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First Response & Advanced Resuscitation

Learning Modules 2 and 3

Based on ILCOR 2020 and ANZCOR 2021

Updated July 2021

Learning objectives

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

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

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Behavioral factors

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

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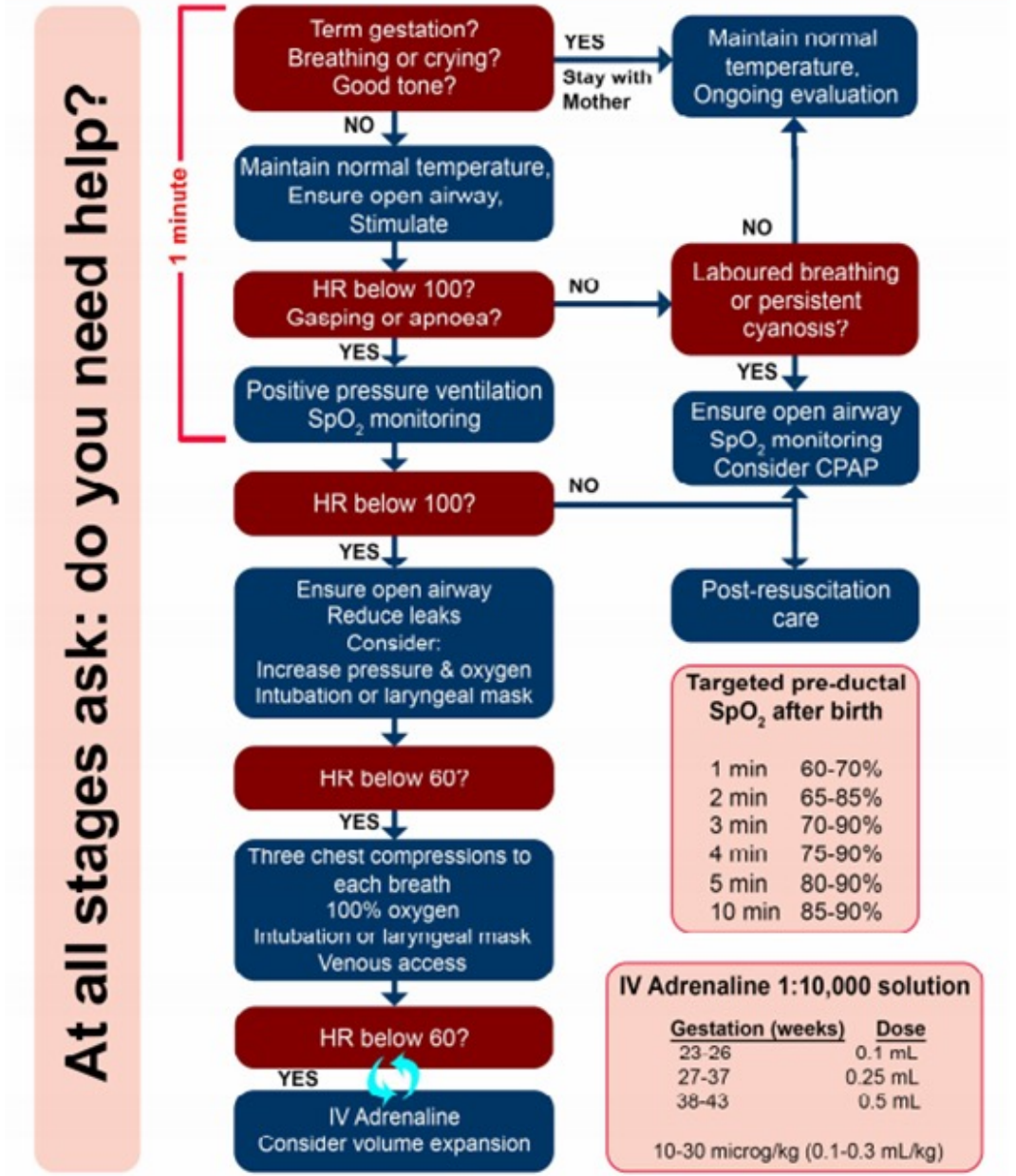
Newborn Life Support



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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

Interventions at birth in Australia in 2018† (300,911 livebirths)	
No intervention other than drying and stimulation	**81%**
Suction and/or oxygen therapy	6.1%
Positive pressure ventilation through mask	5.7%
Intubation & positive pressure ventilation	0.6%
Cardiac compressions & positive pressure ventilation	0.2%

† Australian Institute of Health and Welfare 2020[1]

Delayed cord clamping (DCC)

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Vigorous newborn: ILCOR and ANZCOR suggest:

- DCC for all infants, regardless of gestational age
- Aim to delay cord clamping ≥ 60 seconds if:
  - Uncomplicated term or preterm birth ≥ 34 weeks, **and**
  - Newborn is breathing and has good muscle tone
- Aim to delay cord clamping ≥ 30 seconds if:
  - Newborn <34 weeks who does not require immediate resuscitation interventions
- Ideally wait until breathing is established before clamping the cord. Do not pull on the cord.
- Continue to reassess the newborn until the cord is clamped

Delayed cord clamping (DCC)

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Non-vigorous newborn: ILCOR and ANZCOR suggest:

- In newborns who do not breathe or have poor muscle tone at birth, or become apnoeic or hypotonic during transition on the cord:
  - Cut the cord and move the newborn to the resuscitaire
  - Insufficient evidence regarding initiating resuscitation interventions before cord clamping (studies underway)
- Avoid pulling on the cord
- Document the time of cord clamping
- Continue to assess the newborn

Cord milking ('stripping')

ILCOR and ANZCOR suggest

Term and ≥ 34 weeks' gestation newborns:

- Insufficient evidence of benefit of milking the intact cord

<28^{+0} weeks' gestation newborns:

- ANZCOR suggest **against** intact cord milking

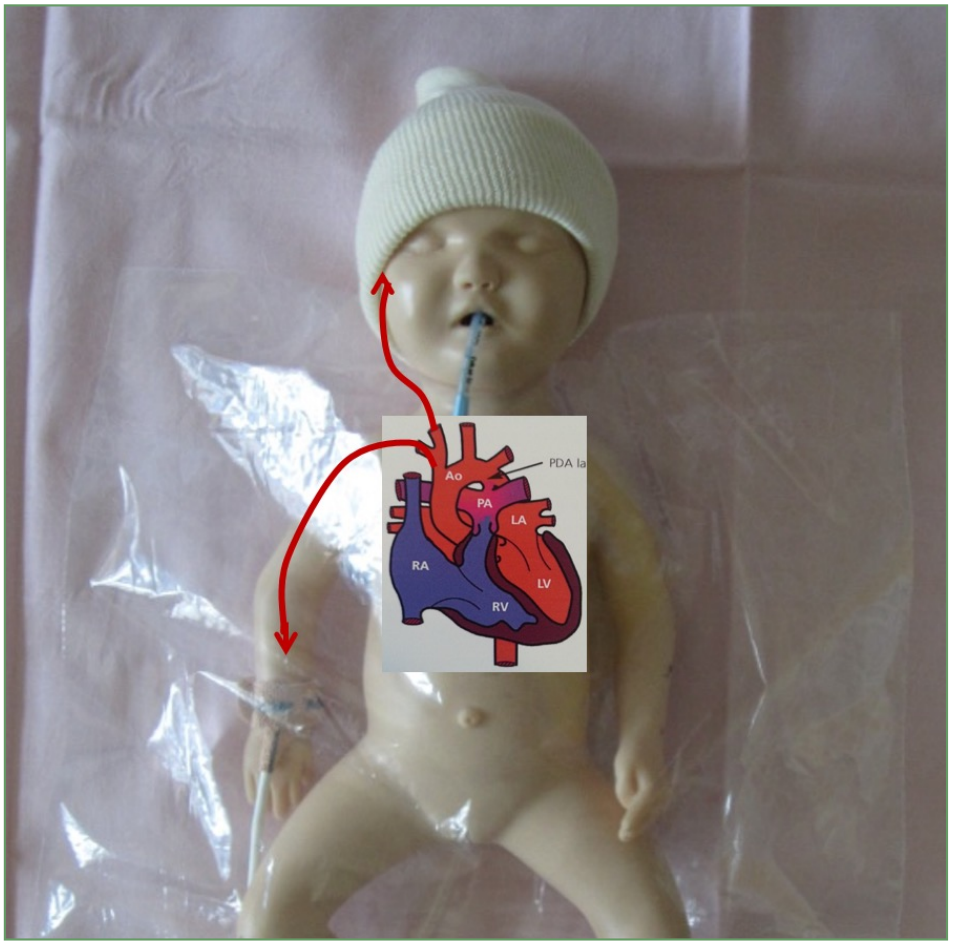
For all newborns, irrespective of gestational age:

- ANZCOR suggest **against** milking a cut cord

Monitoring

- Pulse oximetry is recommended:
  - When the need for resuscitation is anticipated
  - When persistent cyanosis is suspected
  - When CPAP or positive pressure is used
  - When supplemental oxygen is used
  - Place the oximeter sensor on the right wrist or hand (pre-ductal oxygen saturation)
- ECG monitoring:
  - Can be used to more rapidly and accurately display heart rate in the first 3 minutes of life

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˚C

- Uncompromised term/near term: skin-to-skin with mum
- 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):
    - Ambient room temperature at least 26˚C
    - Exothermic warming mattress
    - Warmed, humidified resuscitation gases
    - Cover the head (except the face) with a hat/bedding

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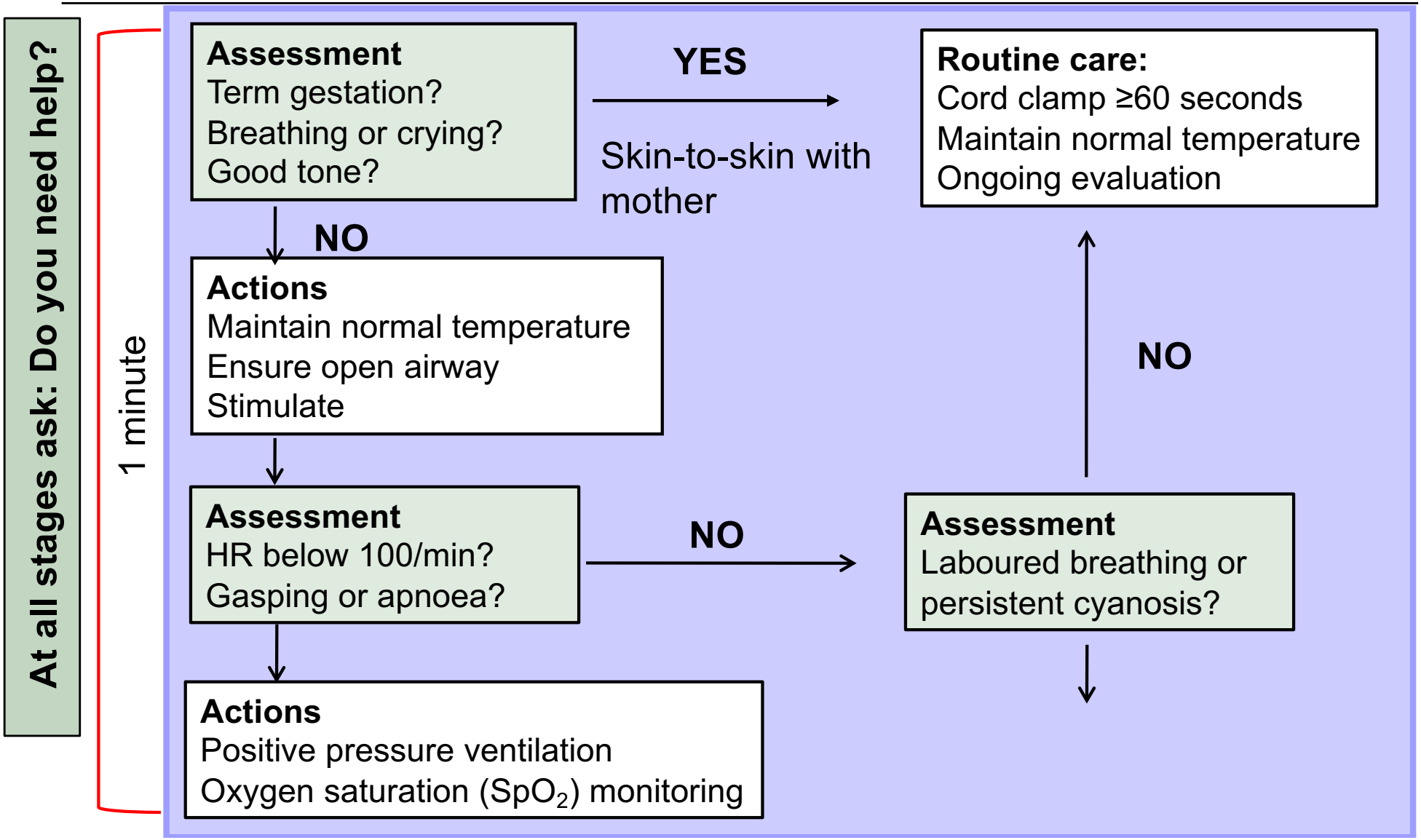
A: Assess and Airway



If meconium liquor is present:

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Regardless of consistency of meconium:

If the newborn is vigorous:

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

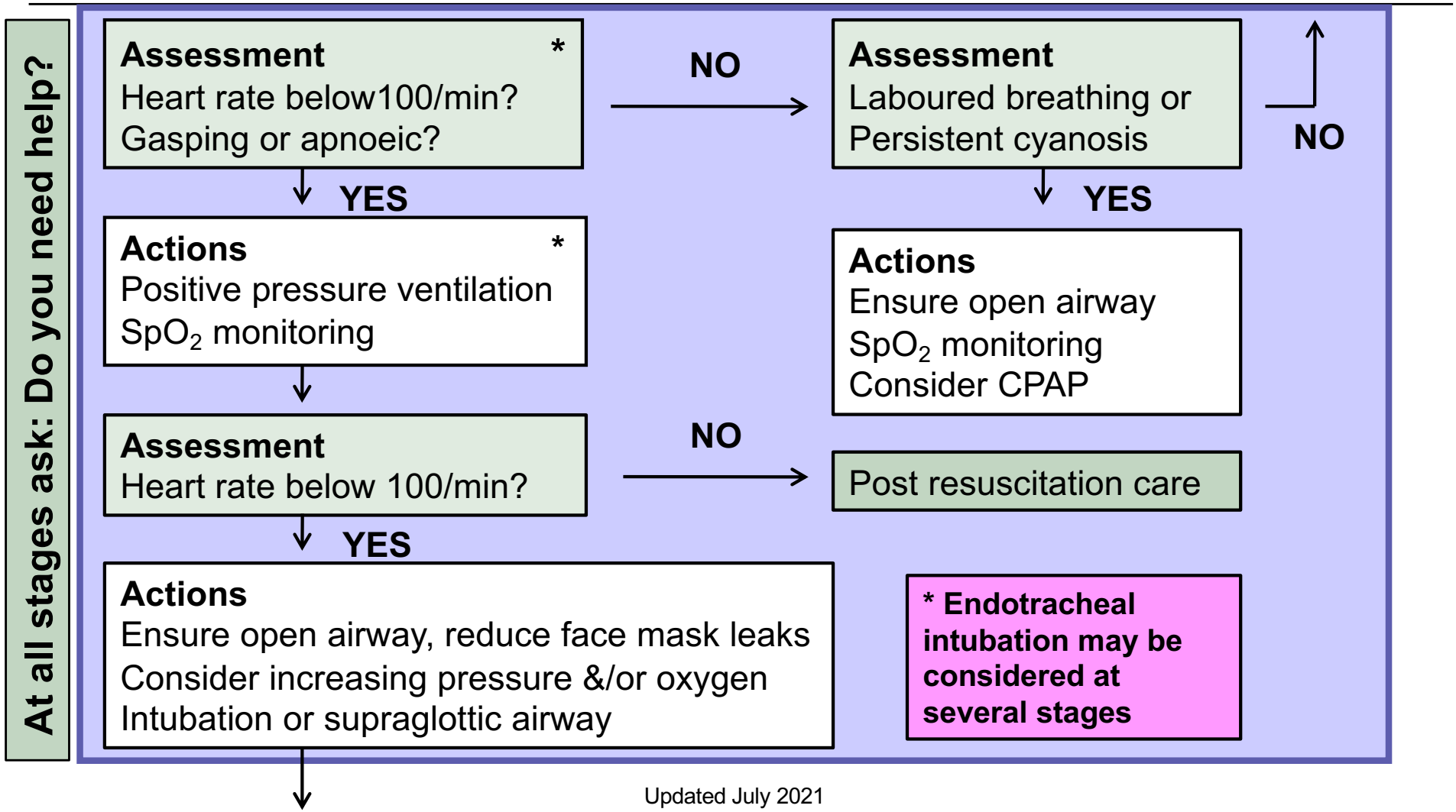
If the newborn is not vigorous:

- No evidence of the value of routine or repeated endotracheal suctioning to prevent meconium aspiration
- Priority is to initiate resuscitation interventions for newborns who are not breathing or ineffective breathing

All newborns exposed to meconium:

- ANZCOR suggests against routine direct laryngoscopy, with or without tracheal suctioning

B: Breathing



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CPAP during resuscitation

- Spontaneously breathing term newborns with respiratory distress
  - A trial of CPAP may be considered
- Spontaneously breathing newborns<32 weeks' gestation with respiratory distress who require respiratory support
  - ANZCOR suggest commencing CPAP in the first minutes after birth rather than intubation and ventilation
  - Use a CPAP pressure at least 5 cm H_20

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Manual ventilation devices

"A T-piece device, a self inflating bag (~240mL) and a flow inflating bag are all acceptable devices to ventilate newborn infants either via a face mask, supraglottic airway or endotracheal tube." (ANZCOR, 2021)

Initial settings: T-piece device

- Gas flow
  - Set at 8-10 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

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 (2021) recommend:
  - PEEP of 5 - 8 cm H_2O during resuscitation of preterm newborns recommended

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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 is >100 bpm and target saturations >90%

Target saturations for newborn infants during resuscitation

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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, 2021, Guideline 13.4

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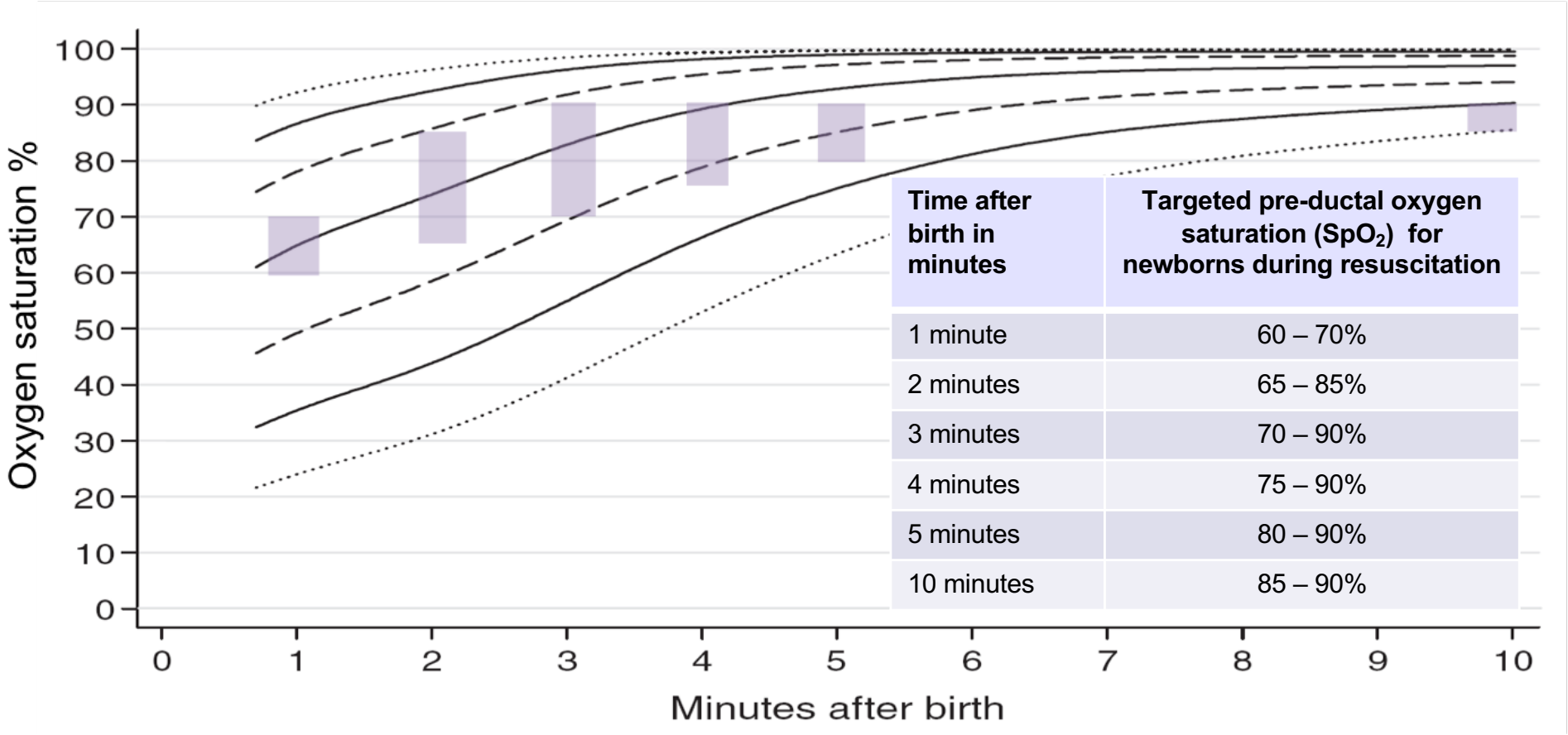
Centile charts with targeted pre-ductal SpO_2 in the first 10 minutes



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, 2021

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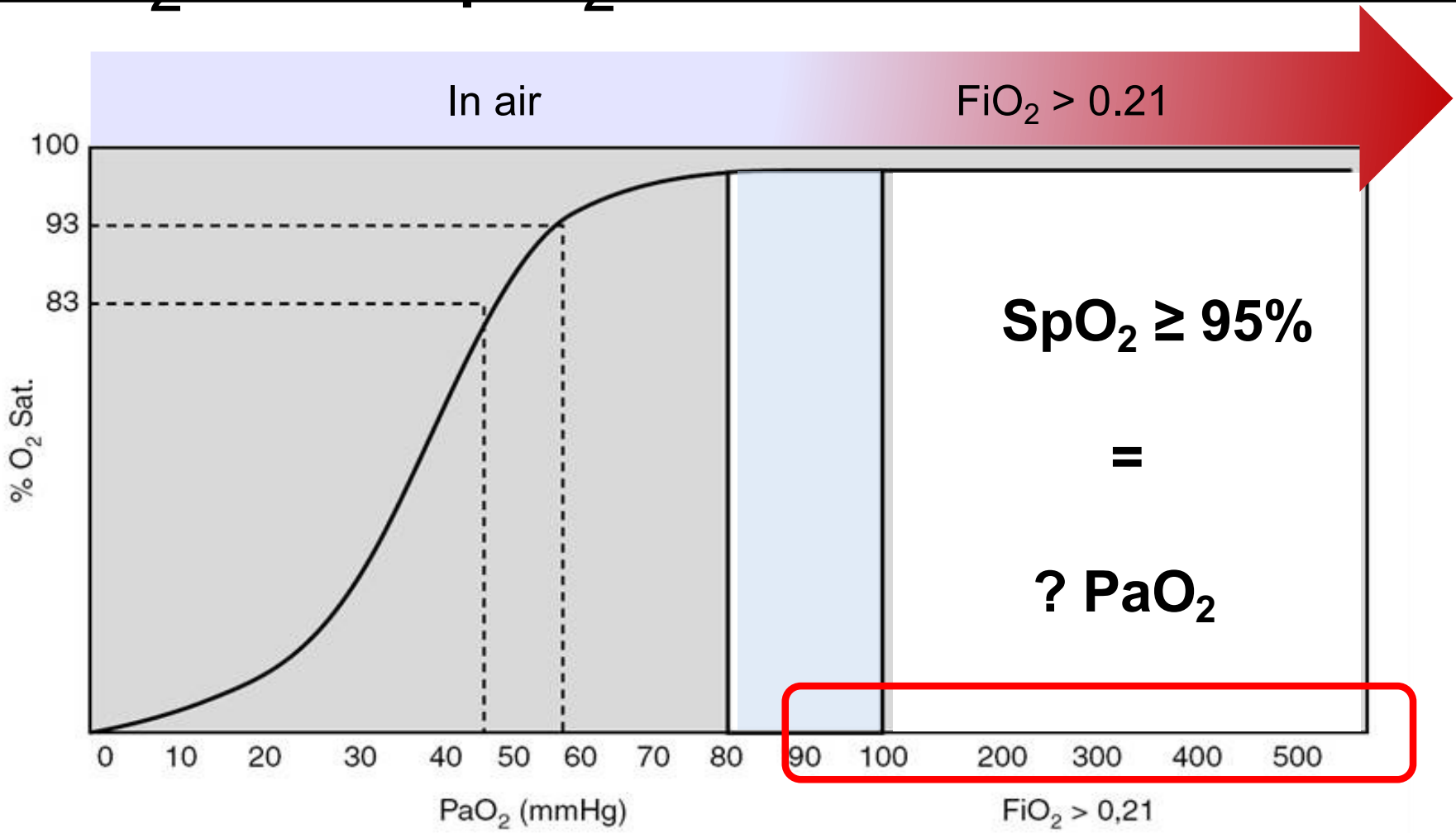
N.B The relationship between PaO_2 and SpO_2 is not linear



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

Initial T-piece 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

Positive pressure ventilation

Optimal positive pressure ventilation requires:

1. An appropriately sized face mask
2. A good seal between the mask and the face to minimise leak
   - Consider two people holding the mask: one supporting the jaw and holding the mask in place with two hands; the second person providing positive pressure inflations

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

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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

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- 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.

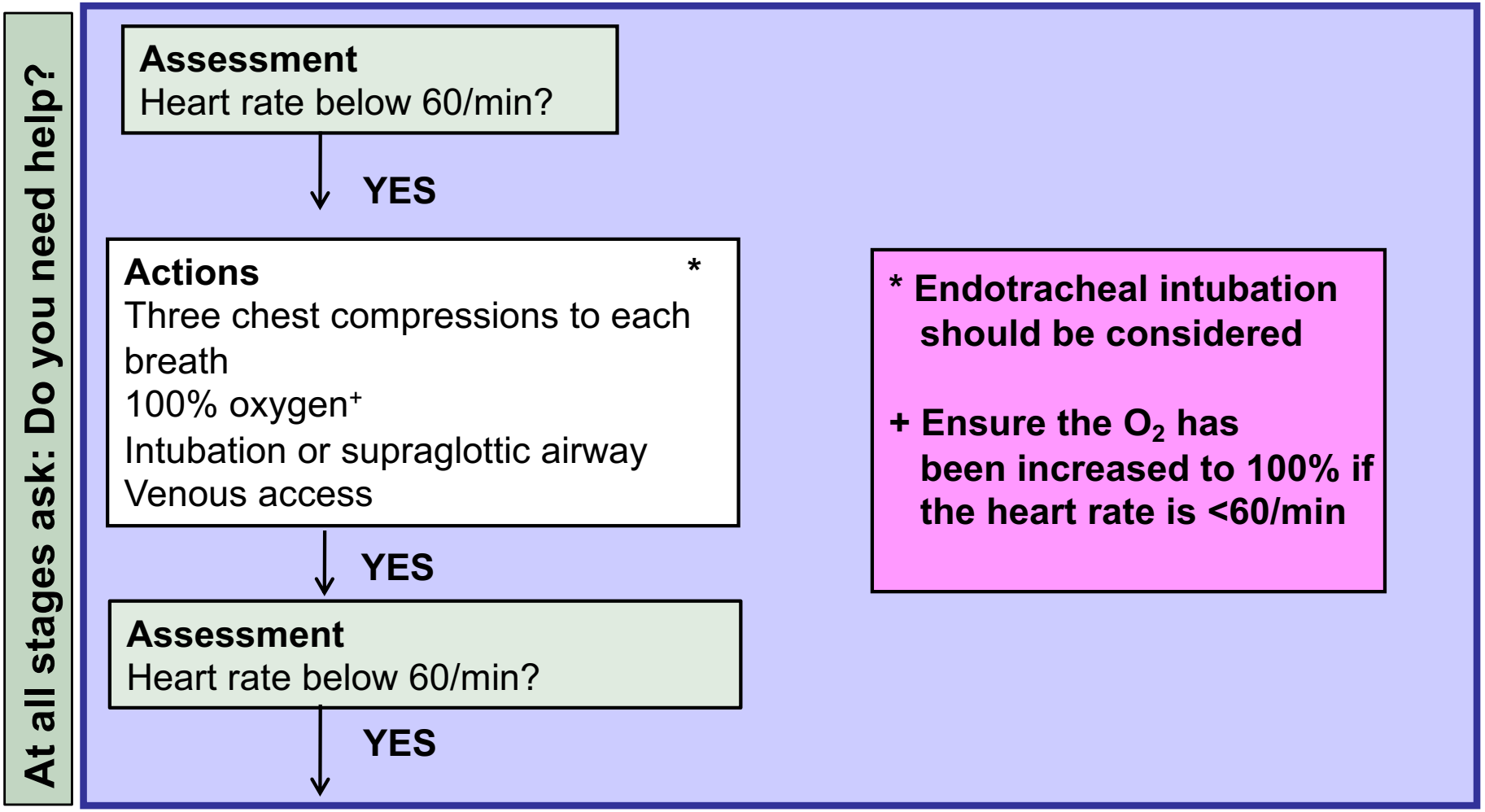
2. A slight rise and fall of the chest and upper abdomen with each inflation.

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



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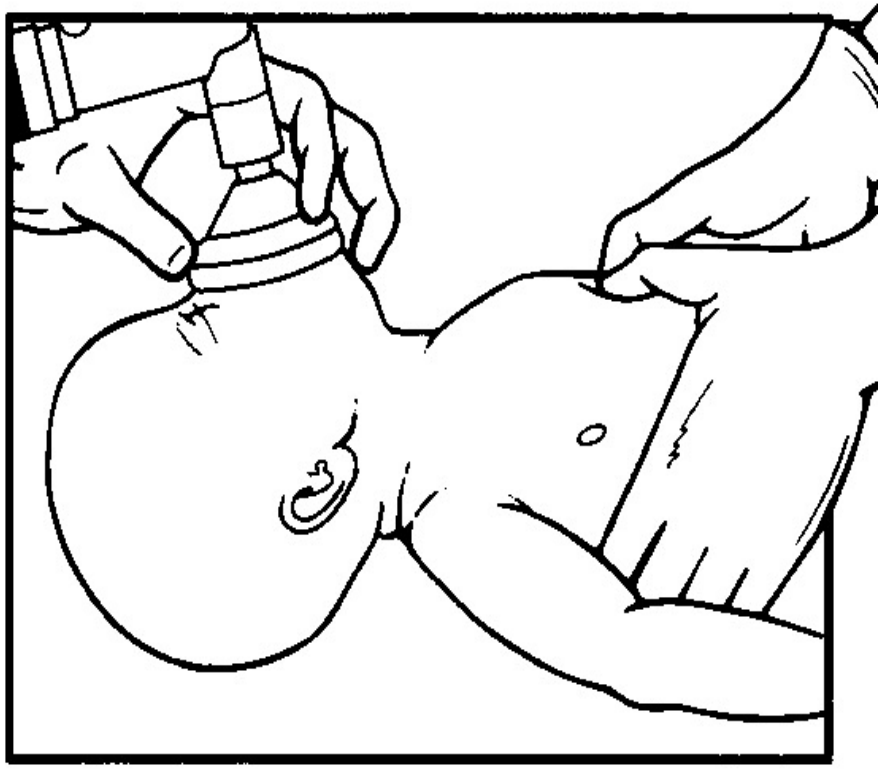
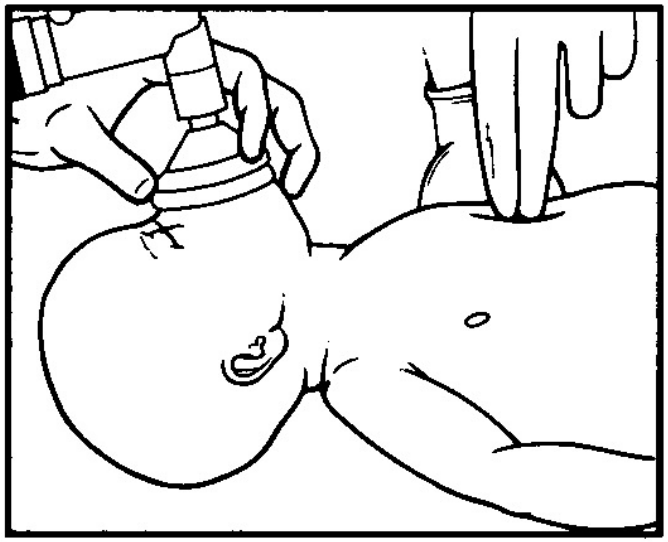
Techniques for ECC in newborns



Hand encircling, two thumb
(recommended technique)



Two finger technique
(only if single operator)

Consider endotracheal intubation at any time, if expertise is available

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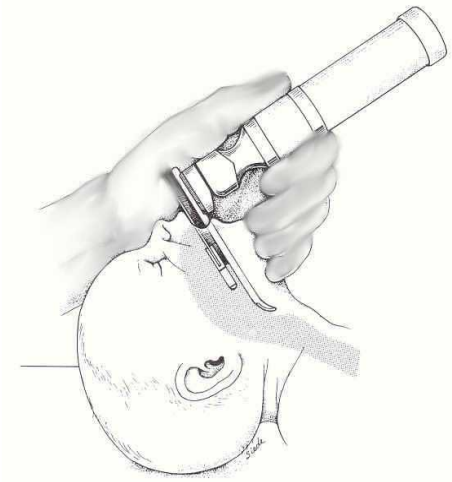
Estimated endotracheal size internal diameter can also be calculated as gestation age in weeks divided by 10

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

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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™)

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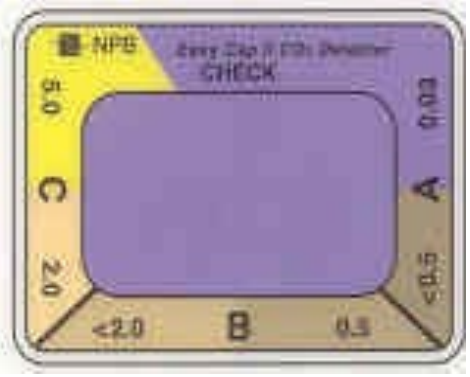
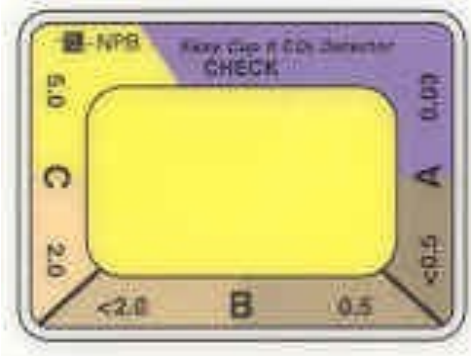
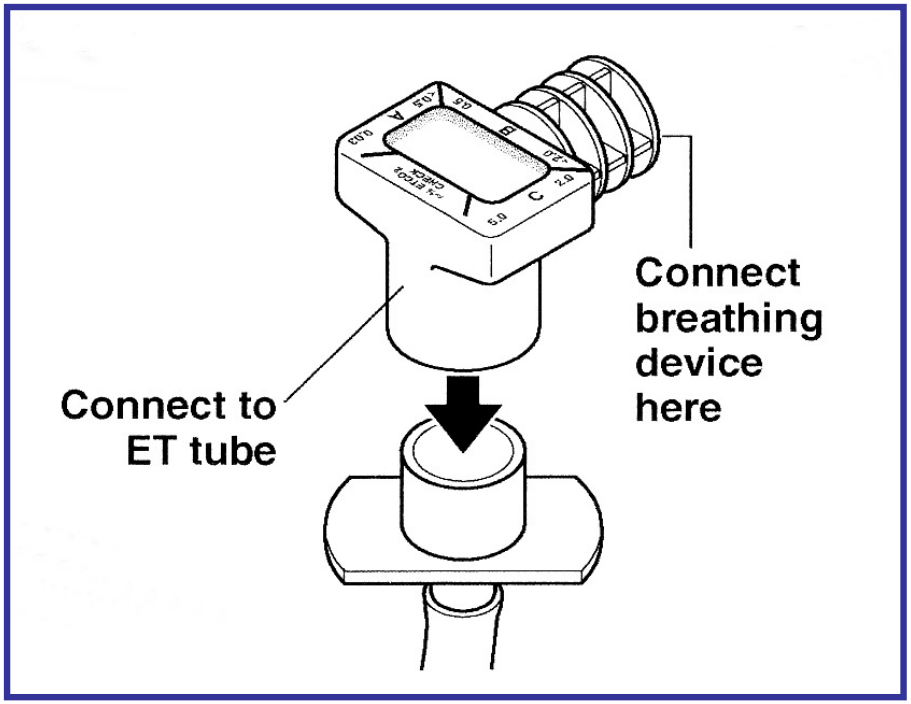
Give 6 positive pressure inflations, then interpret



INSPIRATION



EXPIRATION



"GOLD IS GOOD"

Supraglottic Airway (SGA)

Consider if:

- Face mask ventilation is unsuccessful
- Tracheal intubation is unsuccessful or not feasible
- Term or near-term infant, ≥ 34 weeks' gestation, ~2000g birth weight
- Size 1 SGA

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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

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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 UV/IV access
- Endotracheal adrenaline
  - May be considered if delay in obtaining UV/IV/IO access
  - If endotracheal route is used, up to ten times the IV/IO dose can be given

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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**, over several minutes. Repeat PRN

For more information on:

- Intubation
- Use of an exhaled CO_2 detector
- Use of a supraglottic airway (LMA™/ iGel™ or similar)
- 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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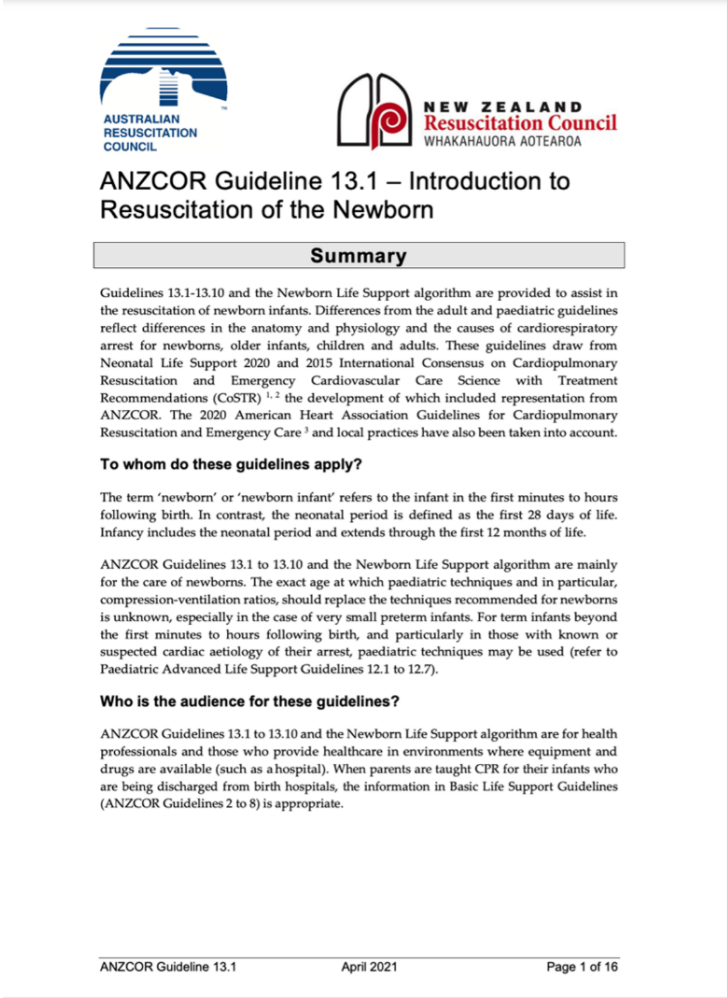
Australian & New Zealand Committee on Resuscitation (ANZCOR)



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ANZCOR Guideline 13.1 – Introduction to Resuscitation of the Newborn

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 anatomy and physiology and the causes of cardiorespiratory arrest for newborns, older infants, children and adults. These guidelines draw from Neonatal Life Support 2020 and 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations (CoSTR) [1, 2] the development of which included representation from ANZCOR. The 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Care [3] and local practices have also been taken into account.

To whom do these guidelines apply?

The term 'newborn' or 'newborn infant' 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.

ANZCOR Guidelines 13.1 to 13.10 and the Newborn Life Support algorithm are mainly for the care of newborns. The exact age at which paediatric techniques and in particular, compression-ventilation ratios, should replace the techniques recommended for newborns is unknown, especially in the case of very small preterm infants. For term infants beyond the first minutes to hours following birth, and particularly in those with known or suspected cardiac aetiology of their arrest, paediatric techniques may be used (refer to Paediatric Advanced Life Support Guidelines 12.1 to 12.7).

Who is the audience for these guidelines?

ANZCOR Guidelines 13.1 to 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 (ANZCOR Guidelines 2 to 8) is appropriate.

ANZCOR Guideline 13.1 April 2021 Page 1 of 16

Section 13.1 – 13.10

Neonatal Guidelines

Published April 2021

Available for download at

www.resus.org.au

Updated July 2021

Key references

1. Australian Institute of Health and Welfare 2020. *Australia's mothers and babies 2018- in brief.* Perinatal statistics series no.36. Cat no. PER 108. Canberra: AIHW.

2. Australian & New Zealand Resuscitation Councils. (2021). Section 13: Neonatal Guidelines. Accessed 4 June 2021 from: http://www.resus.org.au

3. Wyckoff, M.H., & Weiner, G.M. on behalf of the Neonatal Life Support Collaborators. (2020). Neonatal Life Support: 2020 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. *Circulation*; 142 (Supp 1); S185-S221.

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.

Additional Resources

Victoria

Neonatal e-handbook

https://www.bettersafercare.vic.gov.au/clinical-guidance/neonatal

New South Wales

Maternity: Resuscitation of the newborn

https://www1.health.nsw.gov.au/pds/ActivePDSDocuments/GL2018_016.pdf

Queensland

Maternity and Neonatal Clinical Guidelines

https://www.health.qld.gov.au/qcg/publications

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