

RESUSCITATION OF THE NEWBORN

**MANUAL FOR THE ADVANCED
NEONATAL LIFE SUPPORT COURSE**

2019



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Perinatal Society of Sri Lanka
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Resuscitation of the Newborn,
The Manual for the Advanced Neonatal Life Support Course, 2019

This manual for the Newborn Advanced Life Support Course was developed on the best available evidence at the time of preparation. All possible attempts have been made to make the publication accurate and user friendly. It is the responsibility of the users of the manual to keep updated with the latest evidence in the management of the patients.

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Neonatal Life Support (NLS) Course

NLS Provider Course was held for the first time in Sri Lanka in September 2006 at the Lady Ridgeway Hospital (LRH) for Children under the guidance of Dr Babu Kumararatne Consultant Neonatologist at Royal Wolverhampton NHS Trust, Newcross, UK. The Course was sponsored by UNICEF and I wish to thank Dr Aberra Bekele, Head, Early Childhood Programme of UNICEF who took a keen interest in this project. A total of 80 participants, including 65 Consultant Paediatricians, were trained. Efforts taken by Dr Anoma Jayathilake, Consultant Community Physician of the Family Health Bureau who liaised with us on this programme with the UNICEF is deeply appreciated. This course manual is based on the 2nd edition of Newborn Life Support Manual by the Resuscitation Council in the UK and 2010 European Resuscitation Guidelines. I am very grateful to all those who contributed from the beginning and Dr Priyantha Perera who updated the manual in 2009, Dr Nandane Wickramasingha who incorporated 2010 guidelines, Dr. Ranmali Rodrigo and Dr. Nishani Lucas who edited the 2015 manual and Dr. B.J.C.Perera for reviewing all versions. The course is conducted under the auspices of the Family Health Bureau of the Ministry of Health and the Perinatal Society of Sri Lanka together with the Sri Lanka College of Paediatricians. The Objective is to provide clear instructions in resuscitation of babies at birth for doctors, nurses and midwives who are going to be the first responders to a newborn with problem at birth. The Course will provide background knowledge and skills to manage the newborn infant during the first 10-20 minutes in a competent manner. This course concentrates on teaching of practical airway management and ventilatory support. It is recommended that all caregivers of newborns should undergo this course.

Dr Srilal de Silva- Course Director for NLS

Consultant Paediatrician in charge of PICU, Lady Ridgeway Hospital for Children
2001 to 2016

Preface

Perinatal asphyxia is a common cause of morbidity and mortality in developing countries although its true incidence is not known in many countries including Sri Lanka. At the same time we are uncertain about the causes of perinatal asphyxia in Sri Lanka. In some situations the pregnancy outcome is a still birth as a result of asphyxia. It is believed that deficiencies in the health care delivery system are contributory factors for adverse outcomes of perinatal asphyxia.

Availability of skilled human resources is an essential prerequisite for handling asphyxiated infants at birth. The Perinatal Society of Sri Lanka (PSSL) took the pioneering step to formalize the training of health care workers in neonatal resuscitation in 2006. They joined hands with the Resuscitation Council of UK to embark on training of 80 paediatricians in neonatal resuscitation & certify them as providers of Neonatal Life Support (NLS). Now the PSSL is embarking on the second step of introducing formal training of other staff including house officers, senior house officers, registrars, nurses and midwives. This will be an ongoing joint activity between the PSSL and the Family Health Bureau of the Ministry of Health. Dr. Srilal de Silva is in-charge of this activity for the PSSL. He had done an excellent job along with his team to formulate local training guidelines and develop the hand book. I thank every one of them for their untiring efforts & hard work. I wish the programme every success. Undoubtedly this will lead to a reduction of severity of perinatal asphyxia and its adverse outcomes on a long term basis.

Professor Sujeewa Amarasena

President – PSSL. 2006 / 2007

Message from the Head of Early Childhood Programme, UNICEF- 2006

There is no doubt that Sri Lanka has over the last decades made impressive achievements in reducing neonatal mortality. Existing evidence shows that neonatal mortality in Sri Lanka has reduced from as high a level as 76 per 1,000 live births in 1945 to as low a level as 16 per 1,000 live birth in 1985. This is an achievement that demonstrates, as powerfully as anything can, what can be accomplished when national commitments and partnerships are matched by resources and political will. Although the neonatal period is only 28 days of the 365 days of infant life, it accounts for nearly 84 per cent of all infant deaths in Sri Lanka. The death toll is higher within the first week of the child's life and even much higher within the first 24 hours.

With high health coverage and the low level of neonatal mortality that Sri Lanka has attained, further reduction requires strategic thinking, refocus and reaching the difficult to reach. We have made considerable investments on improving care of newborns through sponsoring life-saving newborn resuscitation programme and provision of equipments, linking the care provided in the field setting with referral to care at facilities through provision of transport facilities.

Dr. Aberra Bekele,

Head Early Childhood Programme, UNICEF, 2006

Message from the Director Family Health Bureau - 2007

Sri Lanka has achieved a significant reduction in the Infant Mortality Rate compared to other developing countries over the last several decades. This has been contributed to by the untiring efforts of both preventive and curative health sectors. At present Neonatal Mortality Rate contributes to over three fourths of the Infant Mortality Rate and it demands a concerted effort by all relevant sectors to improve neonatal care. This will invariably lead to a reduction in neonatal morbidity as well.

Family Health Bureau of the Ministry of Health of Sri Lanka has now focussed attention on care of the Newborn as an important strategy for further reduction of infant mortality. Newborn resuscitation plays an important role in preventing neonatal mortality and morbidity. This manual will provide a guide for first responders who attend newborn resuscitation.

Finally I wish to express my gratitude to The Perinatal Society of Sri Lanka, Paediatricians, and my staff, who contributed in numerous ways to make this publication a success, and UNICEF / Sri Lanka for funding this endeavour.

Dr. V. Karunaratne

Director (MCH) 27/07/2007

Message from the President College of Paediatricians - 2007/2008

Sri Lanka is a paradox in terms of health parameters. Impressive gains in mortality and morbidity have been adversely affected by the lack of expected gains in certain areas including morbidity and mortality of neonates. One reason for this is the relative lack of continued professional development together with lack of information on the management of neonatal problems within the Sri Lankan context. I have great confidence that this manual on "Neonatal advanced life support" will fill this void to a large extent. As the President of the Sri Lanka College of Paediatricians it is my pleasure to send this message on the launch of this new edition.

Dr. Chandra Abeysekera

President SLCP 2007/2008

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INTRODUCTION

A childbirth can take place anywhere at any time. At present the vast majority of births in Sri Lanka take place in hospitals. With modern obstetric care most babies are born in good condition and do not need much help to adapt to extra-uterine life. However, some babies fail to establish self-ventilation, which is the first and most crucial adaptation for extra uterine life. In simple terms some babies do not cry at birth. During this course we are focussing on these babies. They are the ones who need resuscitation.

As a birth can sometimes take place under unexpected circumstances, any medical /nursing officer, irrespective of his or her own speciality, should know how to help a baby who needs resuscitation. The procedure of resuscitating a newborn is simple and easy to understand, if one is aware of the principles behind it. Objective of resuscitating a newborn is to save a life without significant brain damage. That means to give the parents a baby with good long-term neurological outcome.

Various strategies and procedures have been carried out over the years during resuscitation of neonates. Some of these have no scientific basis, while others are actually harmful. Objective of this course is to teach the most updated method of resuscitating an asphyxiated neonate, based on latest scientific evidence. You may find some of the procedures you are following at present are wrong and you should be ready to change the practices. Reading this manual before the course will help you to understand what is taught in the course and to get optimal benefit from it.

Dr Priyantha Perera

Consultant Paediatrician & Senior Lecturer (2007)
Colombo North Teaching Hospital, Ragama

IMPORTANT OPERATIVE PHRASES

Inflation breaths

1 – 2 – 3- release
2 – 2 – 3- release
3 – 2 – 3 – release
4 – 2 – 3- release
5 – 2 - 3 – release

Ventilation breaths

- Squeeze 1
- Squeeze 2
- Squeeze 3.....
- Squeeze 14
- Squeeze 15

Chest compressions

- 1 and
- 2 and
- 3 and

RESUSCITATION OF THE NEWBORN BABY

It is estimated that one in twenty babies need help with breathing at birth, but it is not always possible to know in advance which baby would need such help. Resuscitation must be anticipated at each birth. Risk factors are poor predictors of birth asphyxia. Up to half of newborns who require resuscitation have no identifiable risk factors before birth.

Physiological changes that take place at birth

During intra uterine life the fetus gets nutrition and oxygen through the placenta. Placenta is a less effective respiratory membrane compared to the lung. Therefore, fetal haemoglobin has a higher affinity for oxygen and the fetus has a higher haemoglobin concentration. Blood that is returning from the placenta is carried by the umbilical veins and is returned to the heart via the inferior vena cava. Majority of this blood is directed towards the left atrium through the foramen ovale.

The lungs are not aerated during intra uterine life and are filled with amniotic fluid. Therefore, pulmonary vascular resistance is very high. Due to this, majority of blood that is ejected out of the right ventricle is directed towards the aorta via the ductus arteriosus. By this mechanism, the upper part of the body, including the brain, gets blood with a higher oxygen concentration than the lower part which receives a mixture of blood from the aorta and ductus.

After the delivery when the umbilical cord is clamped, the arterial oxygen level of the baby goes down and carbon dioxide level goes up. This stimulates the respiratory centre to initiate breathing and the baby will start to cry. Tactile stimulations created by handling the baby also contribute to the stimulation of the respiratory centre.

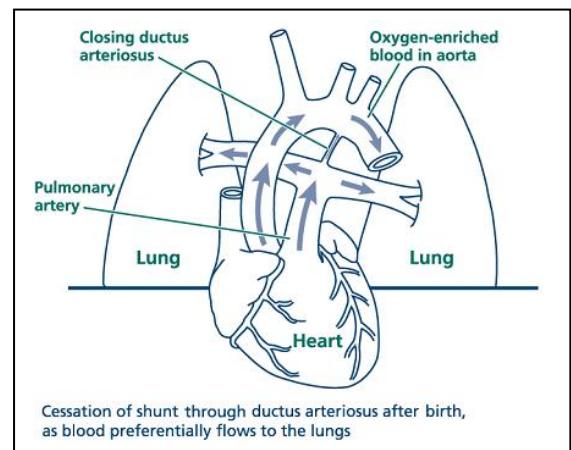
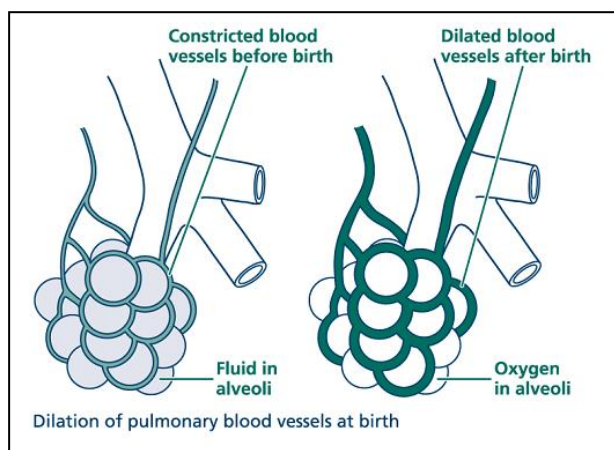
At birth all mammals have about 30ml/kg lung fluid. A small amount of fluid, perhaps 35ml or so in a term baby, is expelled from airways during the passage through the birth canal. With the first few breaths which create a higher negative pressure ($>100\text{cm H}_2\text{O}$), the fluid in the alveoli get absorbed to the lymphatics, allowing alveoli to expand. In a term baby about 100 ml is absorbed in this manner. Stress during normal delivery facilitates this reabsorption. When you inflate a balloon you would have noticed that inflating the initial part is difficult and then the balloon starts to inflate easily. Alveoli are similar to balloons and need a higher pressure to inflate them initially. The newborn achieves this by holding the breath for a while.

**Babies are wet
Lungs are full of fluid**

Stimuli for the first breath

- **Cord obstruction**
- **Cold air**
- **Physical discomfort**

With aeration of lungs, oxygenation of pulmonary arterial blood begins. High oxygen and low carbon dioxide causes vasodilatation in the pulmonary circulation resulting in a considerable drop in the pulmonary arterial pressure. This causes a reversal of blood flow in the ductus arteriosus, inducing its closure. Drop in pressure within the right atrium results in closure of the foramen ovale. Therefore, with inflation of the lungs, the fetal circulation is replaced by the adult circulation.



The primary event that initiates these changes, is aeration of the lungs.

Chapter 01

PHYSIOLOGY OF BIRTH ASPHYXIA

What will happen if a baby fails to establish breathing after the umbilical cord is clamped?

Information comes from a study where a uterus of a pregnant sheep was opened and the baby sheep's head was immersed in a saline bag, after delivering the head of the baby. The cord was then clamped and physiological changes of the fetus were observed. This study provided information regarding changes that take place when a fetus or a newborn baby is asphyxiated.

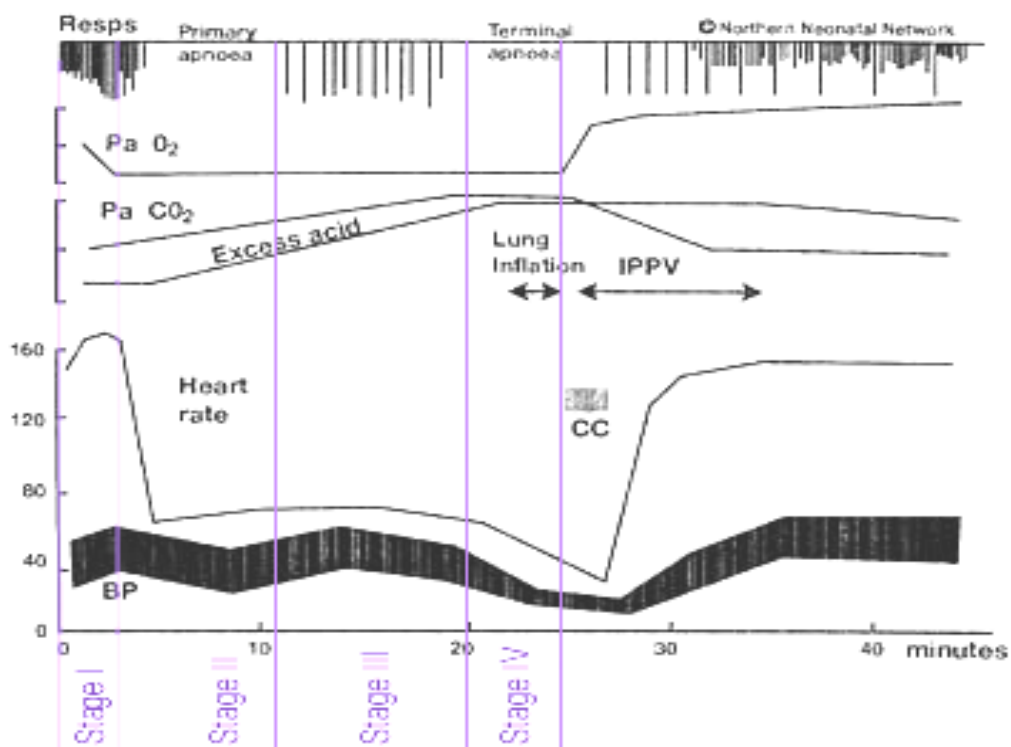
When a fetal or newborn brain is deprived of oxygen, the stimulation of the respiratory centre will result in initiation of breathing, and if everything is in order, normal respiration will be established. However if the initial breathing movements fail to bring in oxygen to the brain, these breathing movements will stop and the baby will become apnoeic. This is termed primary apnoea. During this stage, the baby is in a state of coma and the respiratory centre in the brain ceases to fire spontaneously. Up to this point, the heart rate remains stable and the blood pressure remains normal. Soon the heart rate drops to about half but the blood pressure remains stable. During this period, the circulation to the vital organs is maintained at the expense of other organs. After a few seconds in primary apnoea, primitive respiratory centres in the spinal cord start to fire, and this will result in irregular gasping type of breathing. If this also fails to bring in oxygen, the baby will stop breathing again. This is called terminal apnoea. During this period, the heart rate and the blood pressure drop rapidly and the condition of the baby deteriorates quickly. Duration of primary apnoea can vary and may even be prolonged in a baby whose mother has had pethidine.

A baby who is not breathing at birth may be in either primary or terminal apnoea. At that particular time, it is difficult to say exactly whether it is primary or terminal apnoea. However, a baby in primary apnoea responds to tactile stimulation while a baby in terminal apnoea does not respond to tactile stimulation. Without some sort of artificial respiration, the baby will die within the next few minutes.

Differences between primary apnoea and terminal apnoea

	Primary	Terminal
Breathing	Starts quickly with stimulation	Poor response to stimulation
Heart rate	Around 60/min	Below 60/min
Blood pressure	Normal	Low
Colour	Blue	Mottled & pale
Tone	Mildly reduced	Floppy

- Intra-partum monitoring will give an idea of the degree of stress the baby is under.
- Severe chronic asphyxia seems to be much more damaging than acute asphyxia.
- Measurement of umbilical arterial and venous blood pH and base excess are useful to detect intra-partum asphyxia.
- Babies delivered in terminal apnoea need advanced resuscitation.



Asphyxia affects all systems of the body. A baby who had significant birth asphyxia may develop many complications during next few days. These include: -

- Neurological – hypoxic ischaemic encephalopathy or periventricular haemorrhages in a preterm baby
- Cardiovascular – myocardial damage
- Lungs – secondary surfactant deficiency
- Gut – necrotising entero-colitis
- Renal – acute tubular necrosis
- Metabolic – hypocalcaemia (transient parathyroid dysfunction), Syndrome of inappropriate antidiuretic hormone (SIADH) secretion

Therefore, babies who were successfully resuscitated from significant asphyxia should be closely observed in a Neonatal Intensive Care Unit until he/she is stable.

SARNAT GRADING

Sarnat grading is used in babies who required significant resuscitation at birth to assess the neurological status. This is documented over the first few days and not only just at birth.

Modified Sarnat Stage			
Stage	Stage 1	Stage 2	Stage 3
Level of Consciousness	Hyper alert	Lethargic or obtunded	Stupor or coma
Activity	Normal	Decreased	Absent
Neuromuscular control			
Muscle Tone	Normal	Mild hypotonia	Flaccid
Posture	Mild distal flexion	Strong distal flexion	Intermittent decerebration (extension)
Stretch reflexes	Overactive	Overactive	Decreased or absent
Complex / Primitive reflexes			
Moro reflex	Strong	Weak	Absent
Suck reflex	Normal	Weak or absent	Absent
Tonic neck reflex	Slight	Strong	Absent
Autonomic function			
Pupils	Dilated	Constricted	Poorly reactive
Heart rate	Tachycardia	Bradycardia	Variable
Seizures	Uncommon	Common: Focal or multifocal	Uncommon: excluding decerebration

Sarnat HB, Sarnat MS. Neonatal encephalopathy following fetal distress. Arch Neurol 1976; 33:698-705

ANATOMICAL AND FUNCTIONAL CHARACTERISTICS OF A NEONATE WHICH ARE PRACTICALLY SIGNIFICANT

At birth, the newborn is *covered with fluid* which will rapidly evaporate. The baby has a *larger surface area compared to volume*. He/She has a *large head compared to the body* and he/she is *naked*. All these result in rapid heat loss from the baby if the environmental temperature is low. In addition, the thermogenic functions like *shivering are not developed*. The end result is hypothermia unless it is actively prevented. **Hypothermia** will result in low arterial oxygen saturation and acidosis. This will suppress surfactant production.

Newborn has a **prominent occiput and a short neck**. This results in flexion of the head. The **relatively large tongue** can fall back easily in a hypotonic asphyxiated baby. These result in upper airway obstruction, if appropriate steps are not taken to prevent it.

A newborn's **epiglottis is relatively long** and held at an acute angle to the laryngeal opening. This makes visualisation of vocal cords during routine laryngoscopic examination difficult. Due to this fact, a different method of laryngoscope insertion is used in neonates and straight-blade laryngoscopes are used rather than curved-blade laryngoscopes.

Newborn's **heart is relatively large and placed higher** in the precordium. The chest wall is easily compressible. Thus, compared to adults, relatively less force is needed to achieve adequate chest compressions (cardiac massage). Site of chest compression is just below (rather than 1cm below) the nipple level. The **aim** during chest compressions is to **maintain the coronary circulation**.

Newborn's **brain can utilise ketone bodies as a fuel**. Therefore, the newborn brain can survive hypoxia longer than the adult brain.

Chapter 02

PREPARATION FOR RESUSCITATION

2.1 EQUIPMENT AND CONSUMABLES FOR RESUSCITATION

2.2 DRUGS USED IN NEONATAL RESUSCITATION AND POST – RESUSCITATION

2.3 SITUATIONS WHERE PROBLEMS ARE ANTICIPATED

2.1 EQUIPMENT AND CONSUMABLES FOR RESUSCITATION

Unlike Cardio-Pulmonary Resuscitation (CPR) in adults, resuscitation at birth is a somewhat predictable event. It is therefore possible to prepare the environment and the equipment before the delivery of the baby. Resuscitation should ideally take place in a warm, well-lit, draught free area with a flat resuscitation surface placed below a radiant heater together with other resuscitation equipment being immediately available. All equipment must be checked frequently and a record of this maintained.

When a birth takes place in a non-designated delivery area, the recommended minimum equipment includes a device for safe assisted lung aeration of an appropriate size for the newborn, warm dry towels and blankets, a sterile instrument for cutting the umbilical cord and clean gloves for the attendant and assistants. It may also be helpful to have a suction device with a suitably sized suction catheter and a tongue depressor (or laryngoscope) to enable the oropharynx to be examined. Unexpected deliveries outside the hospital would need emergency services and we should plan for such events as well.

Important points about the equipment used for resuscitation:

- Equipment must be cleaned and checked after each delivery and checked again before the next delivery to ensure it is ready for use.
- Broken and defective equipment is dangerous and should be replaced.
- Equipment must be of appropriate size. Adult bags and masks cannot be used on babies who have small and fragile lungs.
- The volume of the self-inflating bag should be 250ml.
- Resuscitation can be done without piped oxygen being available.

Equipment

- Firm stable surface
- Radiant warmer with good light or 100W bulb
- 2 pairs of gloves – for checking the equipment and handling the baby
- Stop clock / timer
- Self-inflating bag of 250 ml OR a T-piece resuscitation device
- 3 different sizes of transparent masks 00, 0, 0/1
- Laryngoscope with size 00, 0 & 1 straight blades and with good illumination. Extra batteries of appropriate size.
- ET tubes of three different sizes 2.5, 3.0, 3.5mm
- Oro-pharyngeal air-ways of different sizes 00, 0, 1
- Oxygen source - wall oxygen or cylinder
- Suction apparatus with suction tubes
- Stethoscope
- Gas supply ideally pressurised air, oxygen and a blender
- Set of cord scissors

Consumables

- Umbilical clamp
- Two 10cc syringes and two 1cc syringes and needles
- Adrenaline 1:1000 solution
- 0.9% sodium chloride (normal saline)
- 10% dextrose (or 5% and 25% dextrose)
- 8.4% sodium bicarbonate
- Adhesive tapes
- Suction catheters 10 - 14FG
- Yellow peripheral intravenous cannula
- Sterile gauze
- Local record sheet
- For insertion of the umbilical venous catheter (UVC)
 - Surgical blade with scalpel blade handle
 - Umbilical catheter or feeding tubes of sizes 3.5 and 5.0 French gauge (FG)
 - A three-way tap
 - Mosquito forceps / Catch forceps
 - Cord tie

2.2 DRUGS USED

2.2.1 DURING NEONATAL RESUSCITATION

a) Adrenaline (1:10,000)

Available	1 : 1000
Preparation	To make 1:10,000 use 10 ml syringe. Take 1ml of adrenaline and draw 9ml of 0.9% NaCl (normal saline) and mix = 1:10,000 Draw 1ml of this solution to a 1ml syringe & label it
Dose Through UVC	0.1ml / kg of 1:10,000 (10µg/kg); up to 0.3ml/kg Flush with 1-2ml of normal saline after each dose
Dose through endo tracheal tube (ETT)	50-100 µg/kg (0.5–1.0ml/kg of 1:10,000 or 0.05-0.1ml/kg of 1: 1000)

Despite the lack of human data, it is reasonable to use adrenaline *when adequate ventilation and chest compressions have failed to increase the heart rate above 60 per min.* If adrenaline is used, a dose of 10µg/kg (0.1ml/kg) should be administered intravenously as soon as possible.

The endotracheal route is not ideal, but if used, a higher dose will be required. Neither the safety nor the efficacy of these higher tracheal doses have been studied. **Do not administer the ET dose intravenously.**

b) 0.9% Sodium chloride (normal saline)

Available	0.9% NaCl
Preparation	Undiluted
Dose	10ml/kg
Route	UVC as a bolus
Indication	Signs of hypovolaemia

If there has been suspected blood loss (eg: placental abruption) or the infant appears to be in shock (pale, poor perfusion, weak pulse) and has not responded adequately to other resuscitative measures, then consider giving fluid. ***This is a rare event.*** Isotonic crystalloid rather than albumin is the solution of choice for restoring intravascular volume. Give a bolus of 10 ml per kg initially. *If successful*, may need to be repeated to maintain improvement. In suspected blood loss, suitable blood (i.e. irradiated and leucocyte-depleted group O Rh-negative blood) would be the first choice; in its absence isotonic crystalloid is the other option.

2.2.2 POST-RESUSCITATION

c) Sodium bicarbonate (4.2%)

Available	4.2% solution; 8.4% solution
Preparation	To make 4.2% solution from 8.4% solution dilute 1:1 with 5% or 10% dextrose
Dose	1 – 2 mmol/kg 2 – 4 ml/kg of 4.2%
Route	UVC as bolus, followed by a flush

If effective spontaneous cardiac output is not restored despite adequate ventilation and adequate chest compressions, reversing intra-cardiac acidosis may improve myocardial function and achieve an effective circulation. There is insufficient data to recommend routine use of bicarbonate in resuscitation of the newly born baby. The hyper-osmolarity and carbon dioxide-generating properties of sodium bicarbonate may impair myocardial and cerebral function. Use of sodium bicarbonate is discouraged during brief CPR. If it is used during prolonged arrests unresponsive to other therapy, *it should be given only after adequate ventilation is established with CPR.*

d) Dextrose (10%)

Available	10% dextrose ; 10g/100ml = 100mg/ml
Preparation	Mix 10ml of 5% dextrose with 4 ml of 25% dextrose (total volume 14 ml of 10% dextrose)
Dose	2-3ml/kg of 10% dextrose
Route	UVC as a bolus
Indication	Documented hypoglycaemia

An infusion of 10% dextrose should be commenced immediately afterwards.

e) Naloxone

Available	400 micrograms
Preparation	Undiluted
Dose	200 micrograms / 0.5ml
Route	IM
Indication	If the mother has had Pethidine (risk higher with IV than IM) within 4 hours of delivery, baby may develop apnoea shortly after birth. Effect of Pethidine may last upto 24 hours. <u>Administration of Naloxone should not be given priority over ensuring delivery of adequate breaths when spontaneous breathing is inadequate.</u> May need repeated doses of Naloxone.

2.3 SITUATIONS WHERE PROBLEMS ARE ANTICIPATED

Usually all instrumental deliveries should be attended by a medical/nursing officer trained in resuscitating an asphyxiated baby. In the following situations, the chances of a baby needing resuscitation are high and should be attended by a medical/nursing officer, trained in resuscitating an asphyxiated baby.

Maternal situations

- Ante-partum haemorrhage (placental abruption, placenta praevia)
- Prolonged or difficult labour
- Pregnancy induced hypertension, chronic hypertension
- Maternal intrapartum pyrexia
- Prolonged rupture of membranes – i.e.>18 hours/maternal infection
- Maternal sedation (within 4hrs)
- Multiple pregnancy
- Diabetes mellitus
- Rhesus iso-immunisation
- Previous fetal/neonatal deaths
- Poly/oligohydramnios
- No antenatal care
- Maternal age < 16 or >35 years

Fetal situations

- Cardiotocographic (CTG) abnormalities
- Reduced fetal movements
- Cord prolapse
- Meconium stained liquor
- Preterm / post-term
- Abnormal presentation – e.g. breech
- Intra uterine growth restriction
- Forceps/vacuum delivery
- Emergency caesarean section
- Precipitate labour
- Antenatally diagnosed congenital abnormalities: congenital diaphragmatic hernia and congenital heart disease.

WHAT SHOULD YOU DO WHEN CALLED UPON TO ATTEND SUCH A DELIVERY?

Ask for details about the delivery. Be at the site of delivery well in advance. Go through the mother's clinical notes and any information that may be relevant to resuscitate the baby. For example, if there was meconium, then you must be ready to handle the situation. Assess the situation and if you think, you will need a senior person's help or additional help, call for help. If you think the baby might need admission to neonatal intensive care unit, inform the staff.

If the mother is not under the effect of a general anaesthetic introduce yourself to mother and tell that you have come to help the baby.

Close any windows, switch off fans and air conditioners to prevent hypothermia in the baby. This is important as hypothermia lowers oxygen tension, worsens acidosis and causes hypoglycaemia.

Check whether you have all the instruments, appliances and drugs that may be needed for resuscitation. Check their function and correct any defects.

When checking the equipment ensure the self-inflating bag does not leak and the pressure release valve opens at a pressure of 40 cmH₂O.

If using a T-piece device set the peak inspiratory pressure (PIP) at 30 cmH₂O for a term baby and 20-25 cmH₂O for a preterm baby with a positive end expiratory pressure (PEEP) of 5 cmH₂O. Set maximum pressure at 40 cmH₂O.

As we are not aware of the exact size of the baby until delivery have 3 different sizes of mask, oro-pharyngeal airways and endotracheal tubes.

Ensure that other airway equipment such as functioning laryngoscopes, suction catheters and apparatus, a stethoscope and equipment for placement of an umbilical venous catheter (UVC) are available.

Prepare the 1:10,000 adrenaline solution as described above.

Now you are ready for the resuscitation procedure. Remember that a neonate is not a adult of smaller size. There are certain anatomical and functional differences in a newborn which has practical significance during resuscitation.

Chapter 03

INITIATION OF RESUSCITATION

It is essential for health professionals who attend the mother at birth to be skilled at resuscitation and know how to recognise babies at risk. They should be competent in resuscitation skills. If the baby has breathing difficulties, basic resuscitation must begin within one minute of life or earlier.

Being prepared is vital. Before a baby is born the delivery area must be checked to ensure it is ready. Functioning resuscitation equipment should be within easy reach.



Keep the baby under a radiant warmer or 100W electric bulb. Give special attention to the head as it is relatively large and a major part of heat loss can occur through it. In most instances the baby will cry soon after birth and will need no resuscitation. **Irrespective of the condition of the baby the first step is to wipe the baby of all fluid with one warm towel and cover the baby with the second warm towel.** Drying the baby and wiping its eyes will take about 15 seconds. Discarding the wet cloth and replacing it with a warm, dry and clean cloth will take another 5 seconds.



Dry the baby and remove wet linen

Naked, wet, newborn babies cannot maintain their body temperature in a room that even feels comfortably warm for adults. Compromised babies are particularly vulnerable. Exposure of the newborn to cold stress will lower arterial oxygen tension and increase metabolic acidosis.

Keep the delivery room warm. The delivery room temperature should be at least 26°C. Protect the baby from draughts; close windows, switch off fans.

Dry the term baby immediately after delivery. Discard the wet towel.

If resuscitation is not required place the baby skin to skin with the mother and cover both with a warm towel. Cover the head of the baby with a hat.



If resuscitation is required place the baby on a warm surface under the pre-heated radiant warmer and after drying cover the head and body of the baby, apart from the face and upper chest, with warm towels/hat to prevent further heat loss.



Preparation for the birth and initial steps in caring for the normal baby

- Warm room - close windows, switch off fans (draught free environment)
air conditioner – temperature set at 26°C or switch off if not adjustable
- Radiant warmer
- Two-three clean warm towels to dry, wrap or cover the baby
- Note and call out the time of birth
- Delay cord clamping for 1-3 mins while holding baby at/below placenta level
- Deliver the baby on to mother's abdomen or into her arms
- Keep the baby warm
- Thoroughly dry the baby
- Wipe eyes
- Discard wet cloth

Cine-radiographic studies of babies taking their first breath at delivery have shown that those whose umbilical cords were clamped prior to this had an immediate decrease in the size of the heart during the subsequent three or four cardiac cycles. The heart then increased in size to almost the same size as the fetal heart. The initial decrease in size could be interpreted as being due to filling of the newly-opened pulmonary vascular system during aeration with the subsequent increase in size occurring as a consequence of blood returning to the heart from the lung.

Brady and James drew attention to the occurrence of bradycardia apparently induced by clamping the cord before the first breath and noted that this did not occur in babies where clamping occurred after breathing was established. Such early clamping of the cord in a significantly preterm infant, whose ability to inflate his lungs by generating negative intrathoracic pressures is already compromised, might induce or prolong bradycardia leading to a 'need' for resuscitation.

Studies in term infants whose umbilical cords were clamped late have shown an improvement in iron status and a number of other haematological indices over the next 3–6 months. A greater need for phototherapy for jaundice has been noted in neonates whose cord clamping was delayed, but many would regard this as of little consequence.

Studies in preterm infants whose umbilical cords were clamped late have consistently shown improved stability in the immediate postnatal period and reduced the need for blood transfusions in the ensuing weeks and a lower incidence of intraventricular haemorrhages. Some other studies report increased jaundice and use of phototherapy in preterm infants as well but there have been no reports of increased use of exchange transfusions.

In term babies delayed cord clamping reduces iron deficiency in infancy.

Studies have not addressed effect of delayed cord clamping on babies needing resuscitation at birth because such babies have been excluded.

Recommendation: Delay in umbilical cord clamping for 1-3 minutes is recommended for newborn infants not requiring resuscitation. For babies requiring resuscitation, resuscitative intervention remains the priority. If there is excessive maternal haemorrhage too the cord should be clamped immediately and mother's condition attended to.

Initial assessment of the baby

The Apgar score was proposed as a “simple, common, clear classification or grading of newborn infants” to be used “as a basis for discussion and comparison of the results of obstetric practices, types of maternal pain relief and the effects of resuscitation”. It was not designed to be assembled and used to identify babies in need of resuscitation. However, individual components of the score, namely respiratory rate, heart rate and tone, if assessed rapidly, can identify babies needing resuscitation and even Virginia Apgar herself, an obstetric anaesthetist who devised the Apgar score, found that heart rate was the most important predictor of immediate outcome. Furthermore, repeated assessment particularly of heart rate and, to a lesser extent breathing, can indicate whether the baby is responding or whether further intervention is required.

Apgar score has limited use in predicting long term outcome of the baby and is usually calculated retrospectively.

A more practical assessment which is recommended for use during resuscitation is denoted by the abbreviation ‘CTBH’ (colour, tone, breathing and heart rate). Time at which the onset of spontaneous breathing occurred should also be noted and documented.

Assessment of Apgar score

Assessed @ 1 min @ 5 min & @ 10 min	Points	2	1	0
	Breathing	Good	Weak	Absent
	Heart rate	>100	<100	Absent
	Tone	Well flexed	Some flexion	Floppy
	Colour	Pink	Blue	Pale
	Reflex irritability	Vigorous	weak	Absent
	Total	10(max)		0(min)

Look for **C T B H**

C	Colour	-	pink, pale or cyanosed
T	Tone	-	good tone, some tone or floppy
B	Breathing	-	good cry, weak cry or no cry
H	Heart Rate	-	>100/min, <100/min or no heart beat

Colour

Colour is a poor means of judging oxygenation, which is better assessed using pulse oximetry *if possible*. A healthy baby is born blue but starts to become pink within 30 seconds of the onset of effective breathing. Peripheral cyanosis in the fingers and toes (acrocyanosis) is common and does not, by itself, indicate hypoxaemia. Persistent pallor despite ventilation may indicate significant acidosis or rarely hypovolaemia. ***Although colour is a poor method of judging oxygenation, it should not be ignored:*** if a baby appears blue persistently, check oxygenation with a pulse oximeter.

Tone

A very floppy baby is likely to be unconscious and will need ventilatory support.

Breathing

Check whether the baby is breathing. If so, evaluate the rate, depth and symmetry of breathing together with any evidence of an abnormal breathing pattern such as gasping or grunting.

Heart rate

This is best assessed by listening to the apex beat with a stethoscope. Feeling the pulse at the base of the umbilical cord is often effective but can be misleading, cord pulsation is only reliable if found to be more than 100 beats per minute (bpm). For babies requiring resuscitation and/or continued respiratory support, a modern pulse oximeter can give an accurate pulse rate. **ECG is the most accurate method of obtaining a rapid and continuous heart rate reading but is not easily available.**

Tactile stimulation

Drying the baby usually produces enough stimulation to induce effective breathing. Avoid more vigorous methods of stimulation. If the baby fails to establish spontaneous and effective breaths following a brief period of stimulation, further support will be required. It is not necessary to slap the baby or cause pain to be inflicted to the baby.

Possible scenarios after initial assessment

On the basis of the initial assessment, the baby can be placed into one of three groups:

Group 1

Vigorous breathing or crying Good tone Heart rate higher than 100/min
--

This baby requires no intervention other than *drying, wrapping in a warm towel* and, where appropriate, *handing over to the mother*. The baby will remain warm through *skin-to-skin contact with mother* under a cover, and may *be put to the breast at this stage*. Do a quick head to toe examination looking for gross abnormalities.

Group 2

Breathing inadequately or apnoeic Normal or reduced tone Heart rate less than 100/min
--

Dry and stimulate. This baby may improve with *bag and mask inflation* but if this does not increase the heart rate adequately, may also require *chest compressions*.

Group 3

Breathing inadequately or apnoeic Floppy Low or undetectable heart rate
--

Dry and stimulate. This baby will require immediate *airway control, lung inflation and ventilation*. Once this has been successfully accomplished baby may also need chest compressions, and perhaps drugs.

Steps to follow

- Introduction
- Warm environment
- Check equipment
- Start the clock
- Dry and cover the baby
- Assess the situation
- Airway ('Inflation breaths')
- Breathing
- Chest compressions
- Drugs

If the baby is not breathing

Call for help – Do not let pride or ego override the emergency need

Clamp and cut the cord quickly, transfer the baby to a firm surface (under a radiant warmer) and commence resuscitation

Request a helper to inform mother that baby has difficulty in breathing and that baby is receiving help

Commence newborn life support if the assessments show that the baby has failed to establish adequate regular normal breathing, and/or has a heart rate of less than 100/min after drying and stimulation within one minute. Twenty per cent (20%) of otherwise normal babies may take 60-180 seconds to start breathing regularly. **Opening the airway and aerating the lungs** is usually all that is necessary. *Furthermore, more complex interventions will be futile unless these two first steps have been successfully completed. Most of them would need only bag and mask ventilation.*

About ninety five per cent (95%) of babies for whom help is needed will recover within a minute or two once air enters the lungs.

Chapter 04

Management of Airway & Breathing

Neutral position

Place the baby on his or her back with the head in the **neutral position**. The airway can be opened by lifting the chin until face becomes parallel to the surface on which the baby is lying. This is called the neutral position of the head. In most newborn babies the occiput is prominent and causes the neck to flex when the baby is placed on the back (supine). If the baby is on a flat surface – place a rolled up piece of cloth (2cm) under the *baby's shoulder* (between scapulae). The rolled cloth should not be too thick as this may cause overextension which will close the airway.



Maintaining the head in neutral position

Make sure that you hold the chin at the bony edge rather than on the soft tissues as pressure on the soft tissues will push the tongue up and close the airway. If you hyperextend the neck, the airway of the newborn will get obstructed as well.

After keeping the head in the neutral position, rub the back or foot of the baby to provide tactile stimulation. If the baby is in primary apnoea, the baby will respond by crying and commencing spontaneous breathing. If the baby does not cry, it indicates that the baby is probably in terminal apnoea. Do not inflict painful stimuli to induce crying. These are not effective, unnecessary and harmful.

If the baby has:
Cyanosis
Moderate tone
Inadequate breathing
Slow heart rate

What should be done?
Dry & Cover
Open the airway
Inflation breaths?

If a baby does not respond to airway opening and tactile stimulation, then you have to initiate artificial ventilation using the bag-valve-mask system or a T-piece device. As mentioned earlier the newborn's alveoli are filled with liquor, which get absorbed into lymphatics with the initial few breaths. A newborn's alveoli have never been inflated before. Alveoli are like balloons which need a higher initial pressure to inflate. To achieve absorption of liquor and inflation of alveoli we use the method called "INFLATION BREATHS". These are different from normal ventilatory breaths in that we use sustained pressure for a longer period during inspiration. Inspiratory phase is maintained for about 2 to 3 seconds and 5 inflation breaths are given. With the initial breaths, liquor gets absorbed and the rest of the breaths will help alveoli to expand. You should count loud. Inspiratory period is counted as 'one-two-three', followed by 'release' which is the expiration.

So the counting is done as

one-two- three – release
two-two-three- release
three-two- three-release
four-two-three-release
five-two-three release

Your eyes and gaze should be fixed on the chest of the baby to look for chest movement. If there is no improvement in the baby's condition and there is no chest expansion you should try airway opening manoeuvres again.

In newly-born babies who do not start breathing despite thorough drying and additional stimulation, positive-pressure ventilation should be initiated within one minute after birth. – WHO Guidelines on basic newborn resuscitation 2012

Jaw Thrust

The figure below demonstrates how jaw thrust is done. In this, you push the jaw up and the tongue with it. This will be demonstrated at the skills stations during the course.

Any pressure on the soft tissues under the jaw should be avoided as it may worsen the situation by pushing the tongue base backwards.

If the baby is very floppy it may be necessary to use one or two fingers under each side of the lower jaw, at the angle of the jaw, to push the jaw forwards and outwards. (Single handed and double handed jaw thrusts).



Double handed jaw-thrust

Assess the improvement of heart rate and chest expansion.

In the event of the number of persons available for the resuscitation being limited an oropharyngeal airway can be used to provide the same airway opening achieved by jaw thrust. The insertion of an oropharyngeal airway is detailed in Annex 1.

Perhaps the most common reason for failure to open the airway is incorrect positioning of the neck; usually over extension

Positioning is the immediate need, not suctioning

Looking for obstruction and suctioning of trachea

Suctioning is needed only if the airway is obstructed by substances. This should be attempted only if both neutral position and jaw thrust fail to open the airway. Obstruction may be caused by particulate meconium but can also be caused by blood clots, thick tenacious mucus or vernix even in deliveries where meconium staining is not present. However, aggressive pharyngeal suction can delay the onset of spontaneous breathing and cause laryngeal spasm and vagally induced bradycardia.

- The presence of thick viscous secretions / meconium in the mouth and nose of a floppy baby who is not breathing warrants suctioning of the mouth, nose and oropharynx rapidly before commencement of positive pressure ventilation in the form of inflation breaths.
- **Do not insert a suction catheter into the mouth blindly.**
- Suction should be done under **direct vision, using a laryngoscope**
- Recommended size of suction tube is **10–12 FG** suction catheter, or a Yankauer sucker
- Maximum suction pressure that should be used is **80-100 mmHg**
- Apply suction while **withdrawing the tube only.**

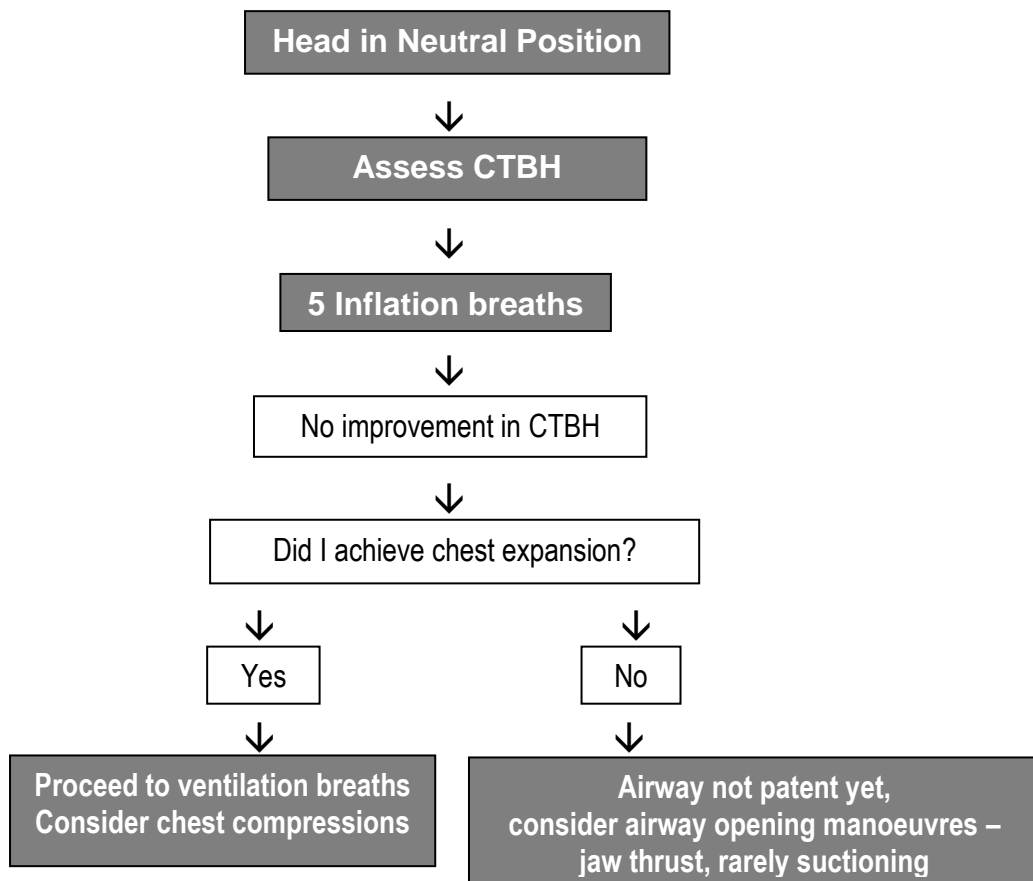
Suctioning is unnecessary in a baby who starts crying or breathing immediately after birth and should not be used routinely

By applying suction at birth you may be withdrawing the negative pressure created by the baby to open the unopened alveoli or fluid filled alveoli.

Endotracheal intubation

If you are competent in endotracheal intubation you can attempt it rather than inserting an air way in a baby with poor tone and breathing efforts. Details of this is discussed in Annex 2.

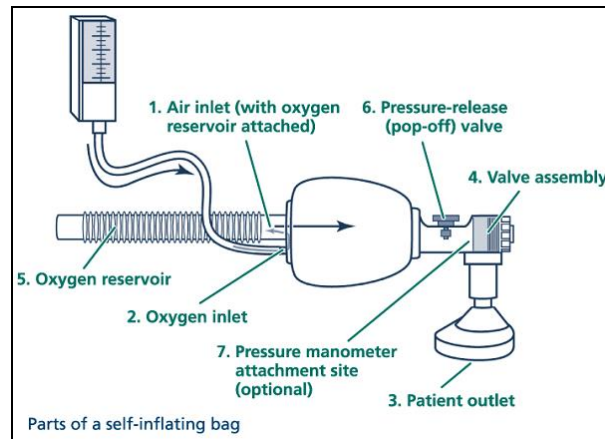
Algorithm for airway management



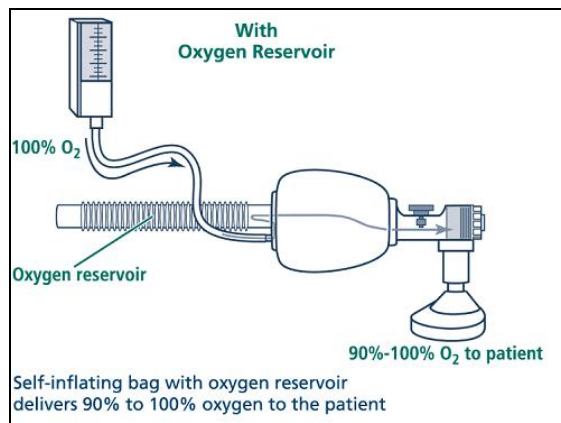
Airway equipment

A baby who is still not breathing after airway opening manoeuvres, needs to be VENTILATED. In such circumstances, this is an essential procedure.

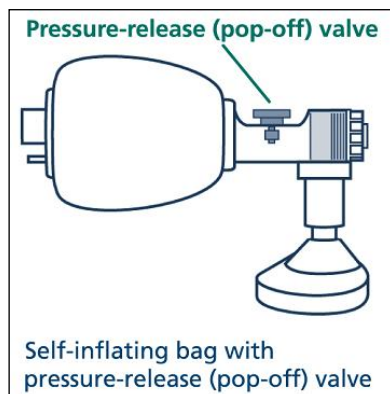
Self inflating (ambu) bag



- Size of the bag
 - 250ml bag
- Colour
 - Transparent bags are preferred
- Can provide only an unmeasured inspiratory pressure; cannot provide PEEP unless a special valve is available
- Does not need an air/oxygen flow for functioning
- Oxygen inlet
 - Located near the air inlet
 - Oxygen tube can be attached to this
 - Make sure that oxygen tube can be fixed without any difficulty with normal connectors.
- Air inlet
 - Large inlet – located at the end of the bag – this is the place for the attachment of the reservoir (bag or corrugated tubing)
 - This chamber provides a high concentration of oxygen and prevents room air from entering the bag and mixing with the oxygen.
 - Without a reservoir bag, 100% oxygen provided via the oxygen inlet gets diluted down to 40% by the normal air driven into the self-inflating bag via the air inlet.
 - Oxygen delivery could be increased to 90-100% by fixing a reservoir bag / tubing to the air inlet.



- Patient Outlet
 - Where air exits from the bag to the patient
 - Connect this to face mask or endotracheal tube
- Valve Assembly
 - This is positioned between the bag and the patient outlet
 - Fish mouth shaped one-way valve which delivers breaths to patient.
 - This closed valve does not allow free flow of gas through the bag
 - Valve is opened when the bag is squeezed during ventilation, then it releases air / oxygen to the patient – This test, shown below, indicates that the bag is functioning well.
 - During exhalation phase of the cycle (when bag re-inflates) this valve is closed. So it prevents exhaled air getting into the bag
 - Identify the valve assembly
 - If this valve is malfunctioning **do not use the bag.**
- Pressure release valve (“Blow off valve”)
 - Commonly known as “pop-up valve” or “safety valve”
 - Valve opens if pressure generated is more than 40 cmH₂O. This prevents high pressures being transmitted to the infant.
 - This valve can be closed if you need to create a high pressure.



Using the self-inflating bag with mask

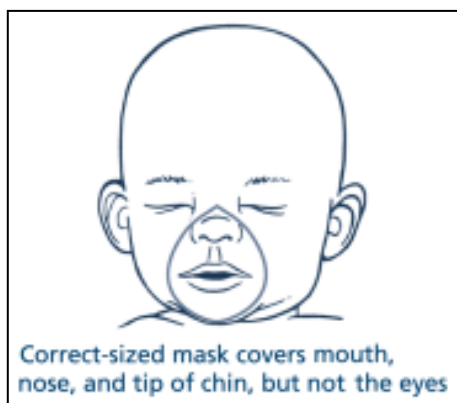
For successful operation the bag should be without leaks, the pressure release valve should open at a pressure of 40 cmH₂O and there should be proper sealing of the mask over the face.

The mask should cover both angles of the mouth and nose and should not extend beyond the chin or above the lower orbital margin.

Check the valve and bag by placing the mask on the palm or a table with a good seal and squeezing the bag. If there are no leaks in the bag you feel the pressure of air on your palm and you will notice the safety valve opening.

Use the correct size face mask

- Size of the mask
 - Different sizes should be available for preterm babies and term babies
 - Size 0/1 for a normal weight baby and size 0 or 00 for a small baby
 - A mask that is too large covers the eyes and extends over tip of chin
 - A mask that is too small does not cover the nose and the mouth effectively.

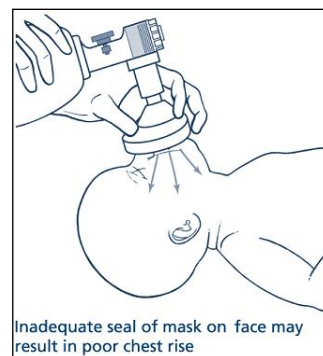
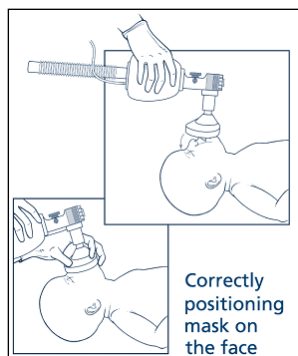


- Rim of the mask
 - Silicon mask with a broad, soft flexible sealing surface or flange such as the Laerdal[®] mask
 - The mask should be held over the firm upper part rather than around the soft rim
 - When holding the mask, even pressure should be applied around the entire circumference, but avoid pressing down too hard
- Colour of the mask
 - Transparent mask
- Shape of the mask
 - use a round shaped mask
- Obtain an effective seal

- Make a seal between the mask and the baby's face.
- Hold the mask in place gently but firmly. Keep the head in neutral position.

How do you ventilate the baby?

- Re-check the baby's position if chest expansion is not adequate.
- Slightly re-position the baby so that the neck is not hyperextended or flexed (i.e. head in the neutral position).
- Put a rolled up piece of cloth under the baby's shoulders at this time (baby with prominent occiput).
- Place the correct size mask on the baby's face, with the ambu bag already attached to the mask, so that it covers the baby's chin, mouth and nose.
- Position of the caregiver – you will need to stand at a side or head end of the infant to use the resuscitation bag effectively. This position will allow you to comfortably hold the mask on the infant's face. If you are right handed you will probably feel most comfortable holding the bag with your right hand and holding the mask with your left hand.
- Holding the mask – Mask is usually held on the face with the thumb and the index finger and / or third finger encircling much of the neck of the mask, ("C" method) while the third / ring finger holds the chin ("E" method)
- Position the bag so that it does not block your view of the infant's chest and does not obstruct the chest compressions and vascular access, if needed.
- Checking the seal – Once the seal is formed it is important to check to be sure it is airtight and that the chest rises as you squeeze the bag. The time taken to make these adjustments will allow you to provide effective ventilation without delay.
- If the mask has been properly applied and the seal is air-tight, you ought to be able to squeeze the resuscitation bag with just your fingertips or fingers and obtain chest expansion if the airway is open.



- Avoid compressing the bag with the palm of your hand. Grasping the bag with your palm can result in poor control of ventilation as well as

excessive pressures and excessive volumes of air being delivered to the patient.

- Remember to adjust the squeezing pressure to achieve chest expansion while avoiding excessive chest movement.

Air is better than oxygen in resuscitation of term babies initially as use of air avoids the harmful effects of oxygen.

In babies less than 32 weeks gestation, commence with an oxygen percentage of 30% and adjust according oxygen saturation and clinical condition.

Initially use air for resuscitation in term babies

Use 30% FiO₂ for resuscitation in preterm babies initially – oxygen tubing without a reservoir should be used in bag and mask ventilation

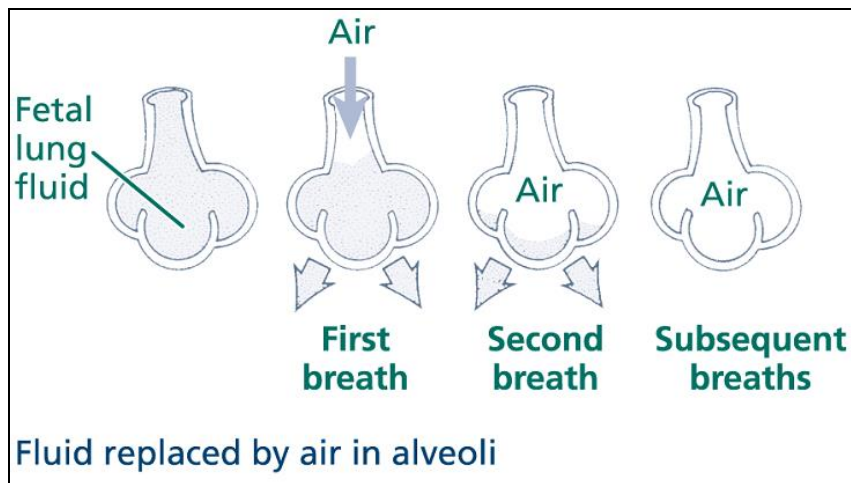
Following are “don’ts”

Do not jam the mask down on the face.

Do not put pressure on the throat (trachea) or on the soft tissues of the neck – this could block the airway.

Do not allow the mask to rest on the infant’s eye or go beyond the chin.

Do not fix the self inflating bag to the mask while the mask is being applied over the baby’s face.



Breathing

After initial steps at birth, if breathing efforts are absent or inadequate, lung aeration is the priority. In term babies, begin resuscitation with air. **The primary measure of adequate initial lung inflation is the prompt improvement in heart rate.** Assess the chest wall movement if the heart rate does not improve.

For the first five inflation breaths, maintain the initial inflation pressure for 2–3 seconds. This will help lung expansion. Most babies needing resuscitation at birth will respond with a rapid increase in heart rate within 30 seconds of lung inflation. If the heart rate increases but the baby is not breathing adequately, ventilate at a rate of about 30-40 breaths per minute, allowing approximately 1 second for each inflation, until there is adequate spontaneous breathing. A ventilation breath rate of upto 60 /minute can be used once heart rate is over 100 / minute and there is no necessity for chest compressions.

Adequate passive ventilation is usually indicated by either a rapidly increasing heart rate or a heart rate that is maintained faster than 100 /min. If the baby does not respond in this way the most likely cause is inadequate airway control or inadequate ventilation. Look for passive chest movement in time with inflation efforts; if these are present then lung aeration has been achieved. If these are absent then the airway control and the lung aeration has not been achieved. Without adequate lung aeration, chest compressions will be ineffective. Therefore, confirm lung aeration before progressing to circulatory support.

Some practitioners will ensure airway control by tracheal intubation, but this requires training and experience. If this skill is not available and the heart rate is decreasing, re-evaluate the airway position and method of delivering breaths while summoning a colleague with intubation skills.

Continue ventilatory support until the baby has established normal regular breathing.

Initial breaths and assisted ventilation

In term infants, spontaneous or assisted initial inflations create a functional residual capacity (FRC). The optimum pressure, inflation time and flow required to establish an effective FRC has not been determined. Average initial peak inflating pressures of 30–40cmH₂O (inflation time undefined) usually ventilate unresponsive term infants successfully. Assisted ventilation rates of 30–60 breaths per minute are used commonly, but the relative efficacy of various rates has not been investigated.

Where pressure is being monitored, an initial inflation pressure of 20cm H₂O may be effective, but 30–40cmH₂O or higher may be required in some term babies. Therefore set the peak inspiratory pressure (PIP) at 30cmH₂O for a term baby and 20-25cmH₂O for a preterm baby initially when using a T-piece resuscitaire. If pressure is not being monitored but merely limited by a non-adjustable ‘blow-off’ valve, use the minimum inflation required to achieve an increase in heart rate. There is insufficient evidence to recommend an optimum inflation time.

In summary, try to provide artificial ventilation at 30–60 breaths/min to achieve or maintain a heart rate higher than 100/min.

Air or 100% oxygen

For the newly born infant in need of resuscitation at birth, the rapid establishment of pulmonary gas exchange to replace the failure of placental respiration is the key to success. In the past it has seemed reasonable that delivery of a high concentration of oxygen to the tissues at risk of hypoxia might help to reduce the number of cells which were damaged by the anaerobic process. However, in the last 30 years the ‘oxygen paradox’ – the fact that cell and tissue injury is increased if hypoxic tissue is then exposed to high concentrations of oxygen, has been recognised, the role of free radicals, antioxidants and their link with apoptosis and re-perfusion injury has been explored, and the idea of oxidative stress established. In the light of this

knowledge it has become increasingly difficult to sustain the idea that exposure to high concentrations of oxygen, however brief, is without risk. *Furthermore, randomised studies in asphyxiated newborn babies strongly suggest that air is certainly as effective as 100% oxygen, if not more effective and less harmful, at least in the short term.*

There is also abundant evidence from animal and human studies that hyperoxaemia alone is damaging to the brain and other organs at the cellular level, particularly after asphyxia. Animal studies suggest that the risk is greatest to the immature brain during the brain growth spurt (mid-pregnancy to 3 years). These risks include deleterious effects on glial progenitor cells and myelination.

Other issues include concerns that pulmonary vascular resistance may take longer to resolve if air is used rather than oxygen for lung inflation at birth. However, though two studies have shown that it may be reduced a little further and a little faster by use of oxygen rather than air, there is a price to pay. Exposure to high concentrations of oxygen at birth results in the creation of increased reactive oxygen radicals which, in turn, reduce the potential for pulmonary artery vaso-relaxation later on in neonatal progress.

There are now numerous reports of oximetry data following delivery. When using technology available from the early 2000s, a reliable reading can be obtained from >90% of normal term births, approximately 80% of those born preterm, and 80–90% of those apparently requiring resuscitation, within 2 minutes of birth. Uncompromised babies born at term at sea level have $\text{SaO}_2 \approx 60\%$ during labour, which increases to >90% by 10 min. The 25th percentile is approximately 40% at birth and increases to ~80% at 10 min. Values are lower in those born by caesarean section and those born at higher altitudes. Those born preterm may take longer to reach >90%. Those given supplemental oxygen had a higher incidence of $\text{SaO}_2 > 95\%$, even when a protocol to decrease the FiO_2 was implemented, although the extent of this was restricted by insufficient power and the particular protocols used in the studies.

Use air (FiO_2 21%) for resuscitation

In all term infants initially

In preterm infants if an air-oxygen blender or any other method of providing 30% oxygen is not available

Use oxygen ($\text{FiO}_2 > 21\%$) for resuscitation

Initially 30% for infants <32 weeks gestation

If poor oxygenation is seen by oximetry

Use 100% oxygen if heart rate is not improving despite effective ventilation

Targeted pre-ductal SpO ₂ after birth	
1 minute	60-65%
2 minutes	65-70%
3 minutes	70-75%
4 minute	75-80%
5 minutes	80-85%
10 minutes	85-95%

Bag and mask inflation is nearly always effective.
Only about 1:500 appear to need intubation

Inflation breaths

- Inflate the lungs with *five “Inflation Breaths”* using 30 cmH₂O
- Apply while squeezing the bag for 2-3 seconds for each breath & count
 - One-----two---three- release
 - Two---- two---three- release
 - Three-----two—three- release
 - Four-----two—three- release
 - Five-----two—three- release
- Check for response
 - Chest movement
 - Increase in heart rate
- First few breaths
 - Helps to push lung fluids into lymphatics and blood stream
 - Chest expansion may not be seen
- Chest expansion is usually seen after 4th or 5th breaths
- T-piece device
 - Constant flow, pressure limited device
 - No risk of high pressure being delivered.

**If lungs are being inflated,
chest will rise with each breath
and the heart rate responds**

Give inflation breaths – then reassess
What do you hope to find out?
An increase in HEART RATE

If there is no chest movement or no increase in heart rate go back to airway opening manoeuvres.

- Is the baby's head in neutral position?
- Do you need jaw thrust?
- Do you need a long inflation time?
- Do you need a 2nd person to help?
- Is there an obstruction in the oropharynx?
- Suction under direct laryngoscopy?
- Need for oropharyngeal airway?

Ventilation breaths

- Rate – 15 ventilation breaths in 30 seconds (30 breaths per minute). Can go up to 60 breaths per minute if cardiac compressions are not required
- Ventilation breaths
 - No lung fluid now
 - Aim is to ventilate lungs with lower pressures
- Re-assess every 30 seconds (after each set of 15 breaths)
- Count
 - Squeeze one
 - Squeeze two
 - Squeeze three.....
 - Squeeze fifteen
- Observe for effectiveness of ventilation
 - Observing chest movements with delivery of breaths
 - Increase in heart rate

Noticeable rise and fall of the chest is by far the best indicator that the mask is sealed and lungs are being inflated. The infant should appear to be taking shallow or easy breaths.

- If the chest rises to a maximum, appearing as if the baby is taking deep breaths, the lungs are being over inflated – *you are using too much pressure and there is a danger of producing a pneumothorax and barotrauma*. If the chest expansion is too much simply reduce the pressure by squeezing less firmly.

Presence of bilateral breath sounds in the lungs indicate that the infant is being effectively ventilated.

What happens if you squeeze the bag TOO HARD?

You may damage the lungs of the baby.

The bag will collapse and it will not refill with air

Chapter 05

CIRCULATORY SUPPORT & VASCULAR ACCESS

After all strategies of airway opening manoeuvres and the five inflation breaths have been successfully delivered, address the circulation.

- Chest compressions are indicated when
 - **Chest expansion** with inflation breaths have been achieved **and**
 - **30 seconds** of effective **ventilation breaths** have been delivered **but**
 - **Heart rate** is still **<60 per minute**

Circulatory support with chest compressions is effective only if the lungs have first been successfully inflated. Give chest compressions if the heart rate remains less than 60/min despite adequate ventilation.

CHEST COMPRESSIONS ARE USELESS IF THE LUNGS HAVE NOT BEEN INFLATED
Increase in heart rate is a good indicator of effective ventilation

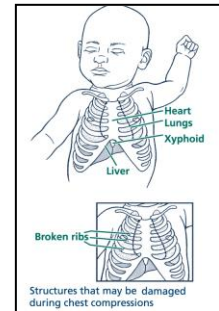
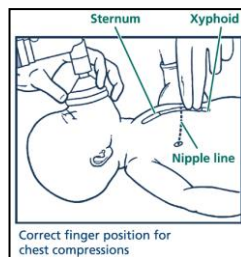
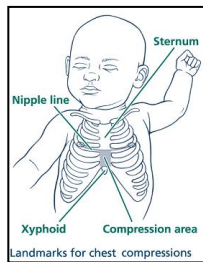
Giving chest compressions is easier and more effective with help
Call for help if not done so already

External chest compressions

At the end of inflation breaths if **C T B H** has not improved and you think that you have achieved good chest expansion and given effective ventilation breaths for 30 seconds, then you should proceed to external chest compressions along with ventilation breaths. Goal of external chest compression is to maintain the coronary circulation and supply the myocardium with oxygenated blood. With oxygenation of the myocardium, the heart is said “to bump start” similar to what happens when you start a car while it is in a gear.

During external chest compressions you mimic cardiac systole and diastole by applying and releasing pressure on the thoracic wall. During diastole improvement of coronary circulation occurs which leads to ‘bump starting’ of the heart. For chest compressions to be of any use, you should make sure that you have achieved an open air way and established ventilation before proceeding to chest compressions. Otherwise you are not going to deliver oxygenated blood to the myocardium. So we first need to achieve Airway then Breathing and then Circulation. – Remember **A B C**.

Position of the chest compressions... lower third of the sternum just below an imaginary line joining the nipples.



There are two methods used to give external chest compressions.

Hand encircling method - in which you encircle the chest wall of the newborn with your hands, with the thumbs placed over the sternum. This method is better than the two finger method but can be employed only when there is another person to look after the airway and breathing.

Two finger method – in this manoeuvre you use your index and the middle finger to press the sternum.



Chest compression

Depth of chest compression: amount of force you need to apply is the force needed to compress 1/3 of the depth (A-P diameter) of the chest.

Use a **ratio** of three compressions to one ventilation, aiming to achieve approximately 120 events per minute, i.e. approximately 90 compressions and 30 ventilations. There are theoretical advantages in allowing a relaxation phase that is slightly longer than the compression phase. However, quality of compressions and breaths are probably more important than the rate.

Check the heart rate after 60 seconds of uninterrupted chest compressions with ventilation breaths at a ratio of 3:1. Check every 30 seconds thereafter. Discontinue chest compressions when heart rate is >60/min.

During chest compressions you count ‘one and,’ ‘two and,’ ‘three and,’ while mentioning the number you compress the thoracic wall mimicking systole and you relax the thoracic wall mimicking diastole during “and” phase. After every third compression a breath is given, which is counted as squeeze 1, squeeze 2..... up to squeeze 15.

During chest compression

Press the chest down quickly and firmly and then release allowing the chest to recoil fully. However **keep the fingers/thumbs used for chest compressions in contact with the baby.**

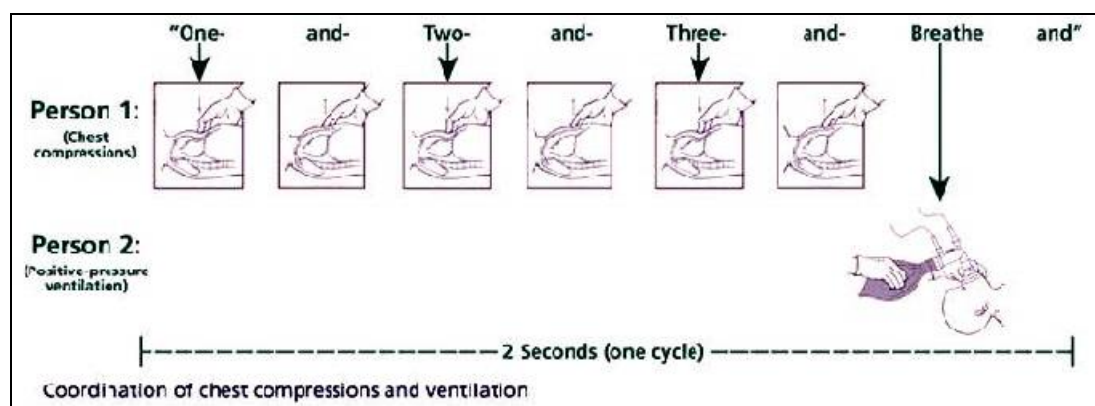
Too rapid a rate gives the chambers of the heart no chance to refill passively after compressions.

Re-inflate the lungs after every 3 compressions (3:1 ratio).

Maintain good quality resuscitation

For every 2 seconds,
3 chest compressions & 1 ventilation breath

Reassess after 15 ventilation breaths



Chest Compressions— Summary	
Land mark	Just below an imaginary inter mammary line Lower one-third of the sternum
Technique – 1 handed chest compressions (Hand encircling method)	Most effective method Place the thumbs together at the front, on the sternum, with fingers over the spine Encircle the whole chest with both hands Person delivering chest compressions should be standing at the foot end of the baby, facing the baby
Technique—2 Two finger method	Press the lower third of the sternum with two fingers while the back of the baby is well supported on a firm surface Useful when there is only one rescuer, if the rescuers hands are too small to encircle the chest, and while UVC is being inserted
Depth	$\frac{1}{3}$ of the chest towards the back bone (A-P diameter) with each compression
Counting	One and Two and Three and
Ratio	Chest compressions : Ventilation = 3 : 1 In a minute (60 seconds) 90 compressions : 30 Breaths 120 events in 1 minute; $\frac{1}{2}$ second for each event every 2 seconds – One breath & 3 chest compressions
Coordination	One – (Chest compression); and – (release) Two – (Chest compression); and – (release) Three – (Chest compression); and – (release) Squeeze one – (Ventilation one) three chest compressions Squeeze two – (Ventilation two) three chest compressions..... Squeeze fifteen – (Ventilation fifteen)
How often should I check the heart rate?	Initially in 60 seconds, then every 30 seconds (after 15 ventilation breaths or 45 chest compressions)
No response	May have to resort to drugs

VASCULAR ACCESS AND DRUGS

Compression:ventilation cycle will take about 60 seconds, after which you will reassess the C T B H. If things do not improve then you should consider drugs. As there is no proper circulation, there is no point in giving drugs intramuscularly. Drugs delivered via small peripheral veins are also ineffective for the same reason. Best route to administer drugs at this stage is through the umbilical vein. ***But never inject drugs directly in to the umbilical vein.*** You should insert an umbilical catheter or a feeding tube in to the umbilical vein and deliver the drugs through the catheter. This procedure is simple, quick and it is described below. Resuscitation should continue while the line is being inserted.

Umbilical vein cannulation

The umbilical vein provides a ready access to the vascular system. There are two umbilical arteries and one vein. Arteries have a relatively small lumen and a thick wall and a circular opening. Umbilical vein has a thin wall with a larger lumen and an irregular opening.

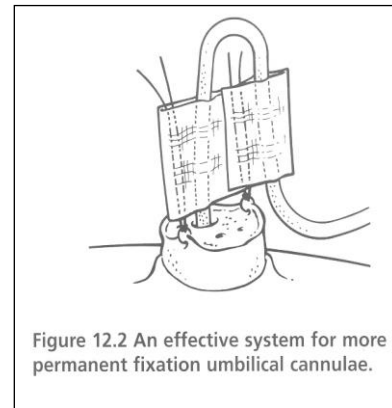
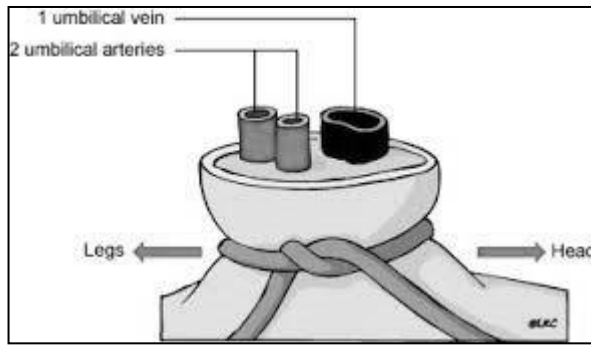
If a cord tie is not available take a piece of gauze and make a string out of it. Place it at the bottom of the umbilical cord and put a loose knot, so that in case there is significant bleeding, you can control it by tightening the knot.

Now cut the umbilical cord with a clean cut using a surgical blade about 2.5 cm away from skin margin. Then take an umbilical catheter or feeding tube ***which has been primed fully with normal saline***, and insert it into the umbilical vein for about 2-4 cm until blood can easily be aspirated back.

Direct injection of drugs is not recommended for the following reasons:

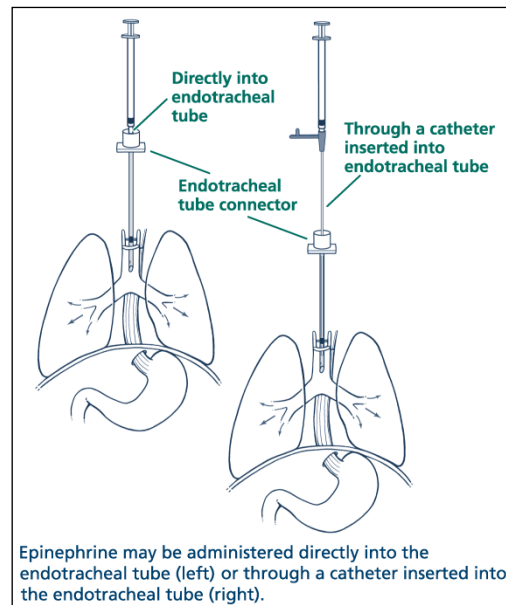
- There is no circulation through umbilical vessels once the cord has been clamped. Therefore drugs will never reach their target organs.
- It can result in inadvertent delivery of drugs to an umbilical artery with serious consequences.

Do not waste time obtaining blood samples during resuscitation. If intravenous adrenaline is indicated administer it via the umbilical catheter as soon as possible.



Endotracheal route administration of adrenaline

This method is used if umbilical venous access cannot be obtained and administration of adrenaline is required.



Chapter 06

POST RESUSCITATION MANAGEMENT

6.1 STABILISATION

6.2 COMMUNICATION WITH THE PARENTS

6.3 RECORD KEEPING

6.4 DISCONTINUING RESUSCITATION

Introduction

A baby who was successfully resuscitated after significant asphyxia may later deteriorate. Once adequate ventilation and circulation are established, the infant should be transferred to an environment in which close monitoring and care can be provided.

- Babies who recovered completely with tactile stimulation or inflation breaths only can be left with the mother. But **NEVER** leave the mother and the newborn unattended. Monitor them every 15 minutes during the first hour and regularly thereafter.
- *If the baby needed more than inflation breaths to recover, the baby needs closer monitoring in a neonatal unit.*
- *Continuing care and monitoring of a baby after successful resuscitation is mandatory.*
- After resuscitation, explain to the mother and the family what has happened and how the baby is now. **This is extremely important.**

6.1 Stabilisation of the baby

/

The following need to be assessed in the stabilisation phase:

Sensorium (alertness)

Temperature

Oxygenation (saturation and breathing pattern)

Perfusion (capillary refill time)

Sugar

Sensorium : Assess the baby's alertness, activity, tone and behaviour

Temperature : check the temperature of the baby using a thermometer. Ensure all wet towels have been removed from the baby and that the baby is adequately covered with dry warm towels while allowing further clinical assessment and management.

Oxygenation : examine the baby for effectiveness of breathing, evidence of respiratory distress (tachypnoea, recessions, grunting) and check oxygen saturation by pulse oximetry. Provide necessary respiratory support

Perfusion : check the capillary refill time of the baby over the sternum. If prolonged give a bolus of normal saline and reassess haemodynamic status, including the heart rate response, to determine effectiveness and need for further boluses.

Sugar : check capillary blood sugar and capillary blood gases if possible. Infants who require significant resuscitation should be monitored and treated to maintain blood glucose in the normal range.

6.2 Communication with parents

It is extremely important that the team caring for the newborn baby informs the parents of the baby's progress. At delivery, adhere to the routine local plan and, if possible, handover the baby to the mother at the earliest opportunity. If resuscitation was required, inform the parents of the procedures undertaken and why they were required.

If possible, allow the mother to cuddle the baby briefly before transferring the baby to the neonatal unit. At least show the baby to the mother before transfer.

Talk to both parents at the earliest opportunity. This task should be done by the most senior available staff member.

Introduce yourself and explain what you have done and about the condition of the baby. Amount and depth of information should depend on parent understanding and education. ***Do not put the blame on anyone.*** If they ask you to comment on obstetric management, say that you represent the Paediatric Team and that you are not in a position to comment about the obstetric management. Request them to consult a member of the obstetric team to get their views. Give a guarded prognosis in babies who recovered after significant asphyxia. If you are a junior member of the team get a senior member of the team to talk to parents. In case of the death of the baby, arrange for a proper counselling session for the parents.

Decisions to discontinue resuscitation should ideally involve senior paediatric staff. Whenever possible, the decision to attempt resuscitation of an extremely preterm baby should be taken in close consultation with the parents and senior paediatric and obstetric staff. *Where a difficulty has been foreseen, for example in the case of severe congenital malformations, discuss the options and prognosis with the parents, midwives, obstetricians and birth attendants before delivery. Record carefully all discussions and decisions in the mother's notes prior to delivery and in the baby's records after birth.*

6. 3 Record keeping

Make sure you do retrospective and prospective record keeping accurately while documenting the times as well. Avoid mentioning your opinion, views or interpretation about the situation; only mention the facts.

Accurate and comprehensive records are very important. Consider very carefully the words used in such a record ***and keep in mind that the contents may be read out in a Court of Law.***

Record the facts related to birth: fetal bradycardia, non re-assuring CTG etc.
Avoid words such as “asphyxia, anoxia and fetal distress”

Overall, the records should demonstrate the following facts

Chronology of events
All significant consultations
Assessments
Observations
Decisions
Interventions
Outcome

What other facts should you record?

When you were called, by whom and why?

The time you arrived, who else was there, condition of the baby on your arrival

What you did, when you did it, and timing and details of any response from the baby

Whether the baby appeared atonic and areflexic at birth

Baby's heart rate at birth and when it first exceeded 100 beats per minute

Timing of spontaneous breathing

The date and time of writing your entry; name and your **full name and signature**

Documentation

- As these are potential cases for litigation, clear documentation of all events that occurred is very important.
- Assign a nurse to write down all the events and medications given (with times).
- After the resuscitation you should document actions taken by you, from the time you were informed to attend the delivery.
- *Mentioning date and time is very important as well as putting down your signature, name and designation.*

6.4 DISCONTINUING RESUSCITATION

Withdrawing resuscitation

Data from infants without signs of life from birth, lasting at least 10 min or longer, show either high mortality or severe neurodevelopmental disability. If faced with a newly born baby with no detectable heart rate which remains undetectable for 10 min in spite of adequate resuscitation, it is appropriate to then consider stopping resuscitation. The decision regarding continuation of resuscitation beyond 10 minutes has to be individualised taking into consideration the adequacy and accuracy of the resuscitative measures up to that point, availability of advanced neonatal care, presumed aetiology of the arrest, the gestation of the baby, the potential reversibility of the situation, and the parents' previous expressed feelings about acceptable risk of morbidity.

If the heart rate is less than 60/min at birth and persisting after 10 or 15 min the situation is even less clear and a firm recommendation cannot be made.

In a newly born baby with no detectable heart rate after 10 minutes of adequate resuscitation including effective ventilation, cardiac compression and administration of IV adrenaline as per the guidelines, resuscitation should be stopped.

Explain what has happened to the mother; be very gentle. Give her supportive care. Make sure someone stays with her. If her relatives are nearby, let them comfort and care for the mother. If the mother wishes to see and hold her baby, allow her to do this.

Withholding resuscitation

It is possible to identify conditions associated with high mortality and poor outcome, where withholding resuscitation may be considered reasonable, particularly when there has been the opportunity for discussion with parents.

A consistent and coordinated approach to individual cases by the obstetric and neonatal teams and the parents is an important goal. Withholding resuscitation and discontinuation of life-sustaining treatment during or following resuscitation are considered by many to be ethically equivalent and clinicians should not be hesitant to withdraw support when the possibility of

functional survival is highly unlikely. The following guidelines must be interpreted according to current regional outcomes.

- Where gestation, birth weight, and/or congenital anomalies are associated with almost certain early death, and unacceptably high morbidity is likely among the rare survivors, resuscitation is not indicated. Examples from the published literature include: extreme prematurity (gestational age less than 24 weeks and/or birth weight less than 500 g), and anomalies such as anencephaly and confirmed Trisomy 13 or 18.
- Resuscitation is nearly always indicated in conditions associated with a high survival rate and acceptable morbidity. Please refer the position paper of the Sri Lanka College of Paediatricians on resuscitation of extremely preterm and low birth weight babies. Available from SLJCH 2015;**44**(1):3-11.
- In conditions associated with uncertain prognosis, where there is borderline survival and a relatively high rate of morbidity, and where the anticipated burden to the child is high, parental desires regarding resuscitation should be supported.

As per WHO guidelines a **live birth** is defined as the: complete expulsion or extraction from its mother of a product of conception, *irrespective of the duration of the pregnancy*, which, after such separation, breathes or shows any other evidence of life - e.g. beating of the heart, pulsation of the umbilical cord or definite movement of voluntary muscles - whether or not the umbilical cord has been cut or the placenta is attached. Each product of such a birth is considered live born.

A **birth certificate** should be issued for all such babies and in the event of the death of such a baby a **death certificate** should also be issued

- Neonatal mortality rate: deaths in first 28 days of life / 1000 live births
- ‘Still birth’ for international comparisons: baby born with no signs of life at or after 28 weeks' gestation.
- ‘Still birth’ for each country depends on the country’s limit of viability
- Still birth rate is calculated per 1000 total births
- Perinatal mortality rate : still births + neonatal deaths in first 7 days of life / 1000 total births

Chapter 07

SPECIAL CASES

- 7.1 PRETERM BABIES**
- 7.2 MECONIUM STAINED LIQUOR**
- 7.3 DELIVERY OUTSIDE THE LABOUR WARDS**
- 7.4 BABIES WHO DO NOT RESPOND**
- 7.5 THERAPEUTIC HYPOTHERMIA**

7.1 PRETERM BABIES

Objective

To minimise mortality and morbidity
Prevent sepsis
Safe resuscitation while preventing lung atelectasis

Overview

Preterm infants are different from term babies; they are not just smaller in size.
History and communication prior to delivery is important.
Resuscitation at birth should be planned.
Delivery ideally at a hospital with NICU facilities (in-utero transfer of mother).
Delivery to be attended by senior staff (medical and nursing).

Prior to in-utero transfer

Liaise with NICU / SCBU / Obstetric team.
Check on administration of antenatal steroids.
Identify risk factors for sepsis – administer antibiotics to mother if indicated.

Before the delivery

Communicate with the obstetric team.
Find out available information - gestational age, estimated weight, IUGR?, multiple pregnancy, antenatal scans (doppler findings and anomalies).
Any other antenatal concerns – prolonged rupture of membranes (PROM), hypertension, diabetes, maternal medical /surgical conditions, maternal medications
Steroids given or not? If given, adequacy.

Maternal magnesium sulphate administration for neuro-protection of the baby (<30 weeks)¹

Counsel parents – anticipated short and long term problems and outcome.
Communicate with NICU.

Counselling prospective parents of a preterm infant

Respiratory support requirement - invasive ventilation / nasal CPAP / surfactant
Infection risk – impaired immunity / invasive procedures / possible chorioamnionitis
Blood pressure support
Heart problems – persistence of connection between vessels that are present in-utero
Intracranial bleeding – possible neurological impairment
Expected duration of stay – on average till expected date of delivery
Feeding issues – need for early and regular breast milk expression
Long term outcomes – neurological impairment / vision, hearing
Survival and outcome data are available only for a few units in Sri Lanka yet. Use these local statistics relevant to the particular unit whenever indicated

Problems faced by preterm infants at birth

High risk of hypothermia.

High risk of infections.

High risk of hypoglycaemia – due to fewer reserves.

Fragile thin skin – easily damaged, more evaporative water loss.

Lung immaturity / surfactant deficiency, making alveoli more collapsible.

Chest wall more compliant, less able to protect lungs against hyperinflation

Objective: avoid over-distension and prevent collapse at the end of expiration

Equipment

To maintain temperature

Ambient temperature

Radiant warmer

Warm towels

Plastic bags

Hat and socks

To maintain airway

Laryngoscope – ‘00’, ‘0’, ‘1’ straight blades (Miller)

Endotracheal tube (ETT) with introducer inserted

Endotracheal tube size (approximate estimates of internal diameter)

2.5mm for <30 /40 or <1000g

3.0mm for 31-35/40 or 1000-2000g

3.5mm for >35 weeks or 2000-3000g

Endotracheal tube length at lip (oral) estimate as per birth weight

5.5-6.0 cm for 500-750g

6.0-6.5 cm for 1 kg

7.0-7.5 cm for 2kg

8.0-9.0 cm for 3 kg

Ensure to have ETT of 1 size above and 1 size below

T-piece device - preferred mode of initial respiratory support for a newborn as it can provide a measured PEEP in addition to PIP
ET-CO₂ colour detector– if available

To maintain breathing

Gases – T-piece device with oxygen / air blender (if available)

Surfactant, syringe, needle, size 6 feeding tube cut to be 0.5cm shorter than the length of the ET tube

Lower PIP (20-25cmH₂O) than for term baby - drop PIP further after surfactant administration if condition improving

Saturation monitor

To maintain circulation and give drugs

Umbilical catheters / insertion set : catheter size – 3.5, 4.0, 5.0 Fr

3-way tap

Syringe

0.9% NaCl

Resuscitation drugs - adrenaline

Care of a preterm baby at birth

Prevention of hypothermia

Significantly preterm babies, especially the extremely low birth weight babies, are likely to become hypothermic despite careful application of the traditional techniques for keeping them warm (drying, wrapping and placing under radiant heat).

A combination of interventions are now recommended for maintaining the body temperature of preterm babies, less than 32 weeks gestation, between 36.5°C and 37.5°C.

1. Radiant warmer – turned on before hand
2. Plastic wrapping of body / placing in plastic bag upto the neck immediately after birth.
3. Putting a cap to cover the head
4. Ambient room temperature at 26°C
5. Warmed humidified respiratory gases
6. Thermal mattress

Preterm babies of less than 32 weeks of gestation should be completely covered in a food-grade ***plastic wrap or bag*** up to their necks (babies are placed inside the plastic bag) without drying, immediately after birth. Baby can be initially delivered onto a warm sterile towel carried by the person receiving the baby, who will then carry the baby immediately to the Resuscitaire® / radiant warmer (which should be in the same room where the delivery / Caesarean section is taking place) and place the baby inside the plastic bag. Baby should not be dried with the warm towel prior to placement inside the plastic bag. The baby should then continue to be nursed inside the plastic bag, under the radiant heater, and stabilised prior to transfer to the NICU/SCBU. If using a reclosable bag food-grade plastic bag, you may cut the bottom open, slide the baby into the bag through the cut side, and close the bag below the baby's feet.

Baby should remain wrapped until the temperature has been checked after admission to NICU. If direct access is needed to areas of the baby within the plastic bag a small cut can be made in the bag for this purpose. The baby's temperature must be monitored closely because of the small but known and described risk of inducing hyperthermia with this technique.

Cover the baby's head with a hat leaving the face exposed. All resuscitation procedures including intubation, chest compression and insertion of lines can be achieved with the plastic cover in place.

All babies, especially preterm babies, need to have the ambient temperature of the **delivery room / operation theatre** maintained at **26°C** or higher.

The thermal mattress is not yet available in Sri Lanka.

Procedures that will expose the baby to cold air like checking of weight should be avoided in the delivery room/theatre and should be done only when the baby has been transferred to NICU / SCBU and the temperature is stable.



Baby should ideally be transported from the place of delivery to the neonatal unit in a prewarmed transport incubator.

Delayed cord clamping

In preterm infants, delaying cord clamping by at least 60 seconds after birth, has been associated with improved haemodynamic status, decreased need for blood transfusions, decreased incidence of intraventricular haemorrhage, and decreased incidence of necrotizing enterocolitis. However if a baby is floppy with poor respiratory effort *resuscitation should take precedence* over delaying cord clamping.

The practice of cord-milking in lieu of delayed cord clamping cannot be recommended currently, as there is no evidence by a randomised controlled trial to show a benefit and sudden changes in blood volume may be harmful to preterm babies.

Oxygenation & preterm baby

Preterm babies less than 32 weeks gestation may not reach the same arterial blood oxygenation saturations in air as those achieved by term babies. Therefore, blended oxygen and air should be given judiciously and its use guided by pulse oximetry. If a blend of oxygen and air is not available use an ambu bag with oxygen connected, but without the reservoir bag initially to provide about 40% oxygen. Both hypoxaemia and hyperoxaemia should be avoided.

Saturation monitoring probe should be attached to the right hand in order to obtain pre-ductal saturations.

Resuscitation should be commenced at 30% oxygen and then increased or decreased according to achievement of saturation targets. Excessively high oxygen saturations are as detrimental as saturations below the recommended targets, if oxygen is being used.

The target saturations recommended during resuscitation are as follows. Oxygen should be used judiciously aiming at these recommended targets.

Targeted pre-ductal SpO ₂ after birth	
1 min	60-70%
2 min	65-85%
3 min	70-90%
4 min	75-90%
5 min	80-90%
10 min	85-90%

Courtesy: Australian Resuscitation Council
and New Zealand Resuscitation Council

Ling inflation and use of continuous positive airway pressure (CPAP)

Animal studies show that preterm lungs are easily damaged by large-volume inflations immediately after birth and that maintaining a positive end expiratory pressure (PEEP) immediately after birth protects against lung damage. Positive end expiratory pressure also improves lung compliance and gas exchange. A T-piece device is currently the best method of providing

respiratory support at birth as it can provide a measured PEEP and positive inspiratory pressure (PIP) if required.

Randomised control trials have demonstrated that in spontaneously breathing infants less than 30 weeks of gestation commencing on CPAP may be beneficial when compared to intubation and positive pressure ventilation. Starting CPAP reduced rate of intubation in the delivery room, decreased duration of mechanical ventilation with potential benefit of reduction of death and/or bronchopulmonary dysplasia, and no significant increase in air leak or severe intraventricular haemorrhage. Based on this evidence, **spontaneously breathing preterm infants with respiratory distress may be supported with CPAP initially** rather than routine intubation for ventilation or surfactant.

When positive pressure ventilation is provided use of a **PEEP of at least 5cmH₂O** is recommended. Therefore a T-piece resuscitaire is preferred over a self-inflating ambu bag for resuscitation if compressed air / oxygen is available.

Both over inflation and repeated collapse of the alveoli have been shown to cause damage in animal studies (derecruitment – rerecruitment injuries). Inflation pressure is measured in an imperfect attempt to limit tidal volume.

If a newborn requires CPAP or ventilation with a mask for longer than several minutes, consider placing an orogastric tube and leaving it uncapped to act as a vent for the stomach.

When ventilating preterm infants, very obvious passive chest wall movement may indicate excessive tidal volumes and should be avoided. Monitoring of pressure may help to provide consistent inflations and avoid high pressures. If positive pressure ventilation is required, an initial inflation pressure of 20-25cmH₂O is adequate for most preterm infants. If a prompt increase in heart rate or chest movement is not obtained, higher pressures may be needed. If continuous positive pressure ventilation is required, PEEP alone (eg: via a T-piece device at resuscitation) is very useful. Continuous positive airway pressure (CPAP) in spontaneously breathing preterm infants following resuscitation is also extremely beneficial.

Consider surfactant once the baby has a stable heart rate and has ideally been stabilised in the neonatal unit. Appropriate **endotracheal tube placement** should be confirmed by auscultation of bilateral breath sounds or a chest radiograph prior to **surfactant** administration.

Devices available for providing ventilation during resuscitation

Effective ventilation can be achieved with a flow inflating bag, self-inflating bag or with a T-piece mechanical device designed to regulate pressure.

The blow-off valves of self-inflating bags are flow dependent and pressures generated may exceed the value specified by the manufacturer if compressed vigorously. **The self-inflating bags (Ambu bag) usually** (unless a special valve has been additionally fixed) **cannot provide PEEP.**

Flow-inflating bags (anaesthetic bag) can provide PEEP but pressures provided are not targeted, measurable or consistent. More training / experience is required to use flow-inflating bags compared to ambu bags.

Target inflation pressures, long inspiratory times and desired PEEPs are best achieved more consistently with **T-piece devices.**

PEEP needs to be consistently provided from the delivery room, during transfer and after admission to the NICU.

Preparing the SCBU

Thermoregulation

- Pre-warmed incubator
- Humidity – initially at 85-90%

Airway and breathing

- prepare ventilator, humidifier
- set ventilator

Circulation

- monitor heart rate, BP

Fluids

- prepare peripheral venous cannulae / equipment for umbilical catheterisation
- 10% dextrose
- 0.9% NaCl (if boluses are needed)

Aim for minimal handling

and

AVOID

Over-inflation / under-inflation

Hypothermia / hyperthermia

Hypoglycaemia

Over-handling

Surfactant

Respiratory distress syndrome affects 1% of newborns. Presentation is within 4-6 hrs after birth. Risk is inversely proportional to gestational age. The cause is inadequacy of surfactant in the lung resulting in poor lung compliance.

Survanta which is bovine based is the surfactant currently available in Sri Lanka. Dose is 4ml/kg. It can be repeated in 6-12 hours, upto 3-4 doses.

Indications

In preterm infants less than 26 weeks gestation surfactant may be used prophylactically, but for more mature infants with respiratory distress CPAP from the time of delivery should be provided initially and surfactant administered as rescue therapy. Therefore surfactant is usually not administered in the theatre or labour room.

A Chest X-ray should ideally be done before administration of surfactant to confirm correct endotracheal tube placement and for exclusion of any lung anomalies.

Criteria to be used in deciding on the need to administer surfactant,

- babies <34 weeks gestation (even for higher gestations if clinically and radiologically indicated) at birth in first 36 hours of life
- FiO₂ requirement >0.4 (40%) in spite of PEEP of 7cm H₂O
- in the first 36 hours of life
- with saturation target being 90-94%

7.2 MECONIUM STAINED LIQUOR

Overview

When a baby passes meconium inside the uterus there are two main issues:

- Baby may have passed meconium because he/she has significant asphyxia
- If meconium is aspirated into the lungs it can result in meconium aspiration syndrome (MAS)

You should anticipate the delivery of a baby who is hypoxic and has respiratory distress.

- Stress leads to passage of meconium in utero
- Triggered more easily near term
- Aspiration requires gasping in-utero

At delivery

- **Suctioning mouth and nose of baby when baby's head is visible on mother's perineum, before delivery of the shoulders is ineffective and is therefore not recommended.**
- **Routine endotracheal suctioning is not recommended.**
- Babies born through meconium stained liquor who have a normal respiratory effort, muscle tone and a heart rate >100/min with vigorous activity and crying, can be handed over to the mother.
- While non-vigorous infants born through meconium stained amniotic fluid are at increased risk of MAS, tracheal suctioning has not been shown to improve outcome.
- The presence of thick, viscous meconium in a non-vigorous infant is the only indication for initially considering visualising the *oropharynx* (not intracheal) and suctioning material, which might obstruct the airway. If an infant born through meconium-stained amniotic fluid is also floppy and makes no immediate respiratory effort, then it is reasonable to rapidly inspect the oropharynx with a view to removing any particulate matter that might obstruct the airway as most of these babies do have thick secretions / meconium in the mouth.

- Tracheal intubation should not be routine in the presence of meconium and is performed only for suspected tracheal obstruction if inflation breaths provided with the use of standard airway manoeuvres are unsuccessful in achieving chest expansion.
- **In a non-breathing infant, commencement of ventilation within the first minute of life is the priority** and this should not be delayed, especially if the baby is bradycardic.
- Effective suctioning of meconium requires a large (8-12 French gauge) suction catheter.
- Tracheal lavage is harmful as it may spread the meconium throughout the lungs and therefore should not be performed. Gastric lavage to prevent feeding problems and secondary aspiration has not been shown to be beneficial and is no longer recommended.

7.3 DELIVERY OUTSIDE THE LABOUR ROOM / LSCS THEATRE

Delivery outside the labour ward, including home deliveries are not recommended in Sri Lanka.

Inevitably there will be some limitations to resuscitation of a newborn baby outside the delivery room.

Problems anticipated are,

Maintaining temperature

Cord care

Lack of basic equipment

Difficulties with timing and note keeping

Management

Get help

- When will you ask? ***Immediately***
- Who will you ask? ***MO and a nurse from the closest hospital / ward*** (with Paediatric / Neonatal Services / Emergency Department)
- How will you ask? ***Over the phone*** (general land phone or personal mobile)
- What will you ask for? ***depends on the situation, maturity and clinical condition of the baby*** (eg: if within a hospital request for neonatal staff to come with basic resuscitation equipment)
- How long will it take? ***Find out and prepare accordingly***

What should you do **until help arrives** / you are able to reach help?

- ***maintain normothermia*** (use kangaroo mother care if possible)
- ***monitor vital signs***

If the mother **delivers in an ambulance**

- ***stop the ambulance and attend to both baby and mother.***

7.4 BABIES WHO DO NOT RESPOND

If the baby's heart rate does not respond after 5 inflation breaths, consider the following.

- Is the baby in the neutral position?
- Do you need to give 'jaw thrust'?
- Do you need to give longer inflation time?
- Do you need a second person's help with the airway?
- Is there an obstruction in the oropharynx? (laryngoscope & suction)
- What about an oropharyngeal (Guedel) airway?
- Will intubation be helpful? If intubation difficult consider laryngeal mask airway

In babies who remain blue – Consider:-

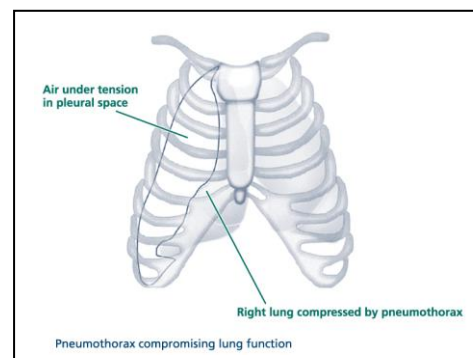
Diaphragmatic hernia
Intra-partum pneumonia
Pneumothorax
Persistent fetal circulation (PFC)
Congenital Heart Disease

**CONTINUED CYANOSIS REQUIRES IMMEDIATE
INVESTIGATION AND SENIOR HELP**

Pneumothorax

How do you suspect?

- Baby's colour is blue
- Poor chest expansion on one side
- Heart sounds muffled
- Poor air entry on the same side
- Cold light positive
- Do not wait for chest X-rays



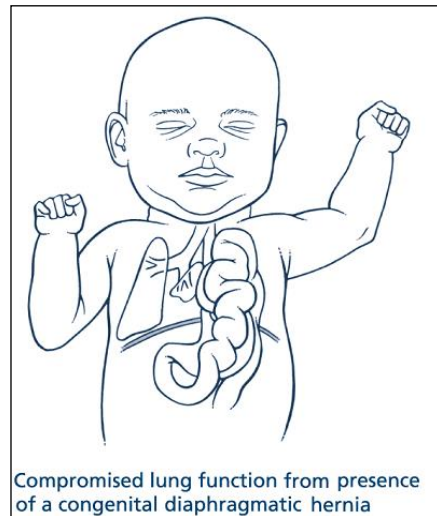
Intervention

- Insert a butterfly needle (gauge 23 / blue cannula) which has its distal end dipped in to a kidney tray containing sterile water (needle thoracotomy)
- Site – 2nd intercostals space in the mid clavicular line
- If bubbling is present – insert an intercostal tube
- Arrange for a chest X-ray

Congenital Diaphragmatic Hernia

How do you suspect?

- May be antenatally diagnosed
- Cyanosed
- Poor chest expansion on one side
- Heart sounds best heard on the opposite side (usually right side)
- Poor air entry on the same side
- Cold light negative
- Abdomen scaphoid



Interventions

- ***No bag & mask ventilation***
- Intubate the baby ***straightaway***
- Insert a N-G tube, leave the distal end open
- Sedate adequately
- Keep nil oral and start intravenous fluids
- Check pre (right hand) and post-ductal saturation – if there is a significant difference start treatment for persistent pulmonary hypertension (PPHN) early with 100% oxygen and pulmonary vasodilators (if available).
- Need to liaise with surgical team

Hypovolaemia

How to suspect?

- There may be a clue - e.g. ante partum haemorrhage
- Pass a UVC, get a blood sample for Hb%, cross matching
- Look for signs of hypovolaemia, prolonged capillary refill time, reduced pulse volume.

Intervention

- 0.9% NaCl (normal saline) 10ml per kg
- may be repeated twice
- uncross matched O negative blood 10-20ml/kg

7.5 Therapeutic hypothermia (Cooling)

Several randomised, controlled, multi-centre trials of therapeutic hypothermia (33.5–34.5°C) of babies born **at/or more than 36 weeks** gestational age, with moderate to severe hypoxic–ischemic encephalopathy have shown that cooling significantly reduced death and neuro-developmental disability at 18 months.

Infants born at or near term, with evolving moderate to severe Hypoxic Ischaemic Encephalopathy (HIE), should be offered therapeutic hypothermia. The whole body cooling and selective head cooling are both appropriate strategies. Use the protocols used in randomised clinical trials

- Begin at less than 6 hours after birth.
- Continue for 72 hours after birth
- Re-warm over at least 4 hours

Carefully monitor for known adverse effects of cooling (e.g: thrombocytopenia and hypotension.)

All treated infants should be followed up longitudinally

ANNEX 1

ENDOTRACHEAL INTUBATION

Most of the babies who are asphyxiated at birth can be successfully resuscitated by good airway management and correct bag and mask ventilation. Even in babies who need intubation one could sustain life by bag and mask ventilation, until someone competent in intubation arrives. If you are not sure about your skills in intubation, do not attempt it, because if you traumatise the upper air way and larynx, even a competent person might find it difficult to intubate. ***However, it is an important skill to learn.*** The procedure will be demonstrated during the course and you will get a chance to practice on manikins. You can also get some experience by intubating cadavers. Once you are confident that you can intubate, attempt on a baby who needs intubation but under supervision. Remember that you have to finish the procedure in 30 seconds from the time you stopped bag and mask ventilation.

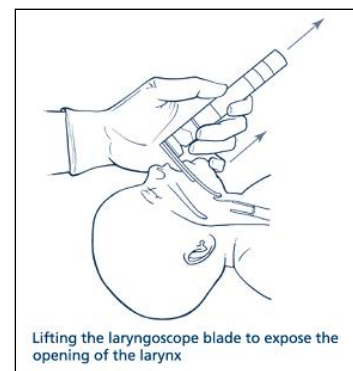
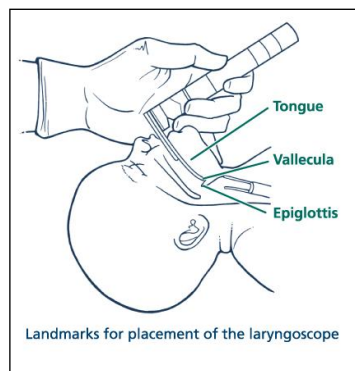
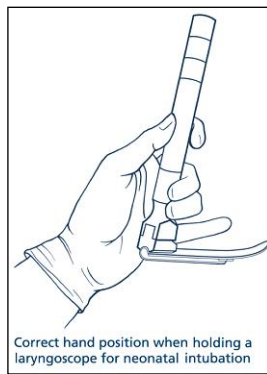
Intubating the baby has the advantage that you can now be sure of the air way and concentrate on other aspects. So any baby who is not responding after inflation breaths should be considered for intubation.

However there are several situations when intubation becomes essential.

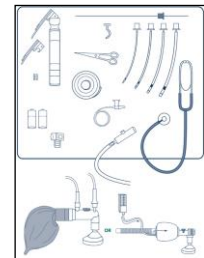
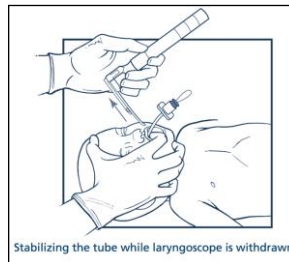
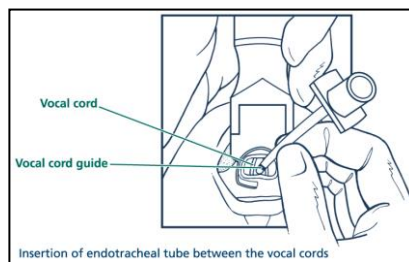
- When jaw thrust and oro-pharyngeal air way fails to provide good chest expansion even after clearing the airway.
- Baby with a diaphragmatic hernia.

Before attempting intubation in any situation other than those mentioned above, you should ensure that oxygenation is satisfactory, if necessary by using bag and mask ventilation with O₂. This is to prevent desaturation during intubation. Select the correct size laryngoscope blade (size 00 or 0 for a preterm and size 1 for a term baby). Never attempt intubation with a short blade because you will not be able to visualize the larynx. Straight blade is preferable to curved blade in neonates. Check the light and make sure you have good illumination. ***Never attempt intubation with a dim light.***

Hold the laryngoscope in the left hand and insert the blade from the right hand corner of the mouth, pushing the tongue to the left and depressing it. Insert the blade until you visualise the epiglottis. Insert the blade posterior to the epiglottis and pull the laryngoscope upwards, to lift the larynx. Avoid doing a levering action of the laryngoscope.

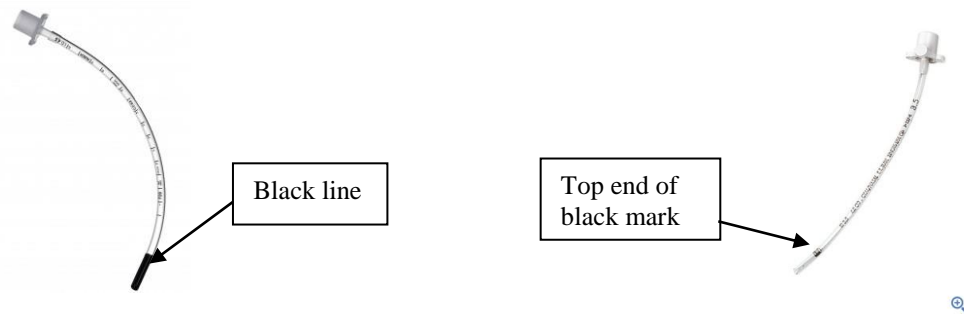


This will bring the laryngeal opening into view. Straight blade is better for this manoeuvre. This method is different to intubation in older children and adults, where you keep the blade in the vallecular fossa (in between the tongue and epiglottis) and lever the epiglottis by lifting the laryngoscope. Curved blade is useful in that manoeuvre. The reason for the difference in technique is because of the anatomical difference of the larynx in a neonate mentioned earlier.



Once you visualize the laryngeal opening insert the correct size endotracheal tube. A tube that is too small will cause a significant air leak with ventilation failure while a larger tube may cause stenosis of trachea and larynx later. The correct size tube causes a small air leak when auscultated at larynx. ***Non cuffed tubes are used in neonates and small children to prevent pressure necrosis and tracheal stenosis later.*** Therefore you must ensure adequate length is inserted into the trachea to prevent accidental extubation. Insertion too deep will result in the tube entering a main bronchus. Unlike in adults, bifurcation of trachea in a neonate is symmetrical so that it can enter either the right or left main bronchus.

There is a black mark / line near the tip of the endotracheal tube. Once the endotracheal tube has been passed through the vocal cords, when the top end of the black mark or the black line is at the level of the vocal cords, the endotracheal tube can be considered to be at the correct position.



However air entry should be checked by auscultation over both axillae and epigastrium. You should hear breath sounds equally over axillae and less louder over the epigastrium. The final confirmatory check of endotracheal tube position would be by a chest X-ray (it should be below the thoracic inlet and at least 1cm above the carina)

ANNEX 2

INSERTION OF OROPHARYNGEAL AIRWAY

Any baby hypoxic enough to require urgent resuscitation is likely to be unconscious and as limp as a patient under general anaesthesia. Therefore the airway needs to be guarded and maintained. An oral airway can be useful in maintaining an open airway in a manner similar to jaw-thrust by moving the tongue away from the tracheal opening.

Select the correct size of oro-pharyngeal airway as shown below.

When held along the line of the lower jaw with the flange in the middle of the lips (immediately below the tip of the nose), the end of the airway should be



at the level of the angle of the jaw.

Assessing the optimal length of the oro-pharyngeal airway

Sizing the airway as above is only approximate. Babies can vary in sizes from 500-5000gms. There are 3 airway sizes which are usually used in neonatal resuscitation. If the airway is too short the distal end will impact on the base of the tongue and occlude the airway. If the airway is too long it may extend into the oropharynx below the tracheal opening and then obstruct the airway itself.

Insert it with the correct side up compared to inserting the wrong side up and rotating it while in the oral cavity as in adults. i.e in babies and young children the airway is inserted in the same direction that it is finally positioned. During insertion make sure the airway slips over the tongue and does not push the tongue backwards on to the back of the mouth. Use a tongue depressor or laryngoscope to keep the tongue pushed down during insertion of the oropharyngeal airway.

Oral airways are useful temporarily if a baby has choanal atresia.

ANNEX 3

MISCELLANEOUS FACTS

Introduction

The following facts are based on interpretation of the evidence presented in the 2010 International consensus on cardiopulmonary resuscitation (ILCOR) guidelines.

1. Babies who do not need resuscitation :

- a. Term?
- b. Crying or breathing?
- c. Good muscle tone?

If the answer is “yes” to all three questions above, baby should be dried, placed skin to skin with the mother and covered with warm dry linen, while observing breathing, activity and colour.

2. If the answer to any of these question is “No” the baby needs one or more of the following four categories of action in sequence.

Initial steps in stabilisation (provide warmth, dry, stimulate, clear airway if necessary)

Ventilation

Chest compression

Administration of epinephrine and or volume expansion

Approximately 60 seconds are allotted to complete the initial steps, re-evaluate and commencement of ventilation if required.

3. Decision to proceed beyond initial steps depends on the evaluation characteristics

Respiration (apnoea, gasping, laboured or unlaboured breathing)

Heart rate greater or less than 100/minute

4. Colour & Oxygen

Colour is not a useful sign. There is increasing evidence that hyperoxia is detrimental to many organs at cellular and functional level. Therefore colour has been removed as an indicator of resuscitation efficacy or oxygenation. Instead pulse oximetry has been introduced to assess the state of oxygenation.

5. Pulse oximetry

A pulse oximeter is useful for babies who require on-going resuscitation or respiratory support or both. Pulse oximeter is used to adjust oxygen therapy, *aiming to match it to those of an uncompromised baby at birth*. However the device takes one to two minutes to apply and it may not function with very poor cardiac output or perfusion. The sensor should be placed on the baby's right hand or wrist (pre-ductal) before connecting the probe to the instrument.

6. Air vs. Oxygen

In the term newborn infants receiving resuscitation with positive pressure ventilation, it is best to begin with air rather than 100% oxygen. If despite effective ventilation, there is no increase in heart rate or if oxygenation (guided by pulse oximetry) remains unacceptable, use of higher concentration of oxygen should be considered.

Targeted pre-ductal SpO ₂ after birth	
1 minute	60-65%
2 minutes	65-70%
3 minutes	70-75%
4 minute	75-80%
5 minutes	80-85%
10 minutes	85-95%

If there is no improvement in SpO₂ or the heart rate falls, recheck the ventilatory strategy and increase the FiO₂ until SpO₂ stabilises

7. **Assessment of heart rate**

This is the most sensitive indicator of a successful response to each step of resuscitation. Auscultation of the heart rate is more accurate than palpation of the cord. Pulse oximeter is more reliable to detect heart rate if less than 100 beats per minute.

8. **Cord Clamping**

Delay the umbilical cord clamping for 1-3 minutes for the newborn infants not requiring resuscitation in both term and preterm.

If the mother is having a post partum haemorrhage or the baby has no spontaneous breathing and requires resuscitation, this should take precedence over delaying of cord clamping.

The umbilical cord should be double clamped immediately after birth in babies who are compromised at birth in order to obtain accurate values on cord blood gas analysis.

9. **Therapeutic Hypothermia**

Infants born at or near term, with evolving moderate to severe hypoxic ischaemic encephalopathy (HIE), should be offered therapeutic hypothermia. The whole body cooling and selective head cooling are both appropriate strategies. Use the protocols used in randomised clinical trials

- Begin at less than 6 hours after birth.
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Carefully monitor for known adverse effects of cooling (e.g: thrombocytopaenia and hypotension.)

All treated infants should be followed up longitudinally

ANNEX 4

CASE SCENARIO

History (*Initial candidate briefing prior to arrival of child*)

A 37 week baby is found to have type II dips during prolonged 2nd stage of labour. You are called for resuscitation. In 5 minutes baby is going to be delivered by emergency LSCS.

Clinical course (*to be given to the candidate as he/she progress through the assessment and treatment of the child*)

Baby born flat needing, inflation breaths, ventilation breaths and CPR. Then baby develops poor respiration again.

Key points

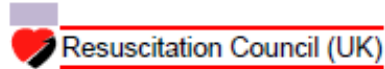
Set the environment		
Airway & Breathing	Neutral Airway & Inflation breaths	
	Jaw Thrust & Inflation breaths	
	laryngoscopy & suction & Inflation breaths	
	Ventilation breaths	
Circulation	Chest compressions	
Drugs	Vascular access and drugs	
Stabilisation & Transport	Inform SCBU	
	Stabilisation,	
	Transport	
	Counselling	

Scenario

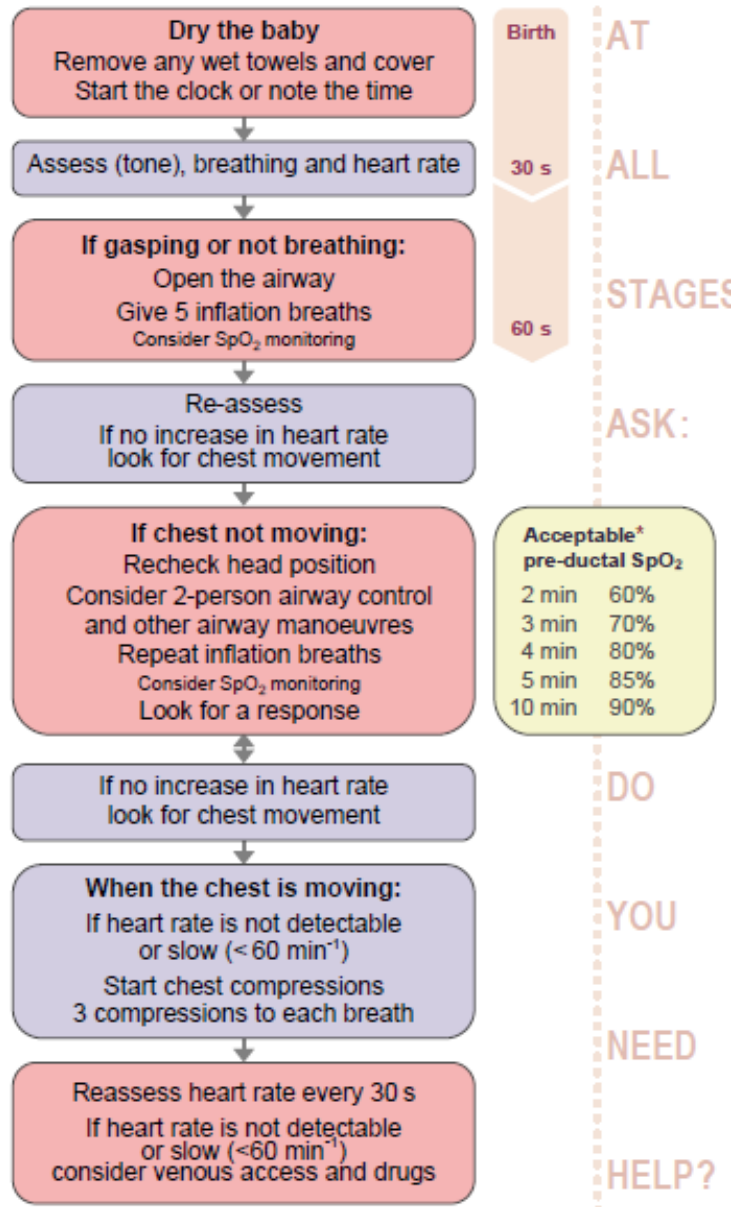
A	SET & DRYING		
	Introduce to Mum & Obstetric staff		
	Switch off A/C and fan, close windows - Maintain temp 26°C-28°C		
	Turn on the heater		
	Turn on oxygen / air supply		
	Hand washing		
	Wear double pairs of gloves		
	Check equipments		
	Start clock		
	Remove one pair of gloves		
	Dry & stimulate the baby		
	Wet cloth discarded		
	Open the airway – Neutral airway and stimulate		
	Assess the baby		
Information available to candidate Colour – Very pale; Tone – some tone present Breathing – Not breathing; Heart rate – Slow			
B	Neutral Airway & Inflation breaths		
	Choose correct size mask with bag		
	Correct position of the mask on face		
	Holding technique “C” and “E”		
	Good seal formed		
	Inflation breaths x 5		
	Correct technique of inflation breaths		
	Chest rise noted		
	Re-assess		
Information to candidate Colour –Pale ; Tone-floppy: Breathing—No respiratory efforts;			

Heart rate—remains slow; Did candidate achieve chest expansion – No			
C	Jaw Thrust & Inflation breaths		
	Call for help to deliver inflation breaths		
	Correct technique of Jaw thrust		
	Fixation of mask both hands – C technique		
	Get the helper to deliver Mask Inflation x 5 (second time)		
	Chest rise noted		
	Reassess		
Information to candidate - Colour –Pale; Tone-floppy; Breathing—No respiratory efforts; Heart rate—remain slow; Did candidate achieve chest expansion – Yes			
D	Chest compressions & Ventilation breaths		
	Hand over to helper to deliver ventilation breaths		
	Start chest compressions		
	Correct land mark		
	Correct depth		
	Correct finger positioning		
	Coordination CPR 3:1 15 breaths in 30 seconds		
	Chest rise noted		
	Good quality & timing resuscitation		
	Re-assess		
Information to candidate Colour –Pale; Tone-floppy; Breathing—No respiratory efforts; Heart rate—remain slow; Did candidate achieve chest expansion –No, It is now lost Baby becomes more obviously pale and shut down			
E	Laryngoscopy & suction & Inflation breaths		
	Check airway with direct laryngoscope & suction		
	Decide on oral airway / intubate if competent		
	Correct size of airway and insertion technique		
	Continue chest compressions & inflation or Inflation followed by Ventilation breaths		
F	VASCULAR ACCESS & DRUGS		
Information to candidates – Colour –Pale; Tone-floppy; Breathing—No respiratory efforts; Heart rate—remain slow; Did candidate achieve chest expansion – Yes			
	Decide on UVC access		
	Correct technique of vascular access		
	Correct Drugs order, doses & flush		
	Drugs in correct reconstitution		
	Reassess		
Information to candidate Heart rate 150, spontaneous rapid breathing with improved colour and tone, but capillary refill time 4 secs.			
G	STABILISATION & TRANSPORT & COUNSELLING		
	Give volume – N.S dose 10ml/kg		
	Check for Tachypnoea, grunting, recessions		
	Give CPAP or nasal prong oxygen as appropriate		
	Check blood sugar		
	Check Temp & re-warm		
Information to candidates – Colour –Pink, Tone – good, Breathing—regular; HR 130/min; CRFT 3 secs			
	Check Capillary blood gas		
	Documentation of notes		
	Counsel the mother		
	Transfer the baby to neonatal unit		
	Acknowledge the co-workers who helped		

NEONATAL RESUSCITATION ALGORITHM



Newborn Life Support



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