neoResus

The Victorian Newborn Resuscitation Project

First Response & Advanced Resuscitation

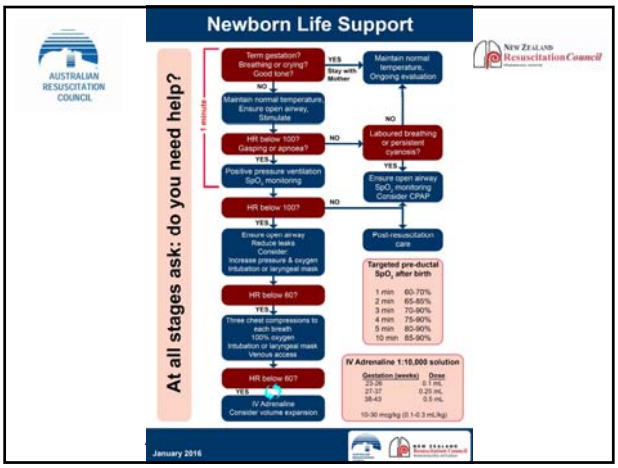
Learning Modules 2 and 3

Based on ILCOR and ANZCOR 2016

Learning objectives

Following completion of the theoretical & practical components of this module, the participant will be able to demonstrate their ability to:

- Assess a newborn infant's transition to extra-uterine life & determine the need for resuscitation.
- Initiate **First Response** interventions including face mask ventilation and external chest compressions.
- Initiate **Advanced Resuscitation** interventions including intubation, insertion of a laryngeal mask airway, establishing umbilical venous access and administration of adrenaline and volume expanders.



Transition to extra-uterine life

- Very few newborns require “resuscitation”
- Most will respond to simple interventions
- First Response interventions are therefore most important & time critical

Resuscitation at birth in Australia in 2015†	
Suction or oxygen therapy	7.8%
Positive pressure ventilation through mask	7%
Intubation & positive pressure ventilation	0.6%
Cardiac compressions & positive pressure ventilation	0.3%
No intervention (other than drying and stimulation)	**81%**

† Australian Institute of Health and Welfare 2017[1]

Preparation for resuscitation

- Anticipation of need
  - Based on risk assessment
- Equipment
  - Checked and ready for use
- Environment
  - Warm and clean
- Skilled personnel
  - Able to form a team, nominate leadership and develop a plan of action

Cord clamping & cord milking

- ILCOR and the ANZCOR *suggest:*
- Delayed cord clamping for 30-60 seconds if:
  - Uncomplicated term or preterm birth, **and**
  - Not requiring immediate resuscitation
- For compromised newborns:
  - Insufficient evidence for optimal timing of cord clamping in term and preterm depressed newborns
- Insufficient evidence of benefit of cord milking, especially if <28 weeks. Not recommended.

Monitoring

- Pulse oximetry is recommended:
  - When the need for resuscitation is anticipated
  - When CPAP or positive pressure is used
  - When persistent cyanosis is suspected
  - When supplemental oxygen is used
  - Place the oximeter sensor on the right wrist or hand (pre-ductal oxygen saturation)
- ECG monitoring:
  - May be used as an adjunct to auscultation and pulse oximetry (if readily available)

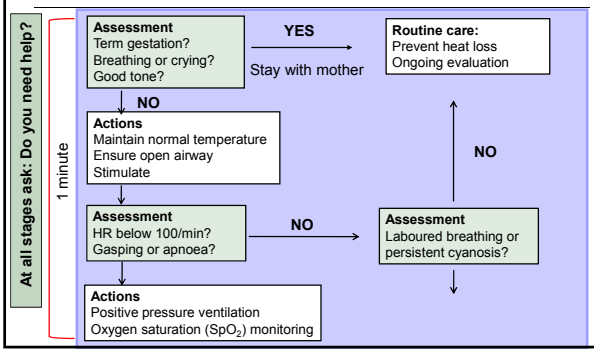
Pre-ductal pulse oximetry (SpO_2)

- Place oximeter sensor on the right hand or wrist
- Measure of arterial oxygen saturation in vessels originating from the aorta before mixing with pulmonary blood at the level of the ductus arteriosus

Strategies to maintain normal core temperature: 36.5 - 37.5^{0}C

- Very preterm newborns (<32 weeks):
  - Place (wet & warm) into a polyethylene bag or under a polyethylene sheet
  - Radiant warmer
- Additional measures (alone or in combination):
  - Covering the head (except the face) with a hat/bedding
  - Ambient room temperature 23 - 26^{o}C
  - Exothermic warming mattress

A: Assess and Airway



If meconium liquor is present

- Clear the oro-pharynx if obvious meconium

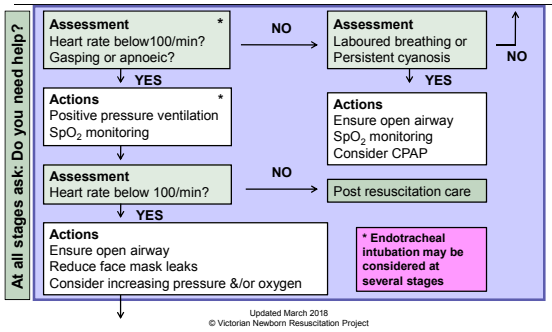
If the newborn is vigorous:

- Endotracheal suctioning is discouraged because it does not alter outcome and may cause harm

If the newborn is not vigorous:

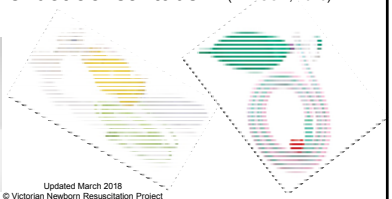
- No evidence of the value of routine or repeated endotracheal suctioning to prevent meconium aspiration
- Likely to cause further delays in resuscitation
- Tracheal intubation for suctioning should only be performed for suspected tracheal obstruction.

B: Breathing



Manual ventilation devices

"A T-piece device, a self inflating bag and a flow inflating bag are all acceptable devices to ventilate newborn infants either via a face mask, laryngeal mask or endotracheal tube". (ANZCOR, 2016)



PEEP during resuscitation

- Without PEEP:
  - Lung aeration is not achieved as quickly
  - Functional residual capacity (FRC) is not established
- With PEEP:
  - FRC is established and maintained
  - Oxygenation is improved
- ANZCOR (2016) recommend:
  - PEEP of 5 - 8 cm H_2O during resuscitation of newborn infants if appropriate equipment available

Initial settings: T-piece device

- Gas flow
  - Set at 10 L/min (8 L/min if using cylinders)
- Maximum pressure relief valve
  - Set at 50 cm H_2O
- Peak inspiratory pressure (PIP)
  - Set at 30 cm H_2O (term newborn)
  - Set at 20 - 25 cm H_2O (preterm <32 weeks)
- Positive end expiratory pressure (PEEP)
  - Set at 5 - 8 cm H_2O

Summary of settings by gestation

Initial settings	Term	<35 weeks	<32 weeks
PIP cmH_2O	30	30	20-25
PEEP cmH_2O	5-8	5-8	5-8
Air/oxygen	21%	21-30%†	21-30%†
		Avoid high O_2 initially (65%-100%)	

† Use room air if air/oxygen blend not available

Oxygen use in resuscitation

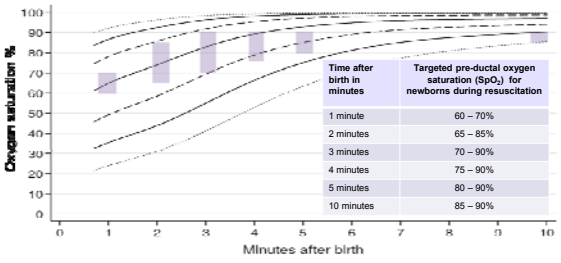
- **All newborns**
  - Oxygen should be used judiciously, guided by SpO_2
  - Introduce supplemental oxygen if lower end of target saturations are not met, despite respiratory support
  - Avoid hyperoxaemia
  - Avoid hypoxaemia
- **If external chest compressions are required:**
  - Increase oxygen concentration to 100%
  - Oxygen concentration should be weaned as soon as the heart rate has recovered and target saturations are being met.

Target saturations for newborn infants during resuscitation

Time after birth in minutes	Targeted pre-ductal oxygen saturations for newborn infants during resuscitation
1 minute	60 – 70%
2 minutes	65 – 85%
3 minutes	70 – 90%
4 minutes	75 – 90%
5 minutes	80 – 90%
10 minutes	85 – 90%

ANZCOR[2], 2016, Guideline 13.4

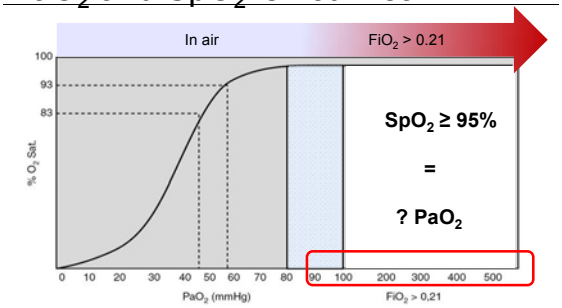
Centile charts with targeted pre-ductal SpO_2 in the first 10 mins



Time after birth in minutes	Targeted pre-ductal oxygen saturation (SpO_2) for newborns during resuscitation
1 minute	60 – 70%
2 minutes	65 – 85%
3 minutes	70 – 90%
4 minutes	75 – 90%
5 minutes	80 – 90%
10 minutes	85 – 90%

Adapted from Dawson *et al*., 2010 and ANZCOR, 2016

N.B The relationship between PaO_2 and SpO_2 is not linear



Adapted from: Sola, Chow & Rogido, 2005, *An Pediatr 62(3): 266-281*

Positive pressure ventilation

Optimal positive pressure ventilation requires:

1. An appropriate sized face mask
2. A good seal between the mask and the face to minimise leak

The 'two-point top hold' is one method shown to reduce mask leak when using the Laerdal™ round mask[4]

Ventilation rate and pressure

- Rate: 40 - 60 inflations per minute
- Peak inflating pressure (PIP):
  - Variable and should be individualised
  - Effective ventilation may be achieved with progressively lower pressures and rates
- Avoid hyperventilation (excessive PIP &/or rate)
  - Can lead to dangerously low CO_2 levels (<30 mmHg)
  - Can depress respiratory drive
  - Can reduce cerebral blood flow

Assessing the effectiveness of positive pressure ventilation

- Re-assess the heart rate every 30 seconds
- The effectiveness of ventilation is confirmed by:
  1. An increase in the heart rate above 100/min.
  2. A slight rise and fall of the chest and upper abdomen with each inflation.
  3. An improvement in oxygenation (assessed by pulse oximetry).

If the heart rate is not improving with positive pressure ventilation

- Check the ventilation technique
  - Is there a face mask leak?
  - Is the airway patent?
- Increase the peak inflating pressure
  - Increase the PIP in 5 cmH_2O increments: 30→ 35→ 40→ 45→ 50^+ cm H_2O if necessary
- Increase oxygen according to SpO_2 targets
  - Increase to 100% if the heart rate is <60/min

C:Circulation

At all stages ask: Do you need help?

Assessment
Heart rate below 60/min?

↓ **YES**

Actions *
Three chest compressions to each breath
100% oxygen+
Intubation or laryngeal mask
Venous access

↓ **YES**

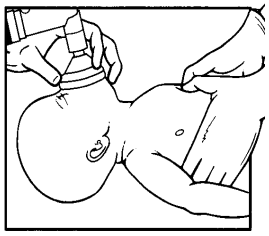
Assessment
Heart rate below 60/min?

↓ **YES**

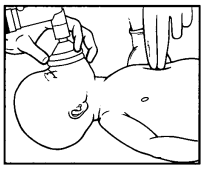
*** Endotracheal intubation should be considered**

+ Ensure the O_2 has been increased to 100% if the heart rate is <60/min

Techniques for ECC in newborns



Hand encircling, two thumb
(recommended technique)



Two finger technique
(only if single operator)

Consider endotracheal intubation at any time, if expertise is available

Estimated endotracheal size internal diameter can also be calculated as gestation age in weeks divided by 10

Estimated depth of insertion
"Rule of 6"
Birth weight in kg + 6cm

Endotracheal size & depth of insertion (oral tube)

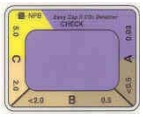
Corrected gestation (Weeks)	ETT size (Guide: GA ÷ 10)	Actual weight (kg)	ETT mark at the lip (cm)
23 – 24		0.5 – 0.6	5.5
25 – 26	2.5 mm	0.7 – 0.8	6.0
27 – 29		0.9 – 1.0	6.5
30 – 32	3.0 mm	1.1 – 1.4	7.0
33 – 34		1.5 – 1.8	7.5
35 – 37		1.9 – 2.4	8.0
38 – 40	3.5 mm	2.5 – 3.1	8.5
41 - 43		3.2 – 4.2	9.0

Confirming tracheal intubation

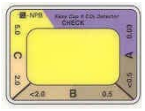
- An exhaled CO_2 detector is a reliable method to confirm endotracheal tube placement in neonates who have spontaneous circulation
- False positive/negative results may occur if:
  - Insufficient inflations (tidal volume) delivered
  - There is very low or absent pulmonary blood flow
  - Contaminated with adrenaline or surfactant
- Do not re-intubate unnecessarily.

Verify ETT position with an exhaled CO_2 detector (e.g. Pedi-Cap™)

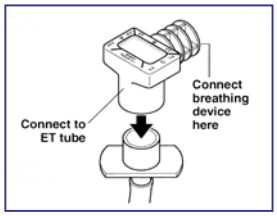
Give 6 positive pressure inflations, then interpret



INSPIRATION



EXPIRATION



"GOLD IS GOOD"

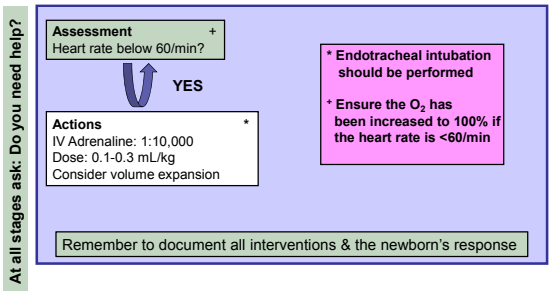
Laryngeal mask airway (LMA)

Consider if:

- Face mask ventilation is unsuccessful
- Tracheal intubation is unsuccessful or not feasible
- Term or near term infant

Size 1 LMA suitable for infants ≥ 34 weeks, >2000g

D:Drugs



Adrenaline

Adrenaline 1:10,000 solution	
Route	**Dose**
Umbilical vein Peripheral IV Intraosseous	0.1- 0.3 mL/kg (10 - 30 mcg/kg)
Endotracheal tube (ETT)	0.5 - 1.0 mL/kg (50 - 100 mcg/kg)

- Use 1:10,000
- Intravenous route recommended - will require venous access (insertion of an umbilical venous catheter, peripheral intravenous cannula or intraosseous needle)

Medications: Adrenaline

- Adrenaline should be given intravenously
  - Dose can be repeated every few minutes if the heart rate remains <60/min despite effective IPPV & ECC
- Intraosseous adrenaline
  - Should be considered if delay/difficulty in obtaining IV/UV access
- Endotracheal adrenaline
  - May be considered if delay in obtaining IV/IO access
  - If endotracheal route is used, up to ten times the IV/IO dose can be given

Medications: Volume expanders

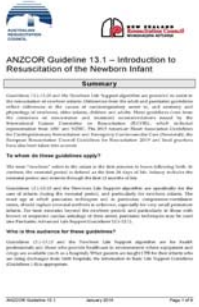
- Intravascular fluids should be considered:
  - If fetal blood loss is suspected and/or
  - The newborn appears to be in shock (pale, poor perfusion, weak pulses)
  - The newborn has not responded to other resuscitation measures (especially if the HR is not improving)
- Normal saline should be used initially, ***but:***
- O-negative red blood cell replacement is the priority in the setting of massive blood loss or suspected blood loss.
- Dose: 10 mL/kg, IV over several minutes. May need to be repeated.

For more information on:

- Intubation
- Use of an exhaled CO_2 detector
- Use of a laryngeal mask airway (LMA)
- Intravenous, umbilical and intraosseous access
- Medications
- Discontinuation &/or withdrawal of resuscitation
- Resuscitation in special circumstances
- Post resuscitation care and stabilisation

- See the "Learning Resources" section of the NeoResus web site at http://www.neoresus.org.au

Australian & New Zealand Committee on Resuscitation (ANZCOR)


ANZCOR Guideline 13.1 – Introduction to Resuscitation of the Newborn Infant

Summary

Section 13.1 – 13.10
Neonatal Guidelines
Published January 2016

Available for download at
www.resus.org.au

Key references

1. Australian Institute of Health and Welfare 2017. *Australia's mothers and babies 2015- in brief.* Perinatal statistics series no.33. Cat no. PER 91. Canberra: AIHW.
2. Australian & New Zealand Resuscitation Councils. (2016). Section 13: Neonatal Guidelines. Accessed 24 February 2018 from: http://www.resus.org.au
3. Perlman JM, Kattwinkel J, Wyckoff *et al.* Part 7: Neonatal Resuscitation 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. *Circulation,* 2015; 132 (Supp 1): S204-S241.
4. Wood, FE, Morley, CJ, Dawson JA *et al.* (2008). Improved techniques reduce face mask leak during simulated neonatal resuscitation: Study 2. *Arch Disease Child, Fetal Neonatal Ed*; 93:F230-234.

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