Policy Compliance Procedure

Health
Hunter New England Local Health District

Maternity and Newborn – Resuscitation of the Newborn Infant

Sites where PCP applies	NICU JHCH, Special Care Nurseries and all Maternity facilities within HNELHD
This PCP applies to:	
1. Adults	Yes
2. Children up to 16 years	Yes – Potential for all maternity care guidelines to apply to girls under 16 years
3. Neonates – less than 29 days	Yes - Approval gained from the Children Young People and Families Network on 23rd September 2016
Target audience	All providers of birthing and newborn care: Includes midwives, registered nurses, obstetricians, medical officers, midwifery and medical students
Description	This Policy Compliance Procedure outlines the steps, equipment and personnel required to provide effective newborn resuscitation.

Hyperlink to Procedure

Keywords	Maternity, airway, breathing, circulation, newborn, pulse oximetry, resuscitation, infant, birth, neonatal
This PCP relates to NSW Ministry of Health Policy Directive	PD2008_027 Maternity – Clinical Care and Resuscitation of the Newborn Infant
PCP number	PD2008_027:PCP 1
Replaces existing document?	Yes
Document number and dates of superseded document/s	1. Maternity, Newborn: Resuscitation of the Newborn Infant PD2008_027:PCP 1 from 14 February 2013 2. Resuscitation of the Newborn Infant JHCH_NICU_01.03

Related Legislation, Australian Standard, NSW Ministry of Health Policy Directive or Guideline, National Safety and Quality Health Service Standard (NSQHSS) and/or other, HNE Health Document, Professional Guideline, Code of Practice or Ethics:

- PD2005_256 Newborn Infants with Respiratory Maladaptation to Birth - Observation and Management
- PD2013_049 Recognition and management of patients who are Clinically Deteriorating.
- ANZCOR (2016) Newborn Resuscitation guidelines 13.1 to 13.10

Tier 2 Director responsible for Policy to which the PCP relates. PCP authorised by	Executive Director of Nursing and Midwifery - Elizabeth Grist
PCP contact person and Network or Service etc. responsible for the PCP	1. CNC Newborn Services 2. CMC, Maternity Clinical Risk Management
Contact details	1. Ph: 4921 3597 2. Ph: 4924 6834
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This document contains advice on therapeutics	Yes - Approval gained from the District Quality Use of Medicines Committee on 9 August 2016
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Note: Over time links in this document may cease working. Where this occurs please source the document in the PPG Directory at: http://ppg.hne.health.nsw.gov.au/

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RISK STATEMENT

This PCP is specifically for newborns (first minutes to hours of life) and applies to babies for the duration of their first hospital stay, these babies may be cared for in the Neonatal Intensive Care Unit (NICU), Special Care Nurseries or post-natal wards located at hospitals throughout the local health district (LHD). Once a baby has been discharged and is readmitted to paediatric/emergency services then paediatric resuscitation guidelines apply.

Any unplanned event resulting in, or with the potential for, injury, damage or other loss to the patient as a result of this PCP must be reported through the Incident Information Management System. This would include unintended patient injury or complication from treatment that results in disability, death or prolonged hospital stay and is caused by health care management.

Open Disclosure procedures must be commenced to ensure the concerns of the patient are identified and managed in accordance with Ministry of Health Policy Directives. The Policy Directives and Guidelines for managing complaints and concerns about clinicians should be used in conjunction with other relevant NSW Health Policy Directives that govern the behaviour and actions of all staff.

The Hunter New England Local Health District operates within a tiered network of maternity and newborn services which helps to ensure that women and their babies have the appropriate access to higher levels of maternity and newborn care when risk factors are identified beyond the designated role delineation of the local service. Clinicians should make the decision as to the most appropriate facility for care based on the baby's individual needs.

Risk Category*:* Clinical Care & Patient Safety

GLOSSARY and ABBREVIATIONS

APH	Antepartum haemorrhage
CTG – Cardiotocograph	Electronic recording of the fetal heart rate and maternal contractions
Multiple birth	More than one fetus *in utero*
Newborn	An infant in the first minutes to hours following birth
T-piece device	A manually-operated, gas-powered resuscitator designed to provide breaths at a set flow with consistent Peak Inspiratory Pressure (PIP) and Positive End Expiratory Pressure (PEEP) to infants e.g. Neopuff™
Neonate	An infant in the first 28 days of life
Pedi-Cap®	End-tidal carbon dioxide detector to verify endotracheal tube placement
Rad-8®	Pulse oximeter- by Masimo
ETT	Endotracheal tube
Resuscitation	Defined as the preservation or restoration of life by the establishment and/or maintenance of airway, breathing and circulation, and related emergency care
ANZCOR	Australian and New Zealand Committee on Resuscitation
ELBW	Extremely low birthweight infant < 1000 gram

This Policy Compliance Procedure (PCP) is based on the ANZCOR (2016) Newborn Resuscitation Guidelines 13.1 to 13.10 which were developed from consensus on resuscitation and treatment recommendations issued by the International Liaison Committee of Resuscitation (ILCOR), which included representation from the Australian Resuscitation Council (ARC) and New Zealand Resuscitation Council (NZRC). When research answers questions that remain uncertain the PCP will need to be reviewed.

Summary

Approximately 85% of infants born at term will spontaneously breathe within 10 to 30 seconds of birth; of the remainder:

- 10% will respond to drying and stimulation,
- 3% will require positive pressure ventilation (PPV),
- 2% will require intubation and PPV, and
- 0.1% will require chest compressions and/or adrenaline (epinephrine) to achieve transition.

As the need for newborn infant resuscitation may be unexpected, suitable environment, equipment and personnel trained to resuscitate must be available at all times and in all places where infants are born (ANZCOR, 2016 Guideline 13.1 p.2).

The Maternity and Newborn Services within the Hunter New England Local Health District endorse the ANZCOR (2016) Guidelines for 'Resuscitation of the newborn infant' 13.1-13.10.

Introduction

Australia has approximately 300,000 births per year, with 100,000 in NSW. In Hunter New England Local Health District (HNELHD) there are approximately 10,000 births per year in public facilities and 2,000 in the private hospital system.

This PCP is specifically for newborns (first minutes to hours of life) and applies to babies for the duration of their first hospital stay, these babies may be cared for in the Neonatal Intensive Care Unit (NICU), Special Care Nurseries or post-natal wards located at hospitals throughout the local health district (LHD). Once a baby has been discharged and is readmitted to paediatric/emergency services then paediatric resuscitation guidelines apply.

Newborns at risk of requiring resuscitation

The transition from fetal to extra-uterine life is characterised by a series of unique physiological events. The lungs change from liquid-filled to air-filled, the blood flow to the lungs increases dramatically and the intra-cardiac and extra-cardiac shunts close. Adaptation to extra-uterine life depends on many coordinated and interdependent physiological events and failure of any of these events can impair successful transition.
Given this complexity, we should always assume resuscitation will be required.

When preparing for a birth and potential resuscitation, assess the history of maternal and intrapartum risk factors including pre-existing maternal conditions, antenatal identified fetal anomalies, problems during pregnancy, maternal indicators of infection and assessments of fetal well-being, presentation and mode of birth.

Anticipating the need for resuscitation

1. Personnel required

Newborn resuscitation training is mandatory for all clinical staff who may be called upon to provide birthing services and/or care for newborns, to ensure that they possess the necessary knowledge and skills to initiate basic newborn resuscitation which includes positive pressure ventilation via face mask or laryngeal airway and cardiac compressions.

Staff trained in advanced neonatal resuscitation with the ability to provide, when necessary, advanced airway management, umbilical venous catheter placement and administration of drugs and fluids may be needed for low-risk births and *in attendance* for all high-risk births (ANZCOR, 2016 Guideline 13.1). Someone with advanced skills should be *on-call* for low-risk births as per local facility guideline.

Staff with advanced skills should attend all high-risk births including:

- Preterm infants < 35 weeks gestation
- Multiple births
- Infants with significant antenatally diagnosed anomalies
- Concerning fetal heart rate patterns on CTG
- Thick meconium
- Breech vaginal birth
- Instrumental births
- Caesarean section (not necessary for elective C/S with no other risk factors)
- Opioids administered to mother within 4 hours of birth
- Any situation where attending staff are concerned as to the condition of the fetus e.g. reduced fetal movements, prolapsed cord, large APH

In some facilities within HNELHD, elective caesarean sections, NOT under general anaesthetic (GA) are attended by midwives trained in basic life support. In other centres, all deliveries with meconium are attended by someone with advanced skills. There may be circumstances when a midwife requests neonatal assistance despite it appearing to be an uncomplicated birth; such requests should be respected. Caesarean sections, if possible, should not commence until required staff are present.

2. Equipment required

As the need for resuscitation cannot be reliably predicted, a complete set of resuscitation equipment should be available at all births, in both the delivery room and the operating theatre. The Neonatal Resuscitation Trolley Flip Chart with standardised equipment list provides a guide to equipment required and should be attached to all Resuscitaires.

This equipment should include:

- Infant Resuscitaire with radiant heat source
- Light source
- Air and oxygen supply with a blender attached (in the absence of a blender, refer to **Appendix 1** for oxygen/air mix)
- Clock/Apgar timer
- Warm towels and blankets
- Neo-HeLP or polyethylene wrap for infants < 30 weeks gestation or < 1500 gram
- Stethoscope
- Pulse oximeter with disposable probe attached
- Self-inflating resuscitation bag (e.g. BAG II™ Disposable Resuscitator, Laerdal) with suitable mask fitted and flow driven T-piece device (e.g. Neopuff™) with suitable mask
- Laryngoscopes and straight blades (size 00 = 6 cm, size 0 = 7.5 cm and size 1 = 10 cm)
- Endotracheal tubes (ETT) ± stylet (sizes 2.5 mm, 3 mm, 3.5 mm and 4 mm)

- Size 2 mm ETT available in NICU
- Size 1 laryngeal mask airway – for babies > 34 weeks gestation or > 2 kg
- Suction source, tubing and catheters (6, 8, 10 & 12 FG)
- Meconium aspirator
- End-tidal carbon dioxide detector (Pedi-Cap)
- Umbilical vein catheterisation (UVC) set and catheters, 3.5 and 5 FG
- Intraosseous needle available if UVC unsuccessful in term infant
- Sodium chloride 0.9% (normal saline)
- Adrenaline (epinephrine) 1 mg/10 mL (1:10,000) solution
- Syringes and needles
- A resuscitation record sheet

The equipment should be checked to be present and working by the midwife and/or clinician in attendance for the birth;

- At a minimum of once in 24 hours or more frequent as per local protocol and
- Prior to all deliveries/births

A log of the equipment checks should include date, time, signature and comments. Compliance should be audited by Manager each month.

3. Communication

Adequate communication between those caring for the mother and baby and those responsible for resuscitation is essential. This should include any factors that may affect the resuscitation and management of the newborn including maternal conditions, antenatal diagnoses and assessment of fetal wellbeing.

Whenever possible, the resuscitation team should introduce themselves to the mother and her partner before the birth and outline their responsibility in the resuscitation. For a complex delivery, the resuscitation team should discuss individual roles and who to call should further help be required.

4. Environment

Prevention of heat loss reduces mortality and morbidity in newborn infants. For every 1°C drop in temperature below 36.5° C in infants, mortality increases by 28%. Newborn infants lose heat by:

- Evaporation
- Radiation
- Convection
- Conduction

If resuscitation is not required, the mother's body can keep the infant warm by placing the infant skin to skin on the mother's chest and covering the infant with a warm blanket. Ensure infant's airway is not compromised and infant is positioned appropriately. See HNELHD Maternity Guideline HNELHD CG 14_32: Safe skin to skin following birth.

To prevent heat loss, if resuscitation is required, dry the infant (gestation and weight appropriate) and place under a radiant heater on a warm surface in a draft-free environment. Operating rooms may be warmed for preterm births if time permits by requesting room temperature to be increased to 26°C (e.g. via Engineering Department) prior to commencement.

Additional measures are recommended to prevent heat loss in very preterm infants < 30 weeks gestation or < 1500 gram:

- Place in polyethylene wrap or a Neo-HeLP polyethylene bag immediately after birth. The baby's body is **NOT** dried before wrapping in "plastic wrap".
- Cover the head (except face) with hat or bonnet
- Establish an ambient room temperature of 26°C if possible
- Use warmed humidified resuscitation gases
- Use exothermic warming mattresses

(ANZCOR Guideline 13.8, 2016)

Assessment of the newborn infant

All babies (> 30 weeks) should be dried and stimulated after birth.

The initial assessment to determine the need for resuscitation includes:

- Breathing
- Heart rate
- Tone

Subsequent and ongoing assessment is based on infant's breathing, heart rate, oxygen saturations and tone.

The Apgar score is used to document postnatal adaptation at 1 and 5 minutes (and at 10, 15 and 20 minutes if < 8 at 5 minutes). Infants with low Apgar scores, cyanosis, bradycardia (< 100 bpm) or irregular or absent respirations require ongoing support.

- Stimulation: Most babies respond to stimulation (e.g. drying) and will not require further resuscitation. If the baby does not breathe or is gasping or has a heart rate less than 100 bpm, resuscitation should be commenced.
- Airway: After stimulation, most babies establish a HR > 100 bpm and regular respirations. If these are not established, then patency of the airway should be ensured. The neonatal airway is patent when in the neutral or slightly extended (the sniffing) position. Normal newborn infants do not routinely require suctioning of the nose, mouth or pharynx after birth as they can clear their airways effectively and suctioning can delay the normal rise in oxygenation (ANZCOR Guideline 13.4, 2016). Suction maybe required when the airway is obstructed by particulate meconium, blood clots, or tenacious mucus.
- Breathing: Most term or near-term babies should establish regular respirations within 10 to 30 seconds of birth, sufficient to maintain a heart rate > 100 bpm. If breathing is not established and the heart rate remains < 100 bpm, positive pressure ventilation is required. If there is marked respiratory distress, continuous positive airway pressure (CPAP) should be administered via the T-piece device and mask. Pulse oximetry should be used in all resuscitations requiring positive pressure ventilation or when there is any concern regarding the infant's colour or at any time when oxygen is to be administered. The oximetry probe must always be placed on the right hand (pre-ductal). Blended air/oxygen should be used to achieve targeted oxygen saturations (as per algorithm).
- Heart rate (HR): Should be determined by listening to apex beat with a stethoscope (gold standard). Feeling for umbilical pulsation is not reliable. The heart rate should be > 100 bpm within 30 seconds of birth. If the HR remains < 100 bpm, positive pressure ventilation is required. Pulse oximetry should be used in all resuscitations requiring positive pressure ventilation and a result should be displayed within 1 minute of birth. An increasing HR is the best physiological measure of effective resuscitation.
- Tone: A floppy infant may be a compromised infant.
- Colour: An uncompromised infant may take 10 minutes to look pink. Colour is generally poorly assessed and if there is a concern of ongoing cyanosis, a pulse oximeter should be attached to the right hand to establish the oxygen saturations of the newborn baby. The following table should be used to blend air /oxygen delivery based on targeted oxygen saturations.

Table showing target saturations from birth

Time from birth	Target saturations for newborn infants requiring resuscitation
1 minute	60–70%
2 minute	65–85%
3 minute	70–90%
4 minute	75–90%
5 minute	80–90%
10 minute	85–90%

Review **Appendix 2** which provides the ARC (2016) algorithm for newborn life support.

Airway management – A

Effective Airway support and mask ventilation is the key to successful neonatal resuscitation

All infants should be placed to maintain a neutral airway position (**Fig 1** – page 8).

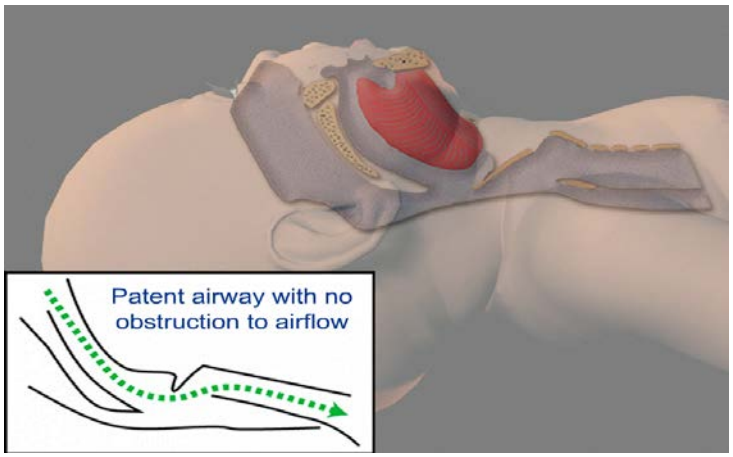

Fig 1: Neutral airway position (NRP, 2006)

Routine airway suction:
Normal newborn infants do not require routine suction. If the airway is obstructed by blood, pus, fluid or meconium this may be cleared with a large bore suction catheter (e.g. 10–12 FG). The suction should be for no more than 5 seconds and enter the oral cavity by no more than 5 centimetres. The negative suction pressure should not exceed 100 mmHg (13 kPa).

Management of meconium:

1) There is no evidence supporting suctioning of either mouth or nose before delivery of the shoulders in the event of meconium at the delivery (Vain et al, 2004) and this should NOT be performed.
2) There is insufficient published evidence to support routine suction of any newborn infant born through meconium (ANZCOR Guideline 13.4, 2016).
3) If tracheal suction is performed on non-vigorous newborn infants, it should be accomplished before spontaneous respirations or assisted ventilation has commenced and very promptly to minimise delay in establishing breathing (ANZCOR Guideline 13.4, 2016).
4) If suctioning below the vocal cords it should be performed by someone experienced in intubation and using a meconium aspirator. The intubation should NOT however delay further resuscitative efforts.
5) Suction once only as there is no evidence to support repeated intubation for endotracheal suction.

Positive pressure ventilation – B

After initial stimulation and prevention of hypothermia , if the newborn infant has absent or inadequate breathing, is gasping or has a heart rate < 100 bpm, the infant should be positioned in the neutral airway position (**Fig 1** – above) and positive pressure ventilation started. Effective ventilation is the most important part of neonatal resuscitation.

The aim of positive pressure ventilation is to move the baby's chest wall and result in an increased heart rate. The face mask should fit well and enough pressure should be delivered to move the chest wall.

Positive pressure devices include:

1. Pressure limited, flow driven t-piece devices (Neopuff)
2. Self-inflating bag and mask devices (BAG II™ Disposable Resuscitator, Laerdal)
3. Flow-inflating devices (anaesthetic bags)

To deliver positive pressure ventilation, ensure the mask covers the baby's mouth and nose but not the baby's eyes. There should be a good seal **(Fig 2** – page 8**)** and the airway should be in neutral position.

Fig 2: Mask placement in a neonate

Ventilation should be at a rate of 40–60 breaths /minute (physiological rate).

For term babies, resuscitation should commence in air but the ability to blend air/oxygen if resuscitation continues must be available (Tan A et al, 2005). If heart rate < 60 bpm or asystole is present, commence cardiac compressions with positive pressure ventilation and 100% oxygen. If resuscitation is successful, oxygen can be blended to target oxygen saturations of 80% by 5 minutes and 90% by 10 minutes

Air versus oxygen

For term infants

1. If PPV required, commence resuscitation in AIR – and apply pulse oximeter to right hand.
2. If infant heart rate < 60 bpm or asystole is present, commence chest compressions with positive pressure ventilation and 100% oxygen and consider intubation or insertion of laryngeal mask airway.
3. If heart rate good (> 100 bpm), blend oxygen to achieve target saturations of:
   - > 80% by 5 minutes; and
   - > 85–90% by 10 minutes
4. If oxygen is required during the resuscitation, begin reducing when oxygen saturations > 90%.

In all cases, the first priority is to ensure adequate inflation of the lungs, followed by increasing the concentration of inspired oxygen only if needed (ANZCOR Guideline 13.4, 2016).

For preterm infants < 36 completed weeks of gestation

1. Commence resuscitation in 30% oxygen and apply pulse oximeter to right hand, *(except for births at JHH < 29 weeks gestation enrolled in the TORPIDO 2 trial see Appendix 3).*
2. If infant heart rate < 60 bpm or asystole is present, commence chest compressions with positive pressure ventilation and 100% oxygen and consider intubation or insertion of laryngeal mask airway.
3. For those babies with a HR > 100 bpm, commence in 30% oxygen and blend oxygen to achieve target saturations:
   - > 80% by 5 minutes; and
   - > 85–90% by 10 minutes.
4. Begin reducing oxygen when saturations are > 90%.

For preterm infants (< 35 weeks) ANZCOR recommends against initiating resuscitation in high oxygen concentrations (65–100%) and recommends commencing resuscitation either in room air or up to 30% oxygen concentration. The optimal starting oxygen concentration and the most appropriate time-specific target saturations for preterm infants remain to be determined (ANZCOR Guideline line 13.8, 2016).

Oxygen saturation monitoring:

Pulse oximetry is a continuous and non-invasive method of measuring the level of arterial oxygen saturation (and heart rate) by placing a disposable sensor on the infant.

Oxygen saturations and HR to be monitored during the resuscitation using the Masimo Rad-8® monitor secured to each resuscitation trolley in Delivery Suite and Theatre. Saturation monitoring should be used in all resuscitations.

To apply sensor and use Masimo Rad-8®:

- First apply the disposable sensor to the infant on the right hand or wrist (pre-ductal).
- Switch unit on after sensor has been applied, as the oximeter then immediately interprets signals from the infant and this reduces artefact. The superior reliability and speed in data display with this method of sensor application suggest that it should be used in the Delivery Suite (O'Donnell, Kamlin, Davis & Morley, 2005).
- Once on, the monitor should be adjusted to maximum sensitivity.
- If saturations reach greater than 90% while supplemental oxygen is being administered, the oxygen concentration should be decreased (ANZCOR Guideline 3.4).
- Other monitors may not have a maximum sensitivity. These can still be used in newborn resuscitation if on the individual trolleys along with local knowledge and training.

If bag and mask ventilation is producing an inadequate response, intubation or laryngeal mask airway (> 34 week or > 2 kg infant) may be required.

Positive pressure devices

A T-piece device, a self-inflating bag (240 mL), and a flow-inflating bag are all acceptable devices to ventilate newborn infants via a face mask, laryngeal airway or endotracheal tube.

Flow-driven, pressure-limited T-piece devices (Neopuff™) are the preferred device for use during resuscitation.
Gas flows into the face mask via the inlet arm and pressure is achieved by interrupting the escape of gas. Pressure is displayed on the manometer. Positive end expiratory pressure (PEEP) is delivered continuously by adjusting the outlet valve. PEEP is used to increase lung volumes and should be set at 5–6 cmH_2O, to begin resuscitation.
To use the T-piece device (Neopuff™):

- A gas supply is ALWAYS needed and should be checked and connected to the gas inlet port. The flow for the Neopuff™ should be set at 10 L/min
- The patient circuit is connected to the gas outlet
- Set desired positive inspiratory pressure (PIP) is 30 cm H_2O for term infants and 20–25 cm H_2O for premature infants
- The maximum pressure relief valve should be set at 50 cm H_2O
- The PEEP should be set at 5–6 cm H_2O
- Ventilate at a rate of 40–60 bpm (2, 3, breath; 2, 3, breath)

Self-Inflating Bags – BAG II™ Disposable Resuscitator, Laerdal Bag
These re-expand without a gas source due to their elastic recoil. Pressure relief valve is fixed at 40 mmHg and can be overcome by occluding the valve if higher pressure is required. PEEP is not provided with this device. A reservoir bag is required to achieve 100% oxygen delivery when used to provide positive pressure ventilation. This device should not be used to provide free flow oxygen to infants. A 240 mL bag is appropriate for neonatal resuscitation.

Flow-inflating bags (anaesthetic bags)
These require a gas source and are operator-dependent and seldom used. Both PIP and PEEP can be provided by this system.

Mask ventilation technique

1. Neutral position and ensure airway is clear.
2. The face mask should be applied using a rolling motion from chin to the nasal bridge and held in place using a suitable grip that minimises leak.
3. Inflate the lungs with enough pressure to generate a normal looking breath.
4. Use a ventilating rate of 40–60 inflations a minute with an inspiration time of 0.3 to 0.5 seconds.
5. Consider two-person technique.

If the chest does not move, complete a MRSOPPI checklist:

- Mask – check position and size
- Reposition airway
- Suction
- Open mouth slightly
- Pressure – increase inspiratory pressure
- Pneumothorax – assess for air leaks, equal-sided chest movement
- Intubate or increase inspiratory time

Effectiveness of ventilation is assessed by:

1. Increase in the heart rate above 100 beats per minute
2. A slight rise of the chest and upper abdomen with each inflation
3. Oxygenation saturations improving

Endotracheal tube (ETT) intubation

A decision to perform tracheal intubation will depend on the gestation of the infant, degree of respiratory depression, response to face mask (or laryngeal mask) ventilation and the skill and experience of the resuscitator.

Tracheal intubation may need to be performed:

- If ventilation via bag and mask/T-piece device has been unsuccessful or prolonged
- In special circumstances such as congenital diaphragmatic hernia or extremely low birthweight
- For infants born without a detectable heartbeat, consideration should be given to intubation as soon as possible after birth

Although tracheal intubation is important, in inexperienced hands it is more important to get chest movement with bag and mask/T-piece ventilation or by using a laryngeal mask in larger babies, before attempting intubation.

Approximate size and length of ETT

Corrected gestation (weeks)	Weight (in gram)	Tube size (mm)	ETT marking at lip (cm)
23–24	500–600	2.5	5.5
25–26	700–800	2.5	6
27–29	900–1000	2.5/3.0	6.5
30 –32	1100–1400	3.0	7
33–34	1500–1800	3.0	7.5
35–37	1900–2400	3.5	8
38–40	2500–3100	3.5	8.5
41–43	3200–4200	3.5/4.0	9.0

To intubate neonates, a straight bladed laryngoscope should be used.
The approximate depth of insertion of ETT from the middle of the lip can be calculated as infant weight in kg + 6 cm.
Once the ETT is placed in the airway, its position should be confirmed with a Pedi-Cap® to check for CO_2, and auscultation with ETT position confirmed by chest X-ray when infant stabilised.

Intubation technique

- For resuscitation, the ETT is usually placed orally.
- The laryngoscope is held in the left hand.
- The tip of the laryngoscope blade is passed over the tongue, sweeping it out of the way. The epiglottis is visualised and gently lifted by the laryngoscope blade. The vocal cords lie behind the epiglottis.
- The ETT is held in the right hand and introduced through the visualised vocal cords. The ETT is placed so that the solid black line (vocal cord indicator) on the ETT rests at the level of the vocal cords.
- The centimetre mark at the lip is noted.

If a stylet is used to aid in the insertion of the ETT, it must NOT protrude beyond the end of the ETT.

The effectiveness of ventilation via endotracheal tube is confirmed by three observations:

- Chest moves with each inflation
- Increase in heart rate above 100 bpm
- Oxygen saturations improve

Other signs to verify the ETT is in the correct position include:

1. Visual inspection as it passes through the vocal cords
2. Colour change of Pedi-Cap® to detect expired CO_2
3. Listening to bilateral symmetrical air entry over the chest (axilla) and listening over the stomach also
4. Mist may condense on inside of the ETT

NOTE:

- The Pedi-Cap®may have false or negative reading if the infant has a very low or absent pulmonary blood flow, so if the chest wall is moving well in a depressed infant, some caution is needed to avoid unnecessary extubation and reintubation.
- False positives may occur if Pedi-Cap®is contaminated with adrenaline (epinephrine) or surfactant.
- In ELBW the Pedi-Cap®may take up to 5 breaths to change colour.

A senior colleague, Fellow or Consultant, should be called if there has been 1 failed intubation attempt during resuscitation or if cardiac compressions have continued for more than 30 seconds.

NOTE: If a baby has been intubated in theatre/delivery suite and the baby needs ongoing respiratory support, the ETT should remain in situ until the baby has safely arrived in NICU or a special care nursery.

Ventilation via the ETT

Ventilation via the ETT should result in chest movement like a normal breath. If there is excessive movement, it can predispose to volutrauma. Initial peak inspiration pressures (PIP) are likely to be 20 to 25 mmHg but may be increased if there is no chest movement and the tube has been checked to be in the correct position. Once resuscitated premature babies are moved to the NICU, and if they remain intubated, they should be placed on a ventilator to achieve tidal volumes of 4–6 mL/kg/breath (Ventilation in the Newborn 5-5. 1.4(a))

PEEP is used to increase lung volumes and decrease oxygen requirements. The PEEP should be set at 5 cm H_2O to begin resuscitation.

Laryngeal mask airways (LMA)

Use of a laryngeal mask, size 1, should be considered in babies born more than or equal to 34 weeks' gestation or more than 2 kg in weight, who require positive pressure ventilation and where a patent airway is difficult to secure. The LMA should be inserted by a skilled operator who can recognise its correct placement.

To use an LMA:

1. Test inflation of the cuff (using a syringe and 4 mL of air) – then slowly and fully deflate LMA cuff before insertion.
2. Lubricate the back and sides of the LMA with baby's saliva or water-soluble lubricant round the anterior surface of the cuff or in the bowl of the mask.
3. Holding the LMA like a pen, insert it with the open side of the cushioned mask facing (towards the tongue, away from the palate). The index finger, placed inside the bowl of the mask, is used to prevent the tip from curling and to guide the mask, sliding the back of it against the hard palate and into the pharynx until resistance is felt.
4. The tube is then held firmly and with slight downward pressure with the other hand while the index finger is removed.
5. The cuff is then inflated with 4 mL of air. The tube may rise up slightly out of the hypopharynx as the mask is inflated.
6. A resuscitation device (BAG II™ Disposable Resuscitator, Laerdel bag or Neopuff™) is then connected to the adapter.

If no chest movement is achieved, the LMA may not be in the correct position and should be removed and bag and mask ventilation should be resumed. There is no evidence to support the routine use of laryngeal masks during CPR or the administration of adrenaline (epinephrine).

LMA placement may be utilized for basic life support, therefore each HNE health site need to assess and recognise suitable staff that have completed training and are thereby qualified to site an LMA in an emergency situation when an airway cannot be successfully established by previously mentioned methods (T-piece, Bag valve and mask, or ETT.

Chest compressions combined with assisted ventilation – C

After initial assessment, drying, stimulation and 30 seconds of assisted ventilation, the HR and breathing of the baby is reassessed, along with tone and saturations:

- If the HR is > 100 bpm and the baby is breathing, then positive pressure ventilation can be stopped.
- If the HR is > 60 bpm and < 100 bpm, then positive pressure ventilation is continued for another 30 seconds and increasing pressure and oxygen should be considered.
- If the HR is < 60 bpm or asystole is present with effective positive pressure ventilation, then commence chest compressions in combination with the positive pressure ventilation and 100% oxygen and intubation or insertion of laryngeal airway.
- Chest compressions should continue until it is obvious that the heart rate is > 60 bpm.
- The heart rate should be checked by auscultation of the apex beat.

Call a senior staff member, Fellow or Neonatologist, if chest compressions need to be continued beyond 30 seconds.

Chest compressions

The preferred technique for chest compression is the 2 thumb encircling technique (**Fig 3** – page 13).
Depress the lower half of the sternum (1 finger breadth below the inter-nipple line) approximately 1/3 of the anterior – posterior (AP) diameter of the chest.

The 2 finger method (Fig 4 – page 14) may be used when there is a lone resuscitator or during insertion of umbilical catheter.

Fig 3: Two thumb encircling chest technique

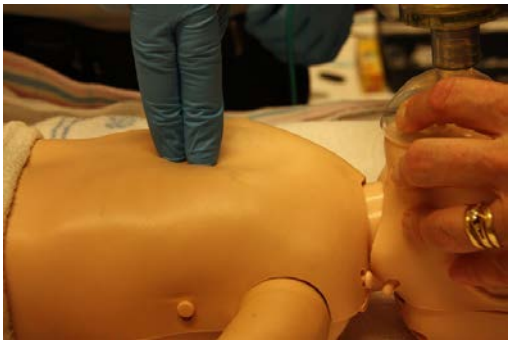

Fig 4: The 2 finger technique

Ratio of compressions to positive pressure ventilation

There should be 90 chest compressions/minute and 30 breaths/minute when performed in combination. Three compressions should be followed by a half second pause to deliver positive pressure ventilation (c-c-c-v-c-c-c-v) a total of 120 events per minute. Chest compressions and positive pressure ventilation should be coordinated to avoid simultaneous delivery of a compression and a breath.

Re-assessment

Following 30 seconds of positive pressure ventilation in conjunction with chest compressions, the baby's HR and respiratory effort is reassessed:

- If the HR remains < 60 bpm, then positive pressure ventilation and chest compressions are continued and medications are used.
- Always ensure effective airway management, positive pressure ventilation and chest compressions are being delivered before progressing to medications.
- If an ETT has been placed and a new resuscitator takes over, then reassessment of ETT position requires direct vision to ensure the ETT is through the vocal cords of the baby. At any stage that chest movement is inadequate, airway and breathing should be reassessed. ETT tubes should never be assumed to be in the trachea – they need constant vigilance.

Medications and fluids in ongoing resuscitation

Fluids are rarely used. As medications and fluids act directly on the heart, delivering them centrally, via an umbilical venous catheter (UVC) is the preferred method.

Vascular access

It is recommended that insertion of UVC should occur as soon cardiac compressions are required. New evidence suggests chest compressions without adrenaline (epinephrine) are insufficient to increase cerebral blood flow (ANZCOR guideline 13.7)

A UVC is the most rapidly accessible intravascular route for administration of adrenaline (epinephrine) and it can also be used for fluid administration.

Alternative routes may include peripheral veins or, in an emergency, the Intraosseous route (for term infants and as per local policy).

Ventilation and chest compressions must be delivered continuously during preparation to administer IV medication and/or fluids.

Insertion of UVC

This is the procedure for an emergency situation, it is not a sterile procedure, however, it should be done with the cleanest possible approach.

- A complete umbilical vessel catheterisation pack is located in the circulation drawer of Resuscitaire©
- Set-up equipment on clean drape/dressing pack and wear appropriate PPE (goggles and gloves)
- Prime the UVC line with sodium chloride 0.9% prior to insertion (see Figure 5)
- Tie the umbilical cord with cord tie (ensure not overly tight to allow passing of catheter
- Cut the umbilical cord approximately 1 cm above the base of the skin (see Figure 6A)
- Insert catheter 3 to 5 cm below the base of the skin and pull back on syringe to assess for blood flashback (see Figure 6, C & B)
- Flush line and administer adrenaline (epinephrine) (remember to continue to hold UVC in place)
- Once patient is stable, secure with tape (see Figure 6D & 7); loop UVC prior to securing with tape to act as anchor.

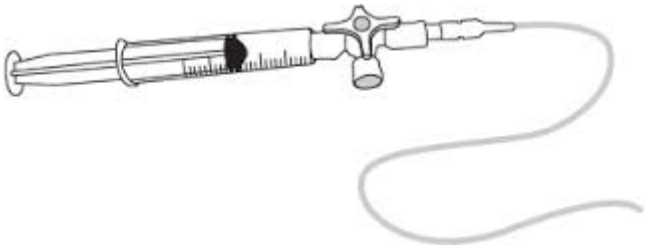

Figure 5: Primed UVC line set-up

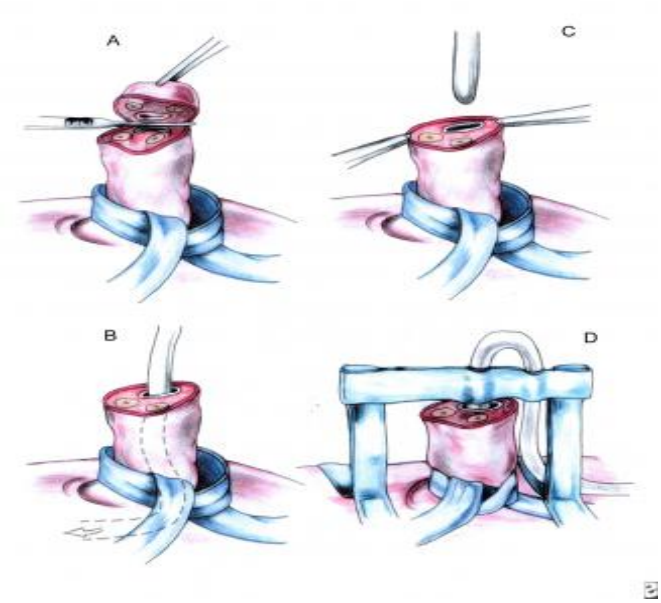

Figure 6: Umbilical venous catheter insertion and securing

Figure 7: Securing of umbilical line (Pictures from Google images)

Medications used

Adrenaline (epinephrine):
Indications: Adrenaline (epinephrine) should be used if the HR remains < 60 bpm despite effective airway management, positive pressure ventilation and cardiac compression.

Dosage: 10 to 30 microgram/kg 1 mg/10 mL (1:10,000) solution (0.1–0.3 mL/kg 1:10,000 solution) given by a quick push.

- Adrenaline (epinephrine) should be used if the HR is < 60 bpm despite effective airway management, positive pressure ventilation and cardiac compression.
- The UVC is the recommended administrative route
- The dose should be followed by a small (1 mL) sodium chloride 0.9% flush.
- This dose can be repeated every few minutes if the heart rate remains < 60 bpm despite effective ventilation and cardiac compressions.

Suggested doses of adrenaline (epinephrine) for specific gestations are listed in the resuscitation algorithm.

There is insufficient evidence for the use of ETT adrenaline (epinephrine), however if intravenous access cannot be gained quickly enough, then use of the endotracheal route is possible. Note*: A higher dose is required via this route, 50–100 micrograms/kg (i.e. 0.5–1 mL/kg of 1:10,000 adrenaline (epinephrine)) this must be followed with a 1 mL sodium chloride 0.9% flush. The efficacy and safety of these doses have not been studied. It is suggested only one dose via this route be given and then aim to gain intravenous access again for subsequent doses. (ANZCOR guideline 13.7)

Bicarbonate: Bicarbonate has not been found to be beneficial in acute resuscitation.
Refer to Drug Protocol, Newborn Service John Hunter Children's Hospital.

Naloxone: Naloxone should NOT be used as part of the initial resuscitation of newborns with respiratory depression in the delivery room. Naloxone should NEVER be given to infants of narcotic-dependent mothers.

Volume replacement during resuscitation
Intravascular fluid should be considered when there is suspected fluid loss or shock and the newborn has not responded adequately to initial resuscitative efforts. Sodium chloride 0.9% is the fluid of choice, although O-negative blood can be used in emergency blood loss situations. Initial fluid replacement should start with 10 mL/kg of sodium chloride 0.9% (normal saline) and this can be repeated. The sodium chloride 0.9% should be pushed in via the UVC.

If there is obvious acute blood loss and blood is required at JHH/JHCH, NICU staff must organise an urgent delivery from blood bank on campus to release uncrossmatched, O-negative blood as an emergency. The blood is placed in a cooler with a timer. If the blood remains unused it should be returned to the blood bank as soon as possible after the delivery.

Each facility should document their processes for accessing uncrossmatched O-negative blood if required.

After-resuscitation care and documentation

Accurate documentation is essential after all neonatal resuscitations. The Apgar scores quantifies the response to resuscitation and should be assessed at 1 and 5 minutes and then every 5 minutes until it reaches 8 or resuscitation is discontinued.

Any infant that has required resuscitation should have paired arterial and venous umbilical blood gases collected.

If there has been resuscitation of a newborn infant at birth, gross examination of the placenta should be undertaken by the specialist medical practitioners and midwives present who have knowledge of placental anatomy and pathology and an understanding of the abnormalities and variations that affect the placenta. Consideration should also be given to a histological examination (NSW Health PD2014_006 Maternity – Indications for Placental Histological Examination).

Any infant requiring extensive resuscitation should be escalated to a higher level facility and admitted to NICU/SCN, and only extubated when safely monitored. They may require ongoing observation and monitoring, including early blood gas analysis and BSL monitoring.

Any infant who has experienced a significant intrapartum event should have their neurological status assessed over the first few hours after birth. Those infants who develop signs of moderate to severe encephalopathy should have a prompt consultation with a Tertiary Centre or NETS to discuss management and arrange retrieval for admission to a NICU. Therapeutic hypothermia (cooling) for moderate to severe encephalopathy needs to commence within six hours of birth as per the care of the infant with hypoxic ischaemic encephalopathy (HIE) (see Guideline 5. 8. 9 Moderate systemic hypothermia for the treatment of neonatal hypoxic ischaemic encephalopathy (HIE)).

There are many people involved in a newborn resuscitation and adequate debriefing should be made available for staff and families involved.

Discontinuing of cardiopulmonary resuscitation

In a newly-born, late-preterm and term baby, ANZCOR suggests that it is reasonable to stop resuscitation if the heart rate is undetectable and remains so for 10 minutes, because both survival and quality of survival deteriorate precipitously by this time. However, the decision to continue resuscitation efforts beyond 10 minutes when there is no heart rate, or a very low heart rate, is often complex and may be influenced by issues such as whether the resuscitation was considered optimal, availability of advanced neonatal intensive care (including therapeutic hypothermia), presumed aetiology and timing of the arrest, the gestation of the baby, specific circumstances prior to delivery (e.g. known timing of insult) and wishes expressed by parents (CoSTR 2015, weak recommendation, very low quality evidence) (ANCOR, 2016 Guideline 13.10).

The absence of spontaneous breathing or an Apgar score of 1–3 at 20 minutes of age in babies > 34 weeks but with a detectable heart rate are strong predictors of mortality or significant morbidity. In resource-limited settings, such as areas remote from neonatal intensive care, it may be reasonable to stop assisted ventilation in babies who meet one or more of these criteria (CoSTR 2015, weak recommendation, very low quality evidence). Consultation with a neonatologist or NETS is recommended, if possible.

In non-tertiary units in HNELHD, contact NETS. Call: 1300 36 2500 and follow the prompts

At JHH and JHCH, call NICU and request assistance from Consultant or Fellow #23171

If it is decided to withdraw or withhold resuscitation, care should be provided in a way that is focused on the baby's comfort (if signs of life are present) and dignity, and support of the parents.

IMPLEMENTATION PLAN

1. Awareness of this Policy Compliance Procedure will be promoted through the CE Newsletter.
2. The Policy Compliance Procedure will be communicated via email to Facility Directors of Nursing & Midwifery Managers and is to be tabled at the relevant Clinical Quality Committee and ward meetings at each Maternity facility.
3. The new and revised Clinical Practice Guidelines, Policy Directives and PCPs are posted on the Policy, Procedure and Guideline Directory.

EVALUATION PLAN

1. Clinical incident investigations concerning clinical practice with regard to Infant Resuscitation will include a review of this Policy Compliance Procedure and amended as warranted in line with the recommendations.
2. The person or leadership team who has approved the Policy Compliance Procedure is responsible for ensuring timely and effective review to ensure contemporary and best practice care.
3. Evaluation will include a review of the most current evidence as well as a consideration of the experience of HNE Health staff in the implementation of the Policy Compliance Procedure.

CONSULTATION WITH KEY STAKEHOLDERS

2016 Review

Updated by: Denise Kinross, CNC Newborn Services
Jo-Ann Davis, Acting CNC Newborn Services

Reviewed by: Dr Paul Craven, Director of Newborn Services
Dr Koert DeWaal, Neonatologist, NICU, JHCH
Dr Javeed Travadi, Neonatologist, NICU, JHCH
Viv Whitehead, CNE, NICU, JHCH
Trish Davidson - Executive Director, Children Young People and Families Services
HNE LHD Maternity and Newborn Services Steering Committee
WHAM Policy and Guidelines Committee

Approved by:

- NICU Committee on 17th September
- Children Young People and Families Network on 23rd September 2016
- District Quality Use of Medicines Committee on 9 August 2016
- HNE LHD Maternity and Newborn Services Steering Committee
- WHAM Policy and Guidelines Committee

2012 Consultation

DEVELOPED BY: Dr Paul Craven, Neonatologist

REVIEWED BY: NICU Executive Group
HNE LHD Maternity and Newborn Services
HNE General Paediatricians
Dr Chris Wake, Director of Newborn Services Children's Young People's & Families' Services
Melissa Harvey, GNAH Accreditation/Policy & Guideline Coordinator

APPROVED BY: NICU Executive Management Committee 26/6/12
AQUMC 19th June 2012

APPENDICES:

APPENDIX 1: Oxygen/air mix (in the absence of a blender)

APPENDIX 2: Flow diagram of neonatal resuscitation procedure

APPENDIX 3: TO2RPIDO 2 Study for NICU JHCH & Delivery Suite JHH only

REFERENCES:

1. Australian & New Zealand Committee on Resuscitation (ANZCOR) Newborn Resuscitation Guidelines (2016) 13.1–13.10
2. AAP (2006) Neonatal Resuscitation Program (NRP) 5th Edition.
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APPENDIX 1:

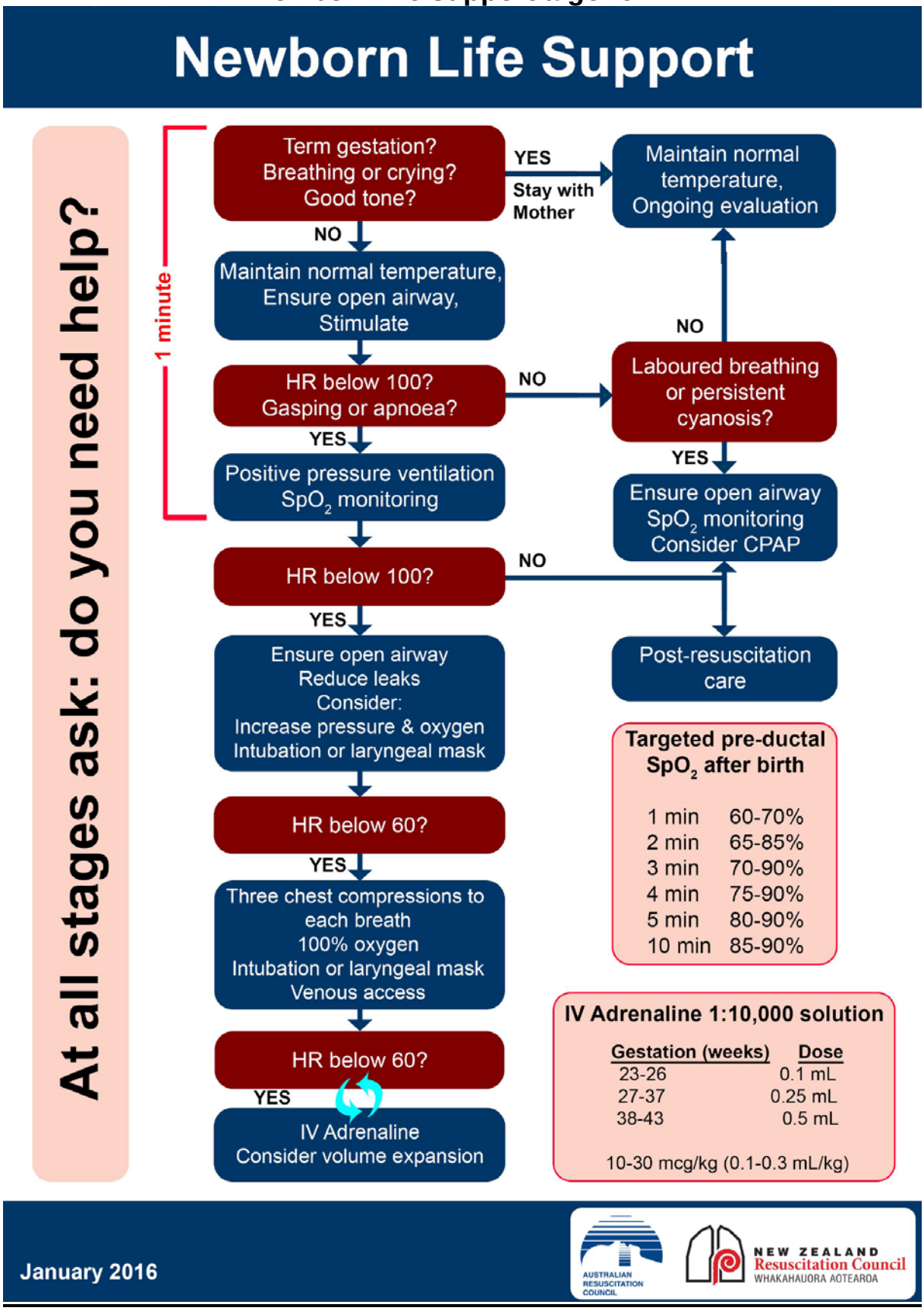
Oxygen/air mix (in the absence of a blender)

Oxygen percentage	Oxygen flow (L/min)	Air flow (L/min)
21%	0	10
30%	1	9
40%	2	8
50%	4	6
60%	5	5
70%	6	4
80%	7.5	2.5
90%	9	1

Reference: NeoResus - The Victorian Newborn Resuscitation Project 2011

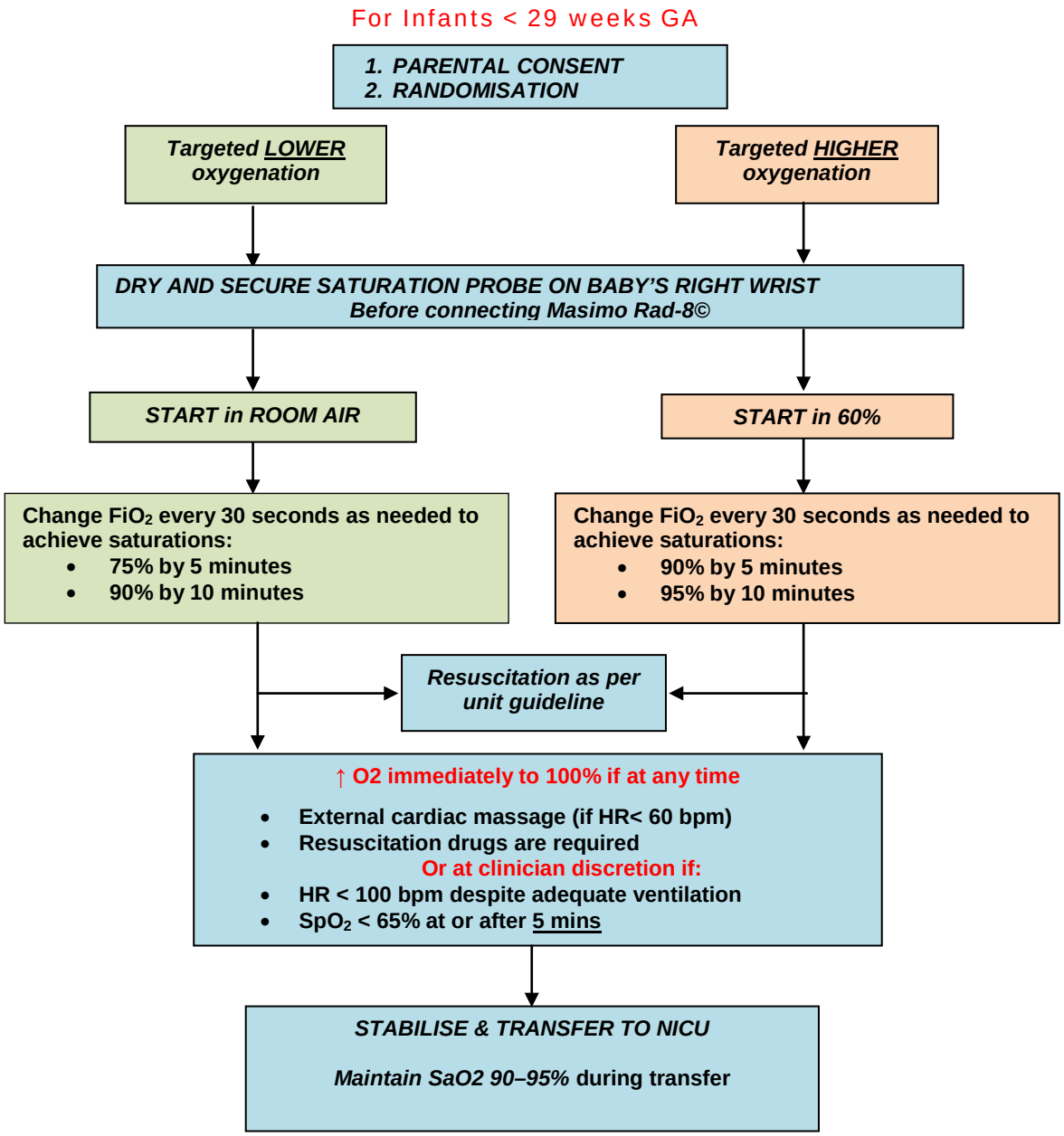
APPENDIX 2:

Newborn life support algorithm



APPENDIX 3: For NICU/Delivery Suite JHH ONLY

FLOW CHART FOR TO2RPIDO-2 STUDY



For neonates NOT in the TO2RPIDO study
follow neonatal resuscitation guidelines as documented