


neoResus
The Victorian Newborn Resuscitation Project

First Response & Advanced Resuscitation
Learning Modules 2 and 3
Based on ILCOR 2020 and ANZCOR 2021

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1




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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2



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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Delayed cord clamping (DCC) neoResus

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

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Cord milking ('stripping') neoResus

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

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8

Monitoring neoResus

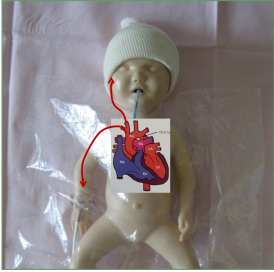
- Pulse oximetry is recommended:
 - When the need for resuscitation is anticipated
 - When persistent cyanosis is suspected
 - When CPAP or positive pressure is used
 - When supplemental oxygen is used
 - Place the oximeter sensor on the right wrist or hand (pre-ductal oxygen saturation)
- ECG monitoring: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

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Pre-ductal pulse oximetry (SpO₂)



- 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

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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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11

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A: Assess and Airway

At all stages ask: Do you need help?

1 minute

```

    graph TD
      A[Assessment: Term gestation? Breathing or crying? Good tone?] -- YES --> B[Routine care: Cord clamp <math>\leq 60</math> seconds, Maintain normal temperature, Ongoing evaluation]
      A -- NO --> C[Actions: Maintain normal temperature, Ensure open airway, Stimulate]
      C --> D[Assessment: HR below 100/min? Gasping or apnoea?]
      D -- NO --> E[Assessment: Laboured breathing or persistent cyanosis?]
      D -- YES --> F[Actions: Positive pressure ventilation, Oxygen saturation SpO2 monitoring]
      E --> B
      E --> F
      
```

12

If meconium liquor is present: neoResus
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:

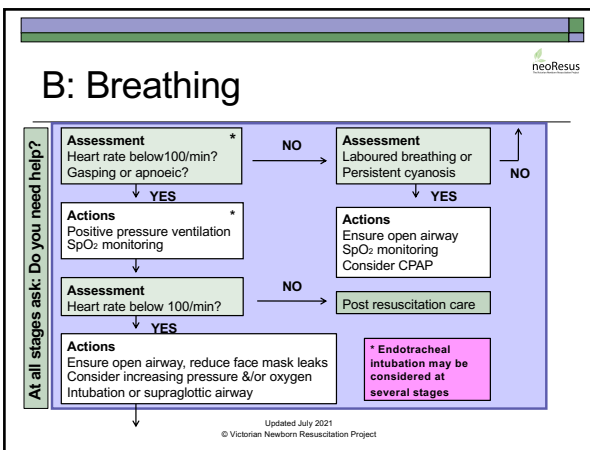
- No evidence of the value of routine or repeated endotracheal suctioning to prevent meconium aspiration
- Priority is to initiate resuscitation interventions for newborns who are not breathing or ineffective breathing

All newborns exposed to meconium:

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

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13



14

CPAP during resuscitation neoResus

- 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 H₂O


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15

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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)



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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 H₂O
- Peak inspiratory pressure (PIP)
 - Set at 30 cm H₂O (term newborn)
 - Set at 20 - 25 cm H₂O (preterm <32 weeks)
- Positive end expiratory pressure (PEEP)
 - Set at 5 - 8 cm H₂O

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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 (2021) recommend:
 - PEEP of 5 - 8 cm H₂O during resuscitation of preterm newborns recommended

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18

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Oxygen use in resuscitation

- **All newborns**
 - Oxygen should be used judiciously, guided by SpO₂
 - 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%

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19

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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, 2021, Guideline 13.4

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20

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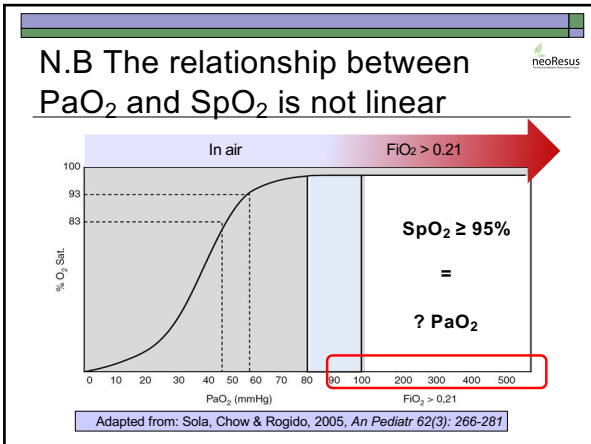
Centile charts with targeted pre-ductal SpO₂ in the first 10 minutes

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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21



22

Initial T-piece settings by gestation

Initial settings	Term	<35 weeks	<32 weeks
PIP cmH ₂ O	30	30	20-25
PEEP cmH ₂ O	5-8	5-8	5-8
Air/oxygen	21%	21-30% [†]	21-30% [†]

Avoid high O₂ initially (65%-100%)

[†] Use room air if air/oxygen blend not available

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23

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

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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 CO₂ levels (<30 mmHg)
 - Can depress respiratory drive
 - Can reduce cerebral blood flow

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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).

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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 cmH₂O increments: 30→ 35→ 40→ 45→ 50+ cm H₂O if necessary
- Increase oxygen according to SpO₂ targets
 - Increase to 100% if the heart rate is <60/min

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27

C: Circulation

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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 supraglottic airway
Venous access

↓ YES

Assessment
Heart rate below 60/min?

↓ YES

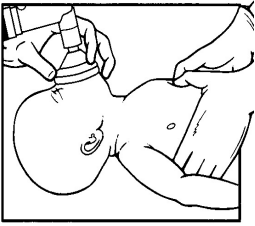
* Endotracheal intubation should be considered
† Ensure the O₂ has been increased to 100% if the heart rate is <60/min

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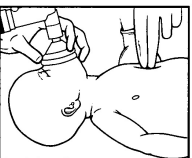
28

Techniques for ECC in newborns

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Hand encircling, two thumb
(recommended technique)



Two finger technique
(only if single operator)

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29

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	2.5 mm	0.5 – 0.6	5.5
25 – 26		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	3.5 mm	1.9 – 2.4	8.0
38 – 40		2.5 – 3.1	8.5
41 – 43		3.2 – 4.2	9.0



30

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Confirming tracheal intubation

- An exhaled CO₂ 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

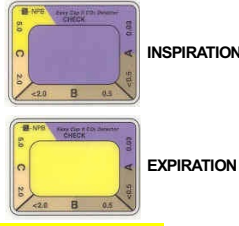
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31

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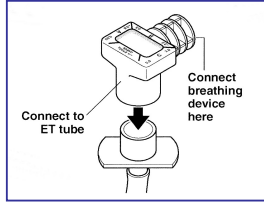
Verify ETT position with an exhaled CO₂ detector (e.g. Pedi-Cap™)

Give 6 positive pressure inflations, then interpret



INSPIRATION

EXPIRATION



"GOLD IS GOOD"

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32

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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 O₂ 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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34

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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)

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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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36

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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

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For more information on:

- Intubation
- Use of an exhaled CO₂ 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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38

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Australian & New Zealand Committee on Resuscitation (ANZCOR)



ANZCOR Guideline 13.1 – Introduction to Resuscitation of the Newborn

Summary

Guideline 13.1 of the Australian and New Zealand Committee on Resuscitation (ANZCOR) provides an overview of the resuscitation of the newborn. It covers the initial steps of resuscitation, including airway management, ventilation, and circulation. It also discusses the use of medications and the role of the neonatal resuscitation team.

To whom do these guidelines apply?

The main intention of these guidelines is to provide a framework for the resuscitation of the newborn. It is intended for use by healthcare professionals who are involved in the resuscitation of the newborn. It is not intended to be used as a substitute for clinical judgement.

Why is this guideline for these guidelines?

ANZCOR Guideline 13.1 is a guideline for the resuscitation of the newborn. It is intended to provide a framework for the resuscitation of the newborn. It is not intended to be used as a substitute for clinical judgement.

ANZCOR Guideline 13.1 – April 2021 Page 1 of 4

Section 13.1 – 13.10
Neonatal Guidelines
Published April 2021

Available for download at
www.resus.org.au

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39

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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.

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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/ActivePDS/Documents/GI2018_01_6.pdf

Queensland
Maternity and Neonatal Clinical Guidelines
<https://www.health.qld.gov.au/qcg/publications>

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41

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42

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