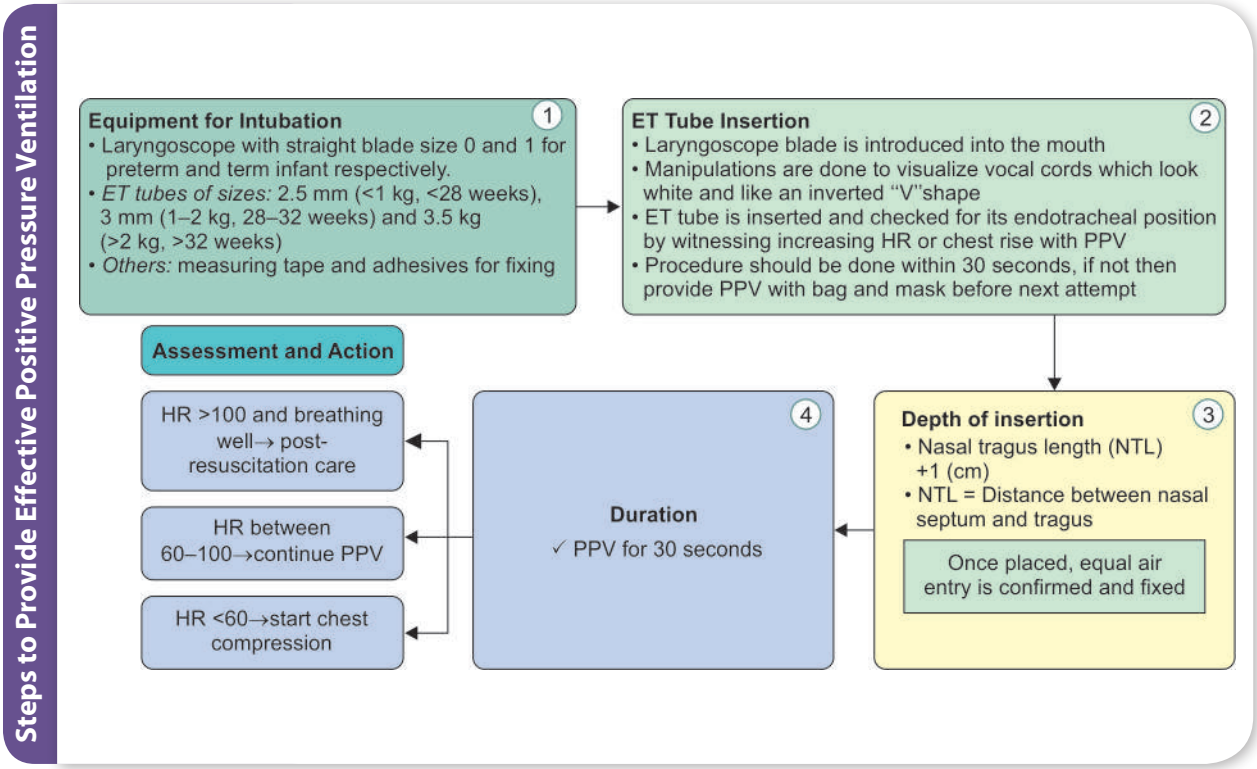
Mask position

PPV with "C" and "E" clamp to provide tight seal

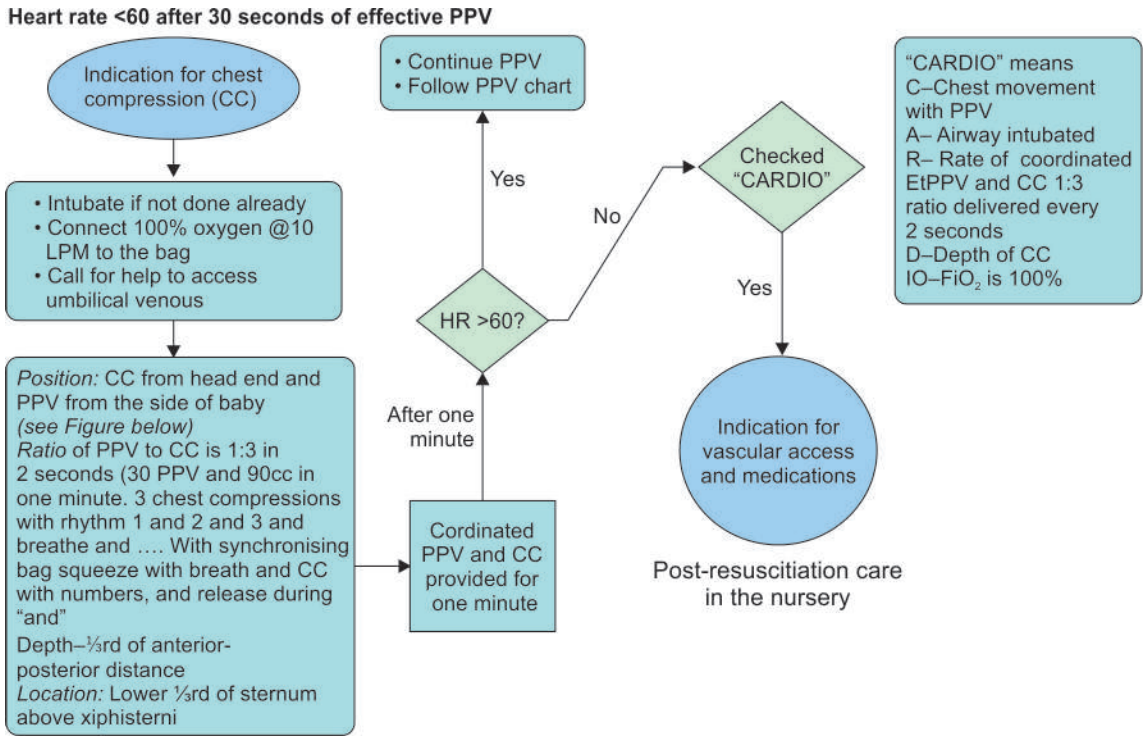
(Video links 3 to 6)

Positive Pressure Ventilation Via Endotracheal Tube (EtPPV)





(Video links 7 to 11)

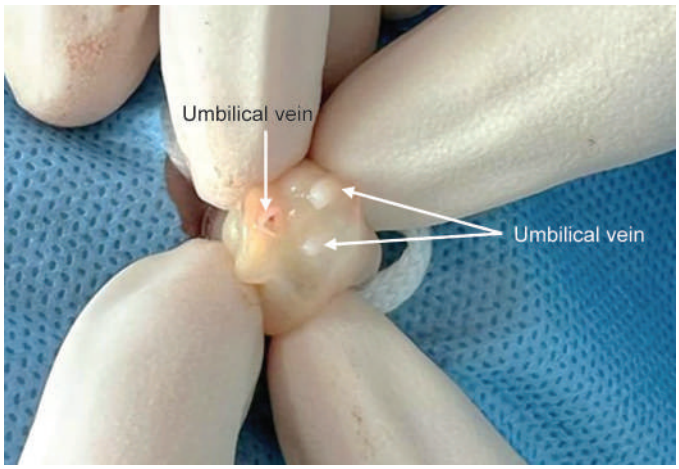


(Video link 12)

Image showing chest compression from head end and PPV from the right side of the infant

Resuscitation If HR <60 after 1 minute of Coordinated CC and EtPPV

	Assessment	Action	Reassessment	Action
MEDICATION	If HR <60 after "CARDIO" check	☑ Continue coordinated PPV and CC ☑ Access umbilical venous line (UVL) to administer drugs. With aseptic precautions, cord is tied and cut about 1 cm above skin → vein is identified and saline flushed umbilical catheter (size 3.5–5 Fr), is inserted and secured at about 2–4 cm until there is free backflow of blood. Injection adrenaline 1:10,000 dilutions of 0.2 mL/kg (0.1–0.3) followed by a saline flush of 3 mL. ET adrenaline may be administered at a dose of 1.0 mL/kg till umbilical venous access is established ***(Video links 13 to 14)***	Reassess HR after 60 seconds	☑ *If HR >60:* Stop CC and continue EtPPV. Once HR >100 and SpO_2 is within target range, shift the baby for PRC ☑ *If HR <60:* Continue EtPPV and CC, reassess after 60 seconds
	If HR <60, after 60 seconds of EtPPV and CC following intravenous dose of adrenaline	☑ Repeat dose every 3–5 minutes and assess every 60 seconds for response. ☑ If history of blood loss and signs of shock present, then give one bolus of normal saline @10 mL/kg over 5–10 minutes ☑ If chest transillumination test is positive → place Intercostal drain using three way stopcock and syringe	If there is no response to adrenaline	☑ Consider discontinuing resuscitation, if HR is zero after 20 minutes of life ☑ Post-resuscitation debriefing and family should be counseled



There are situations where resuscitation may not improve the baby or resuscitation may need to be modified. Some of such situations are mentioned here.

Situation	***Problem***	***Resuscitation technique***
Preterm delivery	Preterm newborns are at higher risk for hypothermia and have immature lungs	☑ Preterm infants <32 weeks, should be covered with a plastic sheet without drying ***(Video link 15)*** ☑ Initial oxygen concentration during PPV is between 21 and 30% ☑ Labored breathing warrants delivery room CPAP ☑ It is preferable to provide peak end-expiratory pressure (PEEP) and peak inspiratory pressure (PIP) during PPV using T-piece resuscitator ***(Video link 16)***
Persistent bradycardia after ensuring effective PPV	☑ Severe *asphyxia* ☑ Congenital heart block	No change in the resuscitation sequence. Suspect heart block if there is maternal history of lupus
Baby not improving or suddenly worsens	☑ Pneumothorax ☑ Pleural effusion	Intercostal drain (ICD) ***(Video link 17)***
Baby is not improving with resuscitation	☑ Congenital diaphragmatic hernia (CDH) or other lung malformation (antenatal diagnosis) ☑ Lung hypoplasia (presence to oligohydramnios) ☑ Severe primary pulmonary hypertension of the newborn (PPHN)	☑ *CDH:* Intubate immediately after birth and insert orogastric tube for draining the stomach ☑ *Lung hypoplasia:* PPV with high pressures to move the chest and this in turn predisposes for pneumothorax
Chest is not moving despite providing EtPPV	Obstruction in the airway possibly due to thick secretion or aspirated meconium	Attach the tracheal aspirator to the ET tube and remove the ET tube with suctioning. Do not move to next step until chest movement is seen with PPV ***(Video link 18)***.
No spontaneous breathing efforts	☑ Severe asphyxia ☑ Neuromuscular disorders ☑ Central nervous system (CNS) malformation	Resuscitation sequence is no different
Airway malformation is suspected difficult to provide effective PPV and difficult to intubate	☑ Retrognathia—Robin sequence ☑ Mass in the lower jaw—cystic hygroma	*Robin sequence:* Put the baby in prone and insert nasopharyngeal airway through the nose using 2.5 size ET tube to be placed beyond the tongue. If not improving, then tracheostomy may be required. If severe obstruction suspected antenatally, then multidisciplinary meeting for ex-utero intrapartum therapy (EXIT) and tracheostomy

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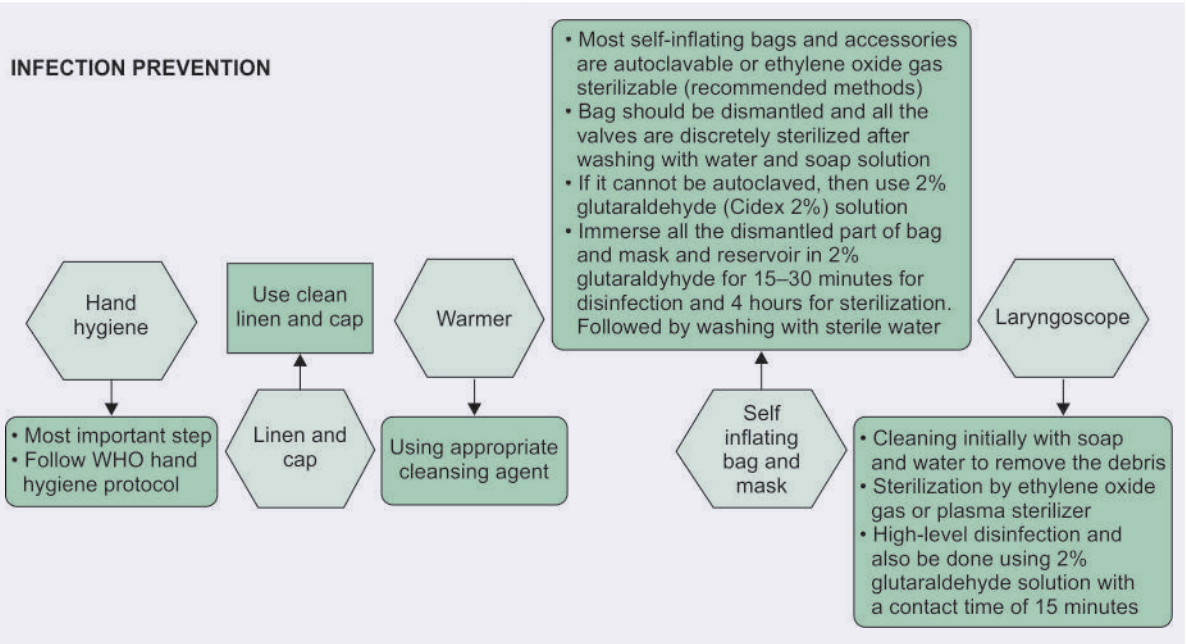
Situation	*Problem*	*Resuscitation technique*
Airway malformation suspected if baby improves with crying but becomes cyanosed when mouth is closed	Choanal atresia—bilateral	Oral airway can be inserted to maintain the airway
Gastrointestinal (GI) malformations	Gastroschisis and omphalocele	☑ Gastroschisis and omphalocele, umbilical cord should be clamped as far away as possible. Place the baby and the exposed bowel in a sterile clean plastic bag and position the baby and bowel on the right side. Insert orogastric tube for continuous gastric drainage. Handle the bowel gently ☑ If baby requires PPV in babies with gastroschisis, then intubation is preferred over bag and mask
Neural tube defect	Meningomyelocele is prone for rupture	☑ Baby to be placed in prone or lateral position. ☑ If baby needs resuscitation, prepare a donut using towel and placed at the level of the lesion to avoid the pressure effect on the lesion due to the body weight. Use non-latex plastic wrap over the lesion.



Conclusion

NRP is a standardized and evidence-based, structured program. Every person attending delivery should be NRP trained to improve neonatal care at delivery and to prevent the neonatal morbidity and mortality due to birth asphyxia. To become NRP provider login to IAP-NNF-NRP-FGM program.

Video Links

1. Testing self-inflating bag: *https://bcove.video/39AC7J4*
2. Initial steps: *https://players.brightcove.net/6056665225001/default_default/index.html?videoId=6222825154001*
3. Use of self-inflating bag: *https://bcove.video/38H1kCl*
4. PPV administration: *https://bcove.video/35Gb65Z*
5. HR assessment during PPV: *https://bcove.video/3oLt6TQ*
6. MR.SOPA: *https://bcove.video/3soVBJf*
7. Intubation supplies: *https://bcove.video/2MTCA1I*
8. Intubation procedure: *https://players.brightcove.net/6056665225001/default_default/index.html?videoId=6222824084001*
9. Role of assistant in Intubation: *https://players.brightcove.net/6056665225001/default_default/index.html?videoId=6222823603001*
10. NTL: *https://bcove.video/38HJHSW*
11. Securing ET tube: *https://bcove.video/2LQhwbs*
12. How to administer chest compression: *https://bcove.video/3byPiNs*
13. Review of emergency umbilical venous access: *http://bcove.video/3gHIP5j*
14. Closed loop communication and administering adrenaline: *https://bcove.video/38IpkFx*
15. Preterm resuscitation: *https://youtu.be/3HNRoXrGjSM*
16. T-piece resuscitator: *https://bcove.video/3spLBj6; https://bcove.video/2LqsTr4*
17. ICD for pneumothorax: *https://youtu.be/B60FqnTC-Xs*
18. Intratracheal aspirator: *https://bcove.video/3qih58W*

Further Reading

- ☑ Berkelhamer SK, Kamath-Rayne BD, Niermeyer S. Neonatal resuscitation in low-resource settings. Clin Perinatol. 2016;43(3):573-91.
- ☑ Indian Academy of Pediatrics. Advanced NRP Workshop Manual: A Joint Initiative by IAP and NNF. Mumbai, India: Indian Academy of Pediatrics; 2021.
- ☑ Weiner GM, Zaichkin J. Textbook of Neonatal Resuscitation, 8th edition. Itasca, United States: American Academy of Pediatrics; 2021.