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The Victorian Newborn Resuscitation Project

First Response & Advanced Resuscitation

Learning Modules 2 and 3

Based on ILCOR and ANZCOR 2016

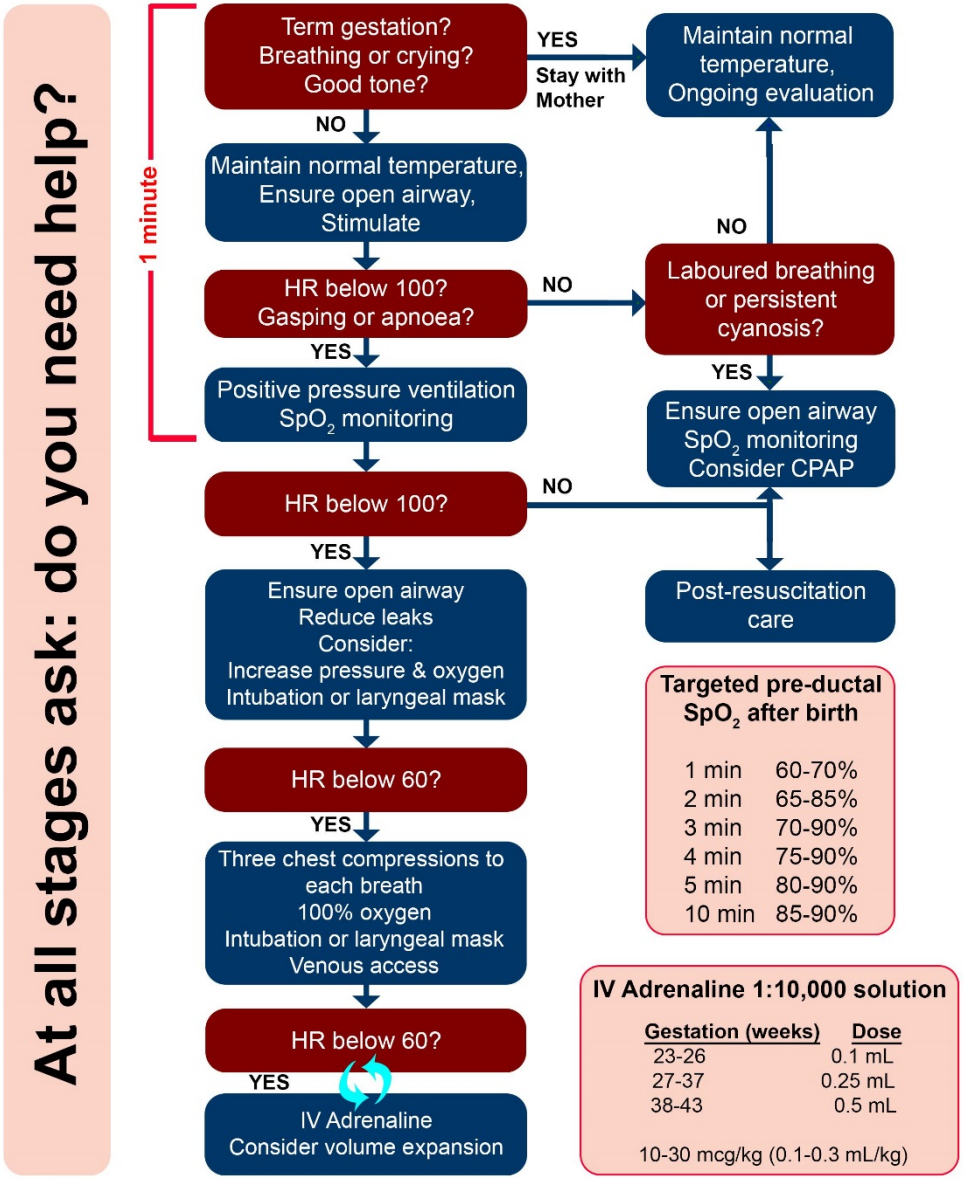
Updated February 2016

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.

Newborn Life Support



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%

IV Adrenaline 1:10,000 solution

Gestation (weeks)	Dose
23-26	0.1 mL
27-37	0.25 mL
38-43	0.5 mL

10-30 mcg/kg (0.1-0.3 mL/kg)

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: 2012	
Suctioning	5%
Oxygen therapy	5%
Positive pressure ventilation	5%
Intubation & positive pressure ventilation	1%
Cardiac compressions & positive pressure ventilation	0.3%

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.

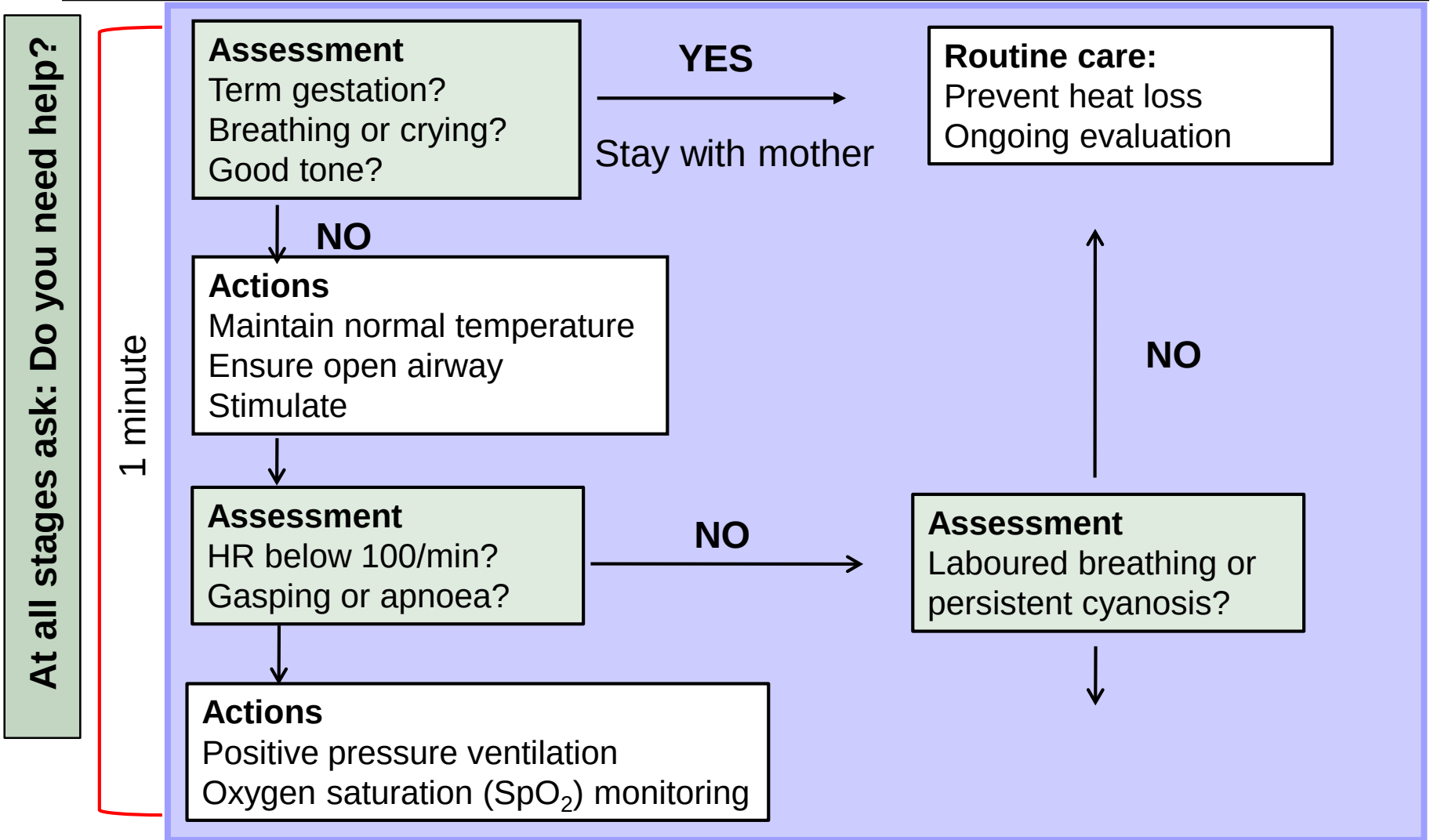
Monitoring

- 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)

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

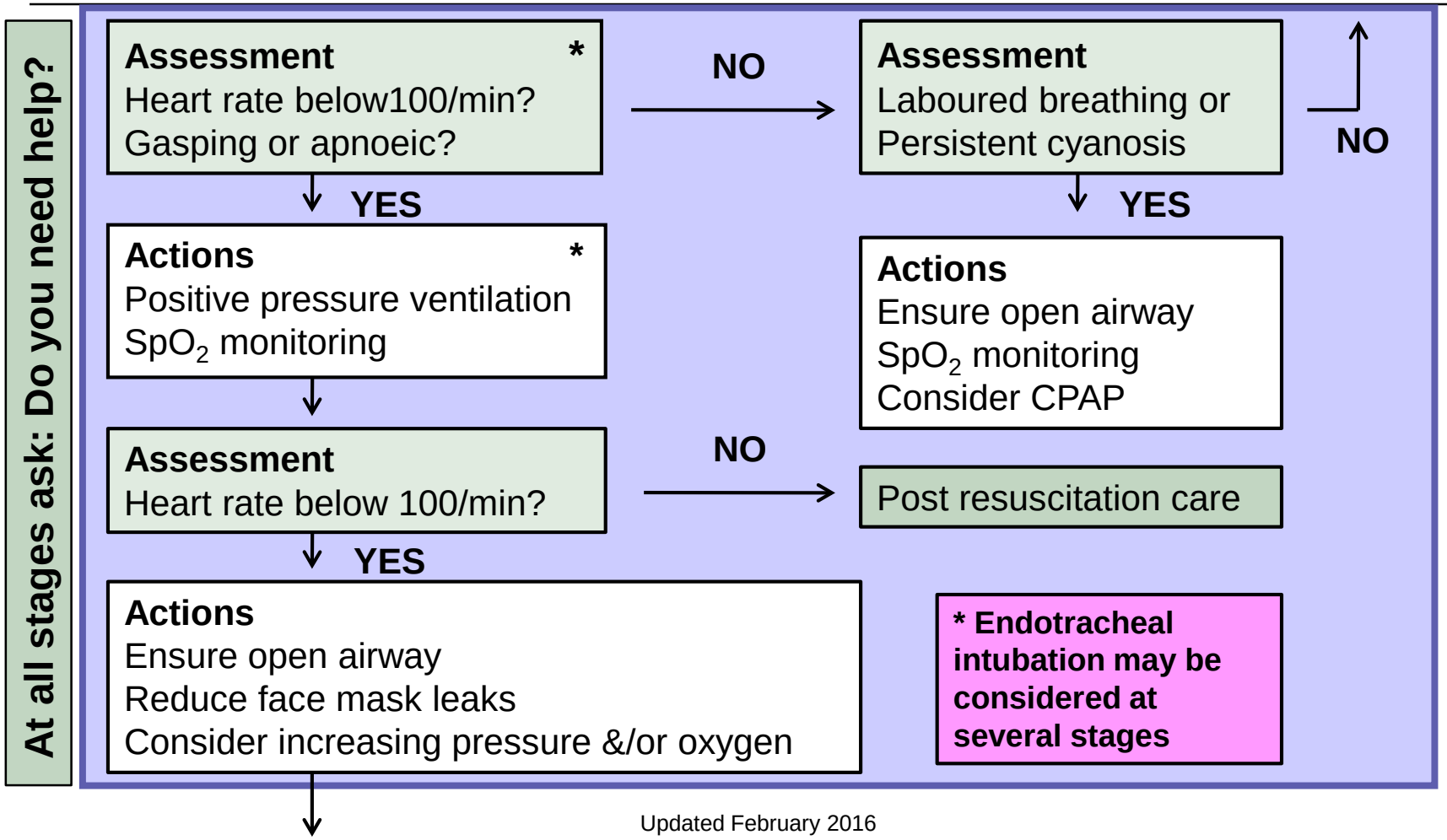
If the newborn is vigorous:

- 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



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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)

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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

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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

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Oxygen use in resuscitation

- **Term and near term newborns**
  - Use room air (21%) initially.
  - Introduce supplemental oxygen if lower end of target saturations are not met, despite respiratory support
- **Preterm newborns <35 weeks' gestation**
  - Use room air (21%) ***or***
  - Blended air and oxygen (up to 30%) to start
  - Avoid initiating resuscitation with high supplementary oxygen concentrations (65-100%)
  - If a blend of air and oxygen is not available, use air

Oxygen use in resuscitation

- **All newborns**
  - Oxygen should be used judiciously, guided by pulse oximetry
  - Avoid hyperoxaemia
  - Avoid hypoxaemia

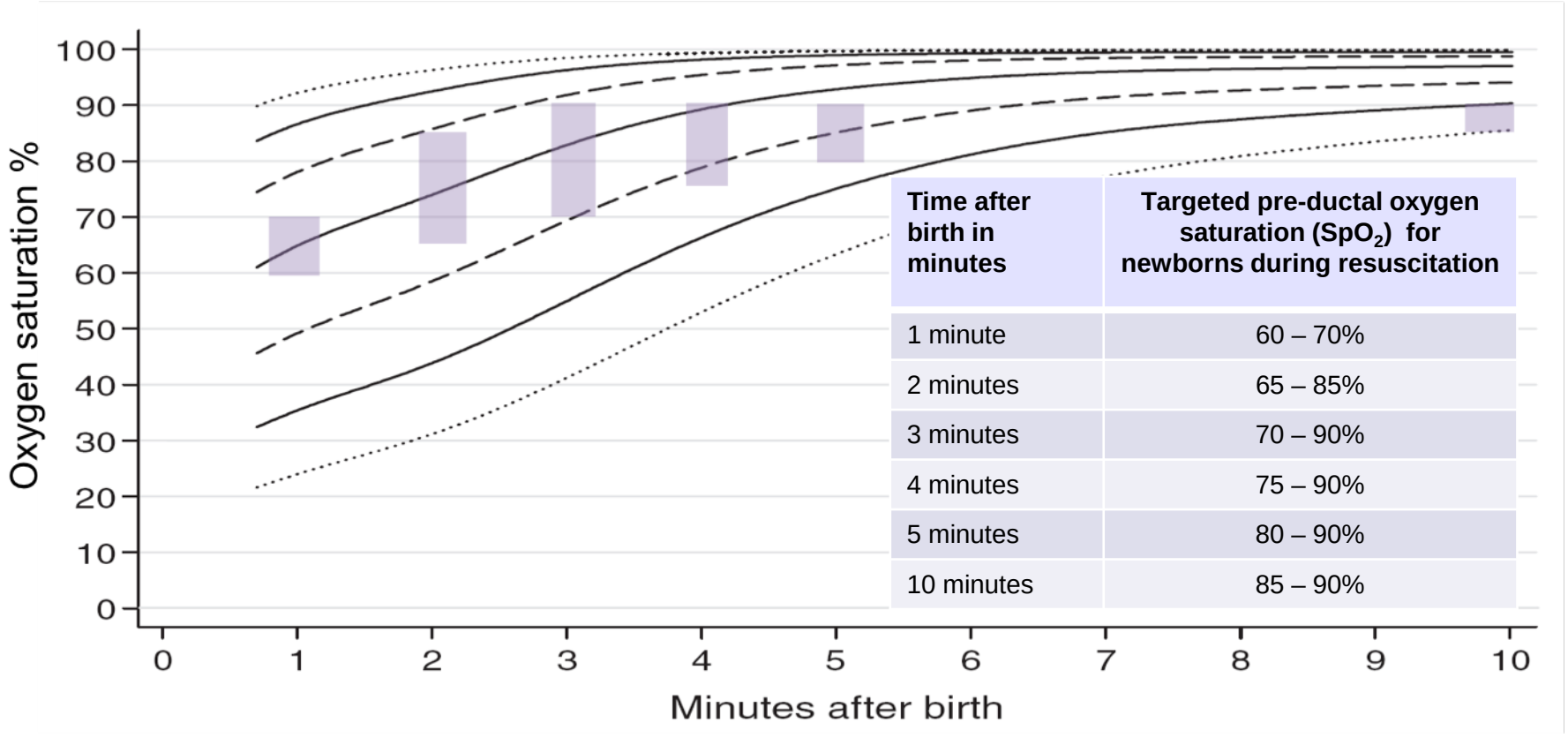
- **If external chest compressions are required:**
  - Increase oxygen concentration to 100%
  - Oxygen concentration should be weaned as soon as the heart rate has recovered and target saturations are being met.

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

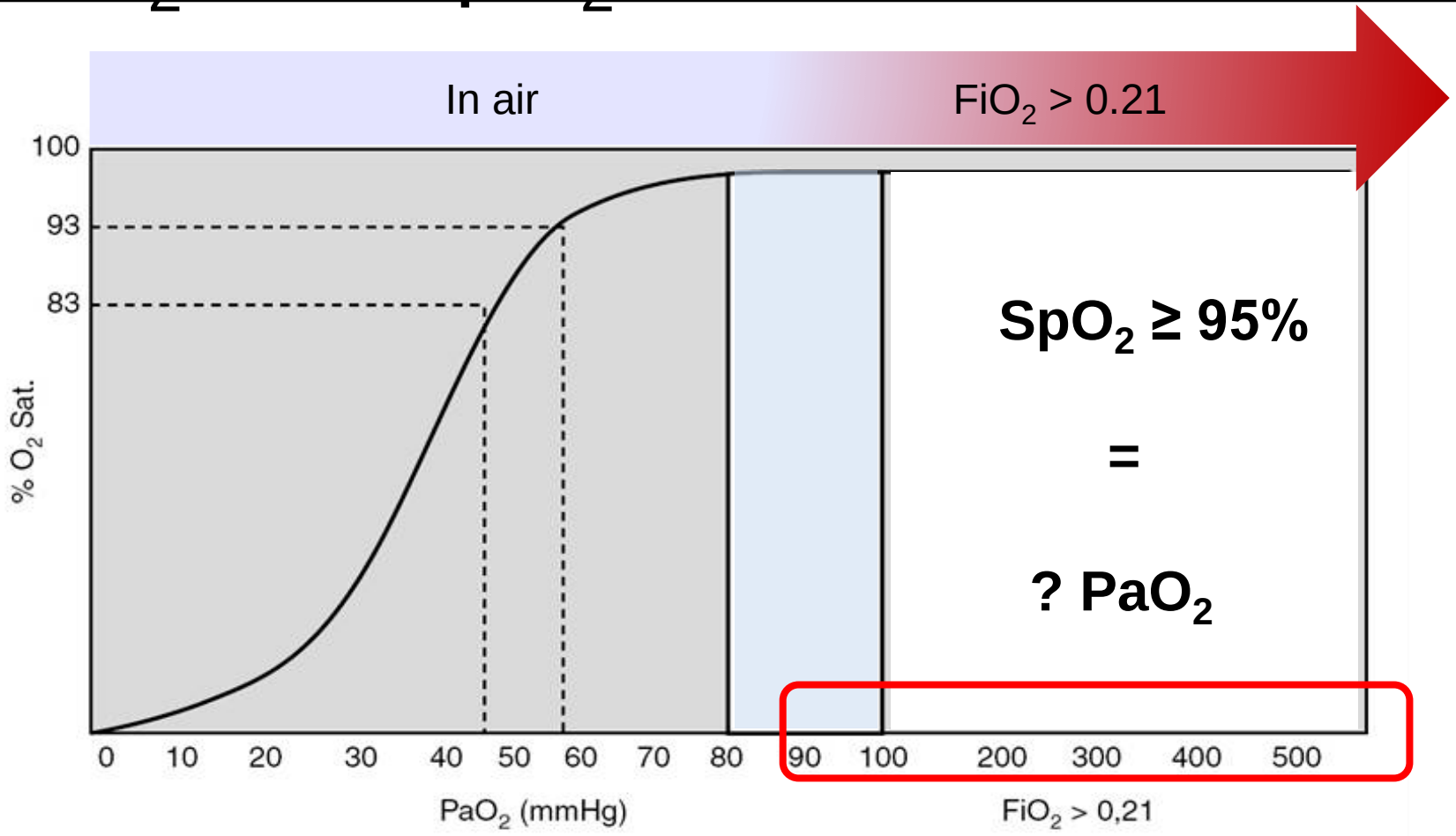
Centile charts with targeted pre-ductal SpO_2 in the first 10 mins



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)

Re-assess the heart rate every 30 seconds.

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

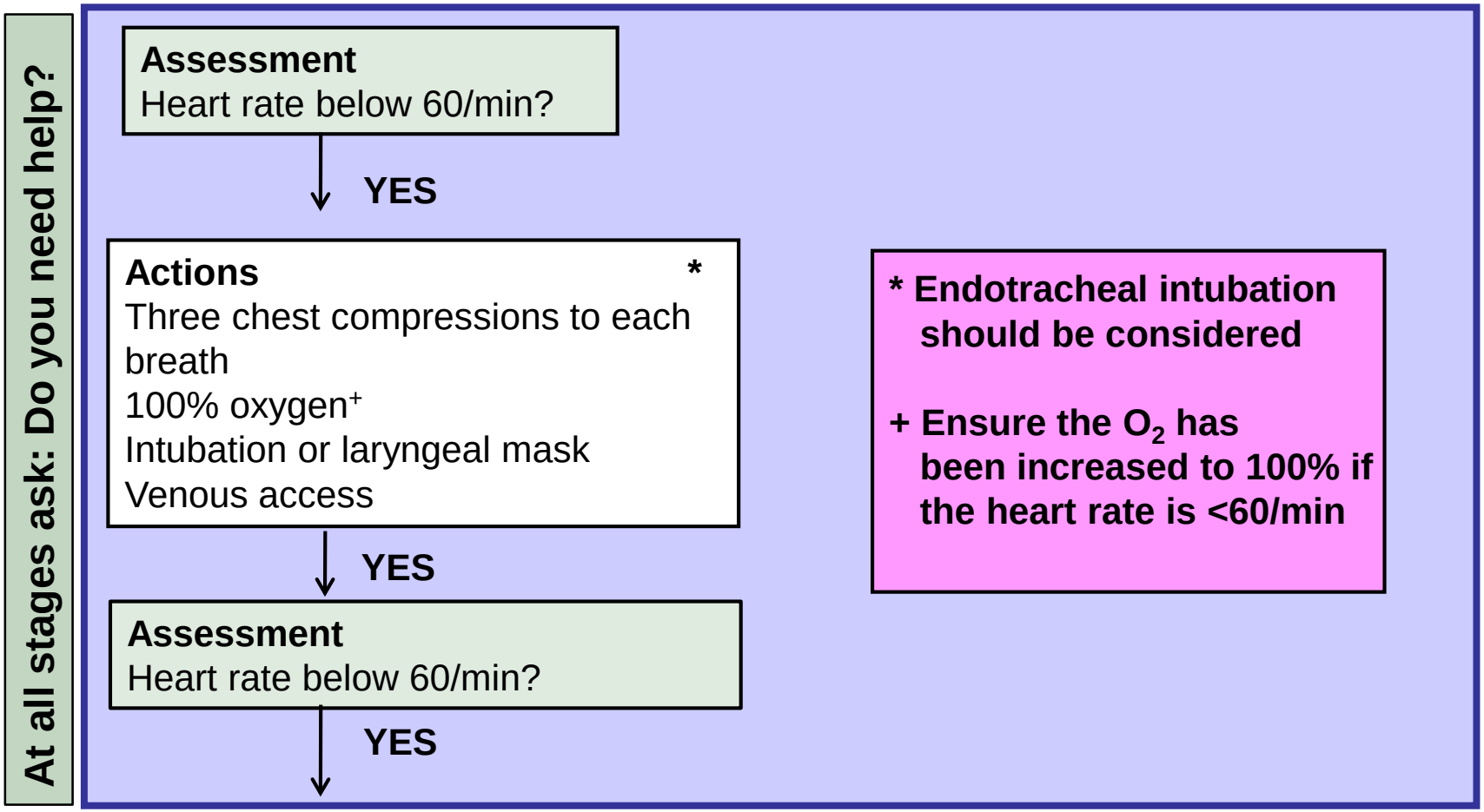
Assessing the effectiveness of positive pressure ventilation

- 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 cm 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



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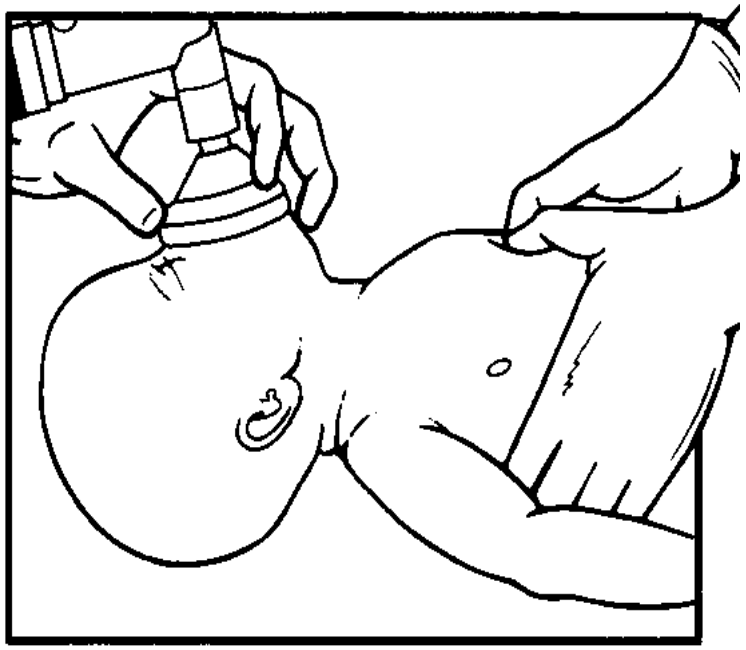
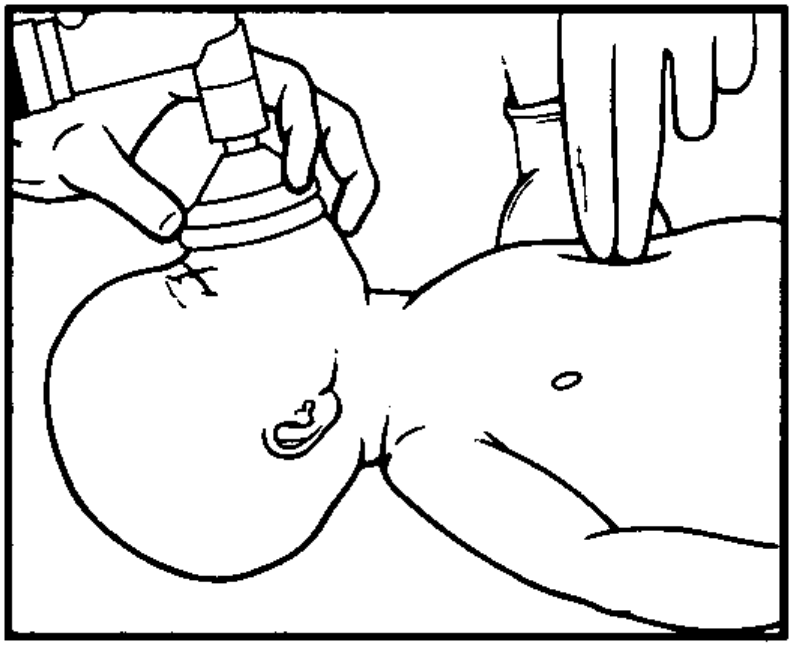
Techniques for ECC in newborns



Hand encircling, two thumb technique (preferred technique)



Two finger technique

Consider endotracheal intubation at any time, if expertise is available

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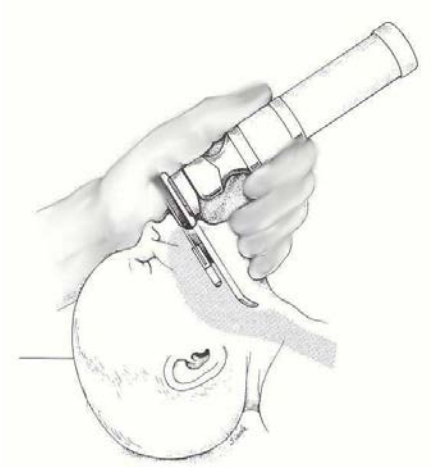
Select an appropriate size endotracheal tube according to estimated birth weight

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



Endotracheal size and depth of insertion

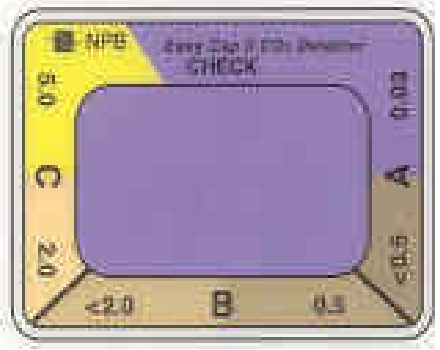
Corrected gestation (Weeks)	ETT size (Guide: GA ÷ 10)	Actual weight (kg)	ETT mark at the lip (cm)
23 – 24		0.5 – 0.6	5.5
25 – 26	2.5 mm	0.7 – 0.8	6.0
27 – 29		0.9 – 1.0	6.5
30 – 32	3.0 mm	1.1 – 1.4	7.0
33 – 34		1.5 – 1.8	7.5
35 – 37		1.9 – 2.4	8.0
38 – 40	3.5 mm	2.5 – 3.1	8.5
41 - 43		3.2 – 4.2	9.0

Confirming tracheal intubation

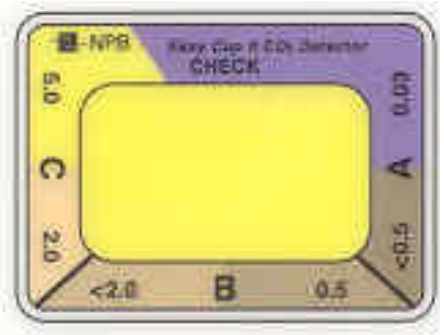
- An exhaled CO_2 detector is a reliable method to confirm endotracheal tube placement in neonates who have spontaneous circulation
- False positive/negative results may occur if:
  - Insufficient inflations (tidal volume) delivered
  - There is very low or absent pulmonary blood flow
  - Contaminated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

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

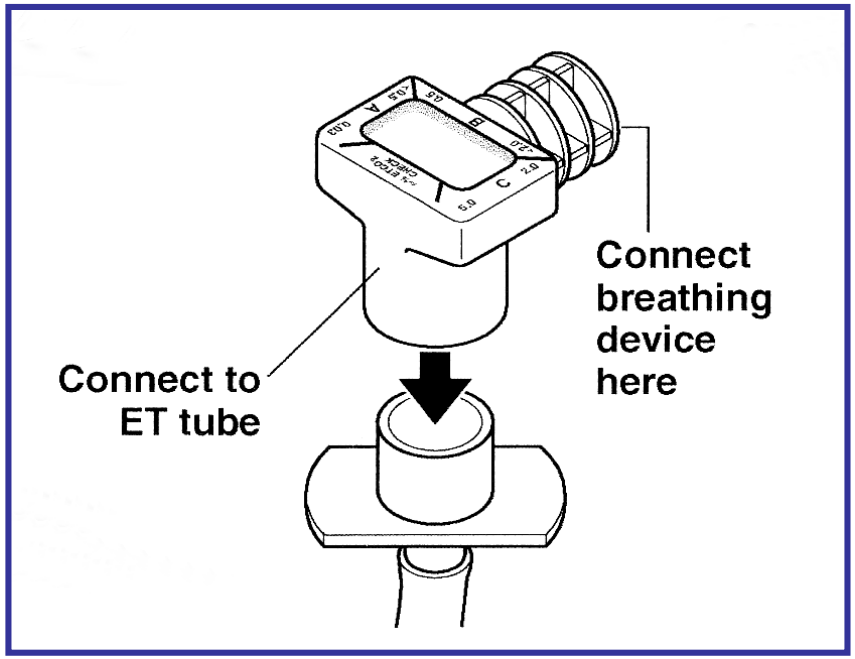
Give 6 positive pressure inflations, then interpret



INSPIRATION



EXPIRATION



"GOLD IS GOOD"

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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

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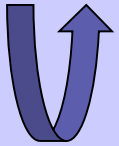
D:Drugs

At all stages ask: Do you need help?

Assessment +
Heart rate below 60/min?



YES

Actions *
IV Adrenaline: 1:10,000
Dose: 0.1-0.3 mL/kg
Consider volume expansion

*** Endotracheal intubation should be performed**

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

Remember to document all interventions & the newborn's response

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
  - Volume expanders should also be considered
- Endotracheal adrenaline:
  - Insufficient evidence for safety and efficacy
  - Likely a higher dose will be required to achieve similar blood levels and effect
  - If endotracheal route is used, dose is 0.5-1.0 mL/kg (50-100 mcg/kg) of 1:10,000 solution

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 mins. 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

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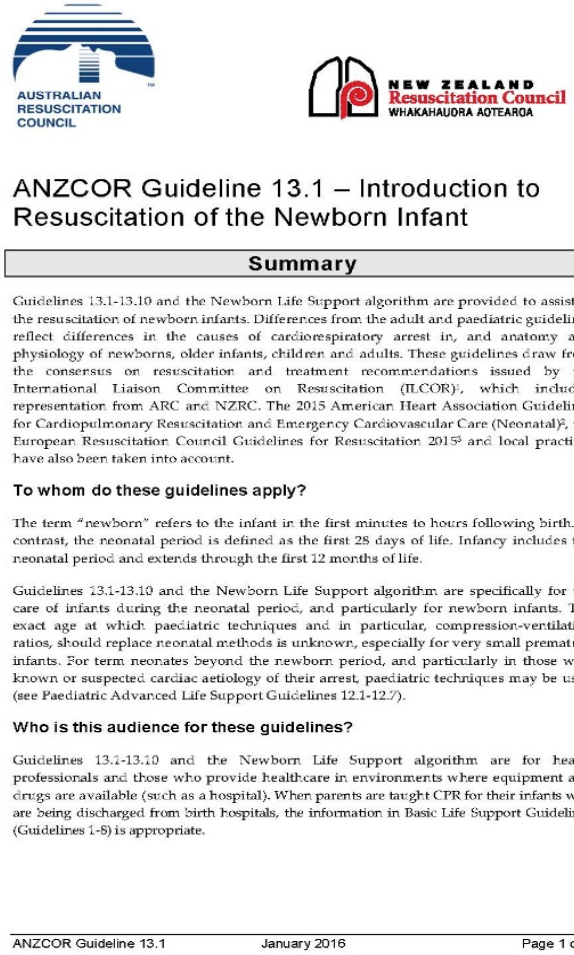
Australian & New Zealand Committee on Resuscitation (ANZCOR)



AUSTRALIAN RESUSCITATION COUNCIL

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ANZCOR Guideline 13.1 – Introduction to Resuscitation of the Newborn Infant

Summary

Guidelines 13.1-13.10 and the Newborn Life Support algorithm are provided to assist in the resuscitation of newborn infants. Differences from the adult and paediatric guidelines reflect differences in the causes of cardiorespiratory arrest in, and anatomy and physiology of newborns, older infants, children and adults. These guidelines draw from the consensus on resuscitation and treatment recommendations issued by the International Liaison Committee on Resuscitation (ILCOR)[1], which included representation from ARC and NZRC. The 2015 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care (Neonatal)[2], the European Resuscitation Council Guidelines for Resuscitation 2015[3] and local practices have also been taken into account.

To whom do these guidelines apply?

The term "newborn" refers to the infant in the first minutes to hours following birth. In contrast, the neonatal period is defined as the first 28 days of life. Infancy includes the neonatal period and extends through the first 12 months of life.

Guidelines 13.1-13.10 and the Newborn Life Support algorithm are specifically for the care of infants during the neonatal period, and particularly for newborn infants. The exact age at which paediatric techniques and in particular, compression-ventilation ratios, should replace neonatal methods is unknown, especially for very small premature infants. For term neonates beyond the newborn period, and particularly in those with known or suspected cardiac aetiology of their arrest, paediatric techniques may be used (see Paediatric Advanced Life Support Guidelines 12.1-12.7).

Who is this audience for these guidelines?

Guidelines 13.1-13.10 and the Newborn Life Support algorithm are for health professionals and those who provide healthcare in environments where equipment and drugs are available (such as a hospital). When parents are taught CPR for their infants who are being discharged from birth hospitals, the information in Basic Life Support Guidelines (Guidelines 1-8) is appropriate.

ANZCOR Guideline 13.1 January 2016 Page 1 of 9

Section 13.1 – 13.10

Neonatal Guidelines

Published January 2016

Available for download at

www.resus.org.au

Key references

1. Pearlman 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.

2. Australian & New Zealand Resuscitation Councils. (2016). Section 13: Neonatal Guidelines. Accessed 24 February 2016 from: http://www.resus.org.au

3. The Victorian Newborn Resuscitation Project: NeoResus. (2016). Accessed 24 February 2016 from http://www.neoresus.org.au/.

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