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.

Recommendations

The Australian and New Zealand Committee on Resuscitation (ANZCOR) makes the following recommendations:

1. Newborns should be assessed for the need for basic and advanced life support and receive care using the Newborn Life Support algorithm and according to these guidelines. [Good Practice Statement]
2. Healthcare providers should implement policies and protocols that utilise this algorithm and these guidelines. [Good Practice Statement]
3. Term newborns who have had low or no risk factors for needing resuscitation interventions, who are breathing or crying and who have good tone must be dried and kept warm. These actions can be provided on the mother's chest (skin-to-skin) and should not require separation of mother and infant. This does not preclude the need for ongoing vigilant clinical assessment of all newborns, as problems of adaptation may manifest as secondary apnoea, persistent cyanosis, or persistence or onset of breathing difficulties. [Good Practice Statements]
4. A suitable location, equipment and personnel trained to resuscitate a newborn must be available at all times, and in all places, where infants are born. [Good Practice Statement]
5. At least one person should be responsible for the care of each newborn. If it is anticipated that the newborn is at high risk of requiring advanced resuscitation more than one experienced person should be present. [Good Practice Statements]
6. All personnel who attend births should be trained in newborn resuscitation skills which include basic measures to maintain an open airway, ventilation via a facemask or supraglottic airway (SGA) device and chest compressions. [Good Practice Statement].
7. Organised programs to develop and maintain standards, skills and teamwork are required for newborn resuscitation and are essential for health care providers and institutions caring for mothers and newborns. [Good Practice Statement]
8. A complete set of resuscitation equipment and drugs should always be available for all births. Equipment should be regularly checked to ensure it is complete and operational. [Good Practice Statements]
9. Preparation for a high-risk birth requires communication between the people caring for the mother and those responsible for the newborn. This should include any factors that may affect the resuscitation and management of the newborn including maternal conditions, antenatal diagnoses and assessments of fetal wellbeing. [Good Practice Statement]
10. The newborn should be cared for in a warm, draft-free area. For term and near-term newborn infants, drying and removing the wet linen reduce heat loss. When resuscitation is not required the mother's body can keep the newborn warm, using her as a heat source by placing the newborn skin-to-skin on her chest or abdomen in a position that maintains airway patency and covering both with a warm blanket or towel. If resuscitation is necessary, place

the newborn under a preheated radiant warmer or if unavailable, an alternative heat source. [Good Practice Statements]

11. ANZCOR recommends that non-asphyxiated newborns of all gestations should be maintained with a temperature of between 36.5 and 37.5**°** [CoSTR 2015, strong recommendation, very low certainty of evidence]
12. ANZCOR recommends that admission temperatures to newborn units are predictors of outcome and should be recorded as a quality-of-care measure. [CoSTR 2015, strong recommendation, moderate certainty of evidence]
13. For term and near-term infants at risk of hypoxic ischaemic encephalopathy, the target during resuscitation and stabilisation should be to maintain normothermia (with care to avoid hyperthermia), until a decision has been made that the newborn has signs of encephalopathy and meets criteria for induced hypothermia. Any newborn who is considered a possible candidate for therapeutic hypothermia should be discussed as soon as possible after initial resuscitation with a neonatal intensive care specialist, and plans should be made for prompt admission to a neonatal intensive care unit. If indicated, whole body cooling can be initiated without specialised equipment. Local guidelines should be in place to ensure that newborns that meet criteria for induced hypothermia are promptly recognised and referred. [Good Practice Statements]
14. Prior preparation of standardised kits containing the equipment needed for procedures such as umbilical catheterisation can save considerable time in emergencies. [Good Practice Statement]
15. Providers should ensure that all equipment is approved and suitable for purpose. [Good Practice Statement]
16. For term and late preterm infants born at ≥34 weeks' gestation who are vigorous or deemed not to require immediate resuscitation at birth, ANZCOR suggests later (delayed) clamping of the cord at ≥ 60 seconds rather than immediate cord clamping. [Weak recommendation, very low certainty of evidence.]
17. For infants born at less than 34 weeks' gestational age who do not require immediate resuscitation after birth, ANZCOR suggests deferring clamping the cord for at least 30 seconds. [Weak recommendation, low certainty of evidence]
18. In infants born at any gestational age who require immediate resuscitation, there is insufficient evidence to make a recommendation with respect to cord management.
19. There is insufficient evidence to make recommendations on cord management for maternal, fetal, or placental conditions that were considered exclusion criteria in many studies (in particular, multiple fetuses, congenital anomalies, placental abnormalities, alloimmunization and/or fetal anemia, fetal compromise, and maternal illness). In these situations, ANZCOR suggests individualized decisions based on severity of the condition and assessment of maternal and neonatal risk. [Weak recommendation; very low certainty of evidence]
20. ANZCOR suggests that there is insufficient evidence to recommend milking of the intact cord for term and late preterm infants (≥34 weeks' gestation), or the cut cord for infants of any gestation.
21. ANZCOR suggests against intact cord milking for infants born at less than 28+0 weeks' gestational age. [Weak recommendation; very low certainty of evidence]
22. Practitioners involved in resuscitation should always be alert to errors of assembly or use of

resuscitation equipment and should have checking processes to minimise these risks before equipment is used.

They should also respond to unexpected situations with further checking procedures, and in the case of unexplained hypoxia, change gas supply and circuits and include removing the patient from ventilators and gas supplies by using a self-inflating bag with room air. In this situation oxygen analysis of delivered gases should be considered and an oxygen analyser should be available. [Good Practice Statements]

Abbreviations

Abbreviation	Meaning/Phrase
ANZCOR	Australian and New Zealand Committee on Resuscitation
CI	Confidence interval (95%)
CoSTR	International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations
CPR	Cardiopulmonary resuscitation
I^2	I squared statistic; measure of percentage of variability in effect estimates that is due to heterogeneity rather than sampling error (chance) [4]
IV	Intravenous
RR	Risk Ratio
UVC	Umbilical venous catheter

1.0 | Need for Newborn Resuscitation Interventions

Approximately 85 percent of babies born at term will initiate spontaneous respirations within 10 to 30 seconds of birth.[5] An additional 10 percent will respond during drying and stimulation, approximately three percent will initiate respirations following positive pressure ventilation, two percent will be intubated to support respiratory function and 0.1 percent will receive chest compressions and/or adrenaline (epinephrine) to achieve this transition.[6-10]} Resuscitation is defined as the preservation or restoration of life by the establishment and/or maintenance of airway, breathing and circulation, and related emergency care (refer to ANZCOR Guideline 1.1). For most newborns, resuscitation manoeuvres are administered as part of a graded strategy to support their own physiological efforts to adapt after birth. Only a very few appear lifeless and require the full range of newborn resuscitation interventions described in these guidelines. Since in most cases, breathing support is all that is needed, terms such as 'initial stabilisation' and 'support during transition' are also used in the literature. However, for the purposes of these guidelines, 'stabilisation' is reserved for processes after resuscitation (refer to ANZCOR Guideline 13.9).

Term newborns who have had low or no risk factors for needing resuscitation interventions, who

are breathing or crying and who have good tone must be dried and kept warm. These actions can be provided on the mother's chest (skin-to-skin) and should not require separation of mother and infant. This does not preclude the need for ongoing vigilant clinical assessment of all newborns, as problems of adaptation may manifest as secondary apnoea, persistent cyanosis, or persistence or onset of breathing difficulties. [Good Practice Statement]

The keys to successful newborn resuscitation include assessment of perinatal risk and a system to rapidly assemble team members with skills that are appropriate to the anticipated need for resuscitation on the basis of that risk. Other critical components of successful resuscitation include an organised resuscitation area that ensures immediate access to all needed supplies and equipment and the standardisation of behavioural skills that foster optimal teamwork and communication. Although the need for resuscitation of the newborn can often be anticipated, and the need for resuscitation in low-risk births may be 1% or less, there remain many occasions when it is unexpected. Therefore, a suitable location, equipment and personnel trained to resuscitate a newborn must be available at all times, and in all places, where infants are born. [Good Practice Statement]

2.0 | Unique Physiology of Newborns

The transition from fetal to extrauterine life is characterised by a series of unique physiological events. Among these, the lungs change from liquid-filled to air-filled, pulmonary blood flow increases dramatically, and intracardiac and extracardiac shunts cease.

During the normal onset of breathing, newborns exert negative pressure on the lung with each breath. For the first few breaths, these pressures are greater than those needed for subsequent breaths, due to the need to clear liquid from the airways and begin lung aeration.[11] If the newborn does not achieve this initial lung aeration and positive pressure ventilation needs to be used, higher peak inspiratory pressures may be needed for the first inflations than subsequently.

The level of pressure will vary from newborn to newborn, depending on the maturity of the lungs and any lung disease that is present. Suggested starting pressures provided in Guideline 13.4 are only a guide, and subsequently, pressures need to be individually adjusted according to the newborn's response.

The fetal lung liquid moves from the airways to the lung tissue, and then reabsorbs more slowly (over several hours) into the circulation. In newborns who are preterm or who have difficulty breathing, lung liquid can move back from the lung tissue into the airways, whereupon it needs to be cleared again, perhaps repeatedly. Continuous positive end expiratory pressure can help prevent this.

Aeration of the lungs triggers a fall in pulmonary vascular resistance and increase in pulmonary blood flow,[12] which rises 5 to 6 fold after birth. In healthy newborns, oxygen levels rise over several minutes, typically taking 5 to10 minutes for oxygen saturation of haemoglobin to reach 90%.[13-19]

Uncompromised fetuses (at sea level) have oxygen saturation levels of about 60% during labour. The 25th centile for oxygen saturation is approximately 80% at 5 minutes.[19] Normal newborns should have a heart rate >100 bpm by 2 minutes after birth. [20]

Adaptation to extrauterine life depends on many coordinated and interdependent physiological events, failure of any of which can impair successful transition. Inadequate lung aeration can cause respiratory failure and prevent the normal increase in pulmonary blood flow. [12] If pulmonary vascular resistance does not fall, the consequence is persistent pulmonary hypertension, with inadequate blood flow through the lungs and hypoxaemia. Haemorrhage from the fetus before birth can cause hypovolaemia and hypotension in the newborn. Acidosis and hypoxia before or during birth can depress respiratory drive and cardiac function.

In preterm infants there are additional considerations. Surfactant deficiency reduces lung compliance.[21] Preterm infants also typically have weaker respiratory muscles, immature airway protective reflexes, and a chest wall that deforms easily. Very preterm newborns and those born by caesarean section, without the effect of labour, may not clear fetal lung liquid and therefore, may not aerate their lungs as easily as term newborns born by vaginal delivery.

In advanced gestation, passage of meconium into the amniotic fluid becomes more common and, in some cases, it is associated with fetal compromise. If meconium is passed into the amniotic fluid, it may be inhaled before or during delivery and lead to inflammation of the lungs and airway obstruction. Complications of meconium aspiration are more likely in newborns who are small for their gestation, and those born after term or with significant perinatal compromise. [22, 23]

Perinatal infections and congenital anomalies are among other potential causes of impaired adaptation at birth.

3.0 | Anticipating the Need for Resuscitation

3.1 | Personnel

At least one person should be responsible for the care of each newborn. Guideline 13.2 lists examples of maternal, fetal, and intrapartum circumstances that place the newborn at increased risk of needing resuscitation. If it is anticipated that the newborn is at high risk of requiring advanced resuscitation more than one experienced person should be present. [Good Practice Statements]

3.2 | Training

All personnel who attend births should be trained in newborn resuscitation skills which include

basic measures to maintain an open airway, ventilation via a facemask or supraglottic airway device and chest compressions. [Good Practice Statement]

A person trained in advanced newborn resuscitation (all of the above skills plus endotracheal intubation and ventilation, vascular cannulation and the use of drugs and fluids) may be needed even for low-risk births and should be in attendance for all births considered at high risk for needing newborn resuscitation. [Good Practice Statement]

Organised programs to develop and maintain standards, skills and teamwork are required for newborn resuscitation and are essential for health care providers and institutions caring for mothers and newborns. [24, 25][Good Practice Statement]

3.3 | Equipment

The need for resuscitation at birth cannot always be anticipated. [26-28] Therefore, a complete set of resuscitation equipment and drugs should always be available for all births. This equipment should be regularly checked to ensure it is complete and operational births. [Good Practice Statement] A list of suggested resuscitation equipment and drugs is provided at the end of this guideline.

3.4 | Communication

Preparation for a high-risk birth requires communication between the people caring for the mother and those responsible for the newborn. This should include any factors that may affect the resuscitation and management of the newborn including;

- maternal conditions
- antenatal diagnoses
- assessments of fetal wellbeing.

[Good Practice Statement]

4.0 | Environment

4.1 | Temperature

Newborns are at risk of hypothermia or hyperthermia, so prevention of both heat loss and overheating is important. Hypothermia can increase oxygen consumption and impede effective resuscitation.[29-31] The newborn should be cared for in a warm, draft-free area. For term and near-

term newborn infants, drying and removing the wet linen reduce heat loss. When resuscitation is not required the mother's body can keep the newborn warm, using her as a heat source by placing the newborn skin-to-skin on her chest or abdomen in a position that maintains airway patency and covering both with a warm blanket or towel. If resuscitation is necessary, place the newborn under a preheated radiant warmer or if unavailable, an alternative heat source. [Good Practice Statements]

ANZCOR recommends that non-asphyxiated newborns of all gestations should be maintained with a temperature of between 36.5 and 37.5° C. [2] [CoSTR 2015, strong recommendation, very low certainty of evidence]

ANZCOR recommends that admission temperatures to newborn units are predictors of outcome and should be recorded as a quality of care measure. [2] [CoSTR 2015, strong recommendation, moderate certainty of evidence] Hypothermia is associated with an increased risk of mortality. There is evidence of a dose effect with mortality increasing by 28% for each degree below 36.5 ^{0}C at admission. [2]

Hypothermia on admission is also associated with worse respiratory outcomes and greater likelihood of hypoglycaemia, late onset sepsis and intraventricular haemorrhage. [2]

For special considerations for preterm infants, refer to ANZCOR Guideline 13.8.

4.2 | Hyperthermia

No studies have examined the effects of hyperthermia after resuscitation of newborn infants. However, newborns born to febrile mothers (temperature >38° C) have an increased risk of death, perinatal respiratory depression, neonatal seizures and cerebral palsy. [32-34]

4.3 | Induced Hypothermia for Hypoxic Ischaemic Encephalopathy

Inducing hypothermia in newborns of 35 weeks' gestation and above with evolving moderate to severe hypoxic ischaemic encephalopathy will reduce the degree of brain injury in some (refer to guideline 13.9).[35-40] The target during resuscitation and stabilisation should be to maintain normothermia (with care to avoid hyperthermia), until a decision has been made that the newborn has signs of encephalopathy and meets criteria for induced hypothermia. Any newborn who is considered a possible candidate for therapeutic hypothermia should be discussed as soon as possible after initial resuscitation with a neonatal intensive care specialist, and plans should be made for prompt admission to a neonatal intensive care unit. If indicated, whole body cooling can be initiated without specialised equipment.[39] Local guidelines should be in place to ensure that newborns that meet criteria for induced hypothermia are promptly recognised and referred. [Good Practice Statements]

5.0 | Recommended Equipment and Drugs for Resuscitation of the Newborn

Resuscitation equipment and drugs should be readily available in the areas of hospitals where infants are born or receive neonatal care. Equipment should be checked regularly according to local policy and before any resuscitation to ensure it is complete and operational. A clear record documenting the checking procedure should be maintained for each set of resuscitation equipment and drugs. [24] [Good Practice Statements]

Prior preparation of standardised kits containing the equipment needed for procedures such as umbilical catheterisation can save considerable time in emergencies.[24] [Good Practice Statement]

Providers should ensure that all equipment is approved and suitable for purpose. [Good Practice Statement]

5.1 | Recommended equipment and drugs

General

- Firm, horizontal, padded resuscitation surface
- Overhead warmer
- Light for the area
- Clock with timer in seconds
- Warmed towels or similar covering
- Polyethylene bag or sheet, big enough for a newborn less than 32 weeks' gestation or <1500g birth weight
- Stethoscope, neonatal size preferred
- Pulse oximeter plus neonatal probe
- Electrocardiographic monitor and leads (where available)

Equipment for **airway** management

- Suction apparatus and suction catheters (6F, 8F, and either 10F or 12F)
- Oropharyngeal airways (sizes 0 and 00)
- Intubation equipment:
    - Laryngoscopes with infant blades (00, 0, 1)
    - Spare bulbs, and batteries
    - Endotracheal tubes (sizes 2.5mm, 3 mm, 3.5 mm and 4 mm internal diameter, uncuffed, no eye)
    - Endotracheal stylet or introducer
    - Supplies for fixing endotracheal tubes (e.g., scissors, tape)
- End-tidal carbon dioxide detector (to confirm intubation)

- Meconium suction device (to apply suction directly to endotracheal tube) (optional)
- Magill forceps, neonatal size (optional)
- Supraglottic airway device size 1

Equipment for supporting **breathing**

- Face masks (range of sizes suitable for premature and term newborn infants)
- Positive-pressure ventilation device:
    - T-piece resuscitator device (or Flow-inflating bag with a pressure safety valve and manometer)
    - Self-inflating bag (< 300mL) with a removable oxygen reservoir
- Medical gases:
    - Source of medical oxygen (reticulated and/or cylinder, allowing flow of up to 10 L/min) with flow meter and tubing
    - Source of medical air plus air/oxygen blender
- Feeding tubes for gastric decompression (e.g., size 6F & 8F)

Equipment for supporting the **circulation**

- Umbilical venous catheter (UVC) kit (including UVC size 5F)
- Peripheral IV cannulation kit
- Skin preparation solution suitable for newborn skin
- Tapes/devices to secure UVC/IV cannula
- Syringes and needles (assorted sizes)
- Intraosseous needles

Drugs and fluids

- Adrenaline (epinephrine): 1:10 000 concentration (0.1 mg/mL)
- Sodium chloride 0.9%
- Blood suitable for emergency transfusion needs to be readily available for a profoundly anaemic newborn

Documentation

- Resuscitation record sheet

6.0 | Cord Clamping

The umbilical cord can be clamped at different times after birth. Later (also referred to as delayed or deferred) cord clamping is defined as application of a clamp to the cord greater than 30 seconds after birth or based on physiologic observations (such as when cord pulsation has ceased or breathing has been initiated), without cord milking.

In both animal and human studies, deferring cord clamping for 30-60 seconds, when compared with immediate cord clamping is associated with increased placental transfusion, increased cardiac output, and higher and more stable neonatal blood pressure. There is good evidence from animal studies that among the benefits, placental transfusion can fill the expanding pulmonary vascular bed, obviating the need for it to fill by "left to right" flow from the aorta across the ductus arteriosus.[12] However, there remains controversy about how long it is appropriate to delay cord clamping if the newborn is perceived to require resuscitation. In addition, other methods aiming to achieve a placental transfusion to the newborn (cord milking or "stripping") have been investigated. These include (single or repeated) compression of the unclamped and uncut (intact cord) or a long segment of clamped and cut umbilical cord towards the newborn, or passive drainage of a long segment of clamped and cut cord towards the newborn.

For the uncomplicated term or near-term birth (≥ 34 weeks' gestation), a meta-analysis of studies comparing an intention to delay cord clamping after birth for a time ranging from 30 seconds until the cord stops pulsating with an intention for immediate cord clamping (usually within 15 seconds) showed higher neonatal haemoglobin levels and improved iron status in early infancy, but higher rates of polycythemia (haematocrit >64%, although higher rates of exchange transfusion were not found). For the outcomes of survival to discharge, need for resuscitation or admission to a neonatal unit, for jaundice treated with phototherapy and for major maternal outcomes, the review could not exclude benefit or harm. [41]

For term and late preterm infants born at ≥34 weeks' gestation who are vigorous or deemed not to require immediate resuscitation at birth, ANZCOR suggests later (delayed or deferred) clamping of the cord at ≥ 60 seconds. [41] [Weak recommendation, very low certainty of evidence]

For the uncomplicated preterm birth <34 weeks' gestation, a systematic review showed evidence of moderate certainty that delaying cord clamping for a minimum time of 30 seconds, when compared to immediate cord clamping may improve neonatal survival (risk ratio [RR]: 1.02, 95% confidence interval [CI]: 1.00 to 1.04; Number needed for benefit: 50, 95% CI: 25 to no benefit). [42]

For the important outcomes of severe intraventricular haemorrhage and jaundice treated with phototherapy the review found no difference with narrow confidence intervals, suggesting that a large benefit or harm was unlikely. For necrotising enterocolitis and bronchopulmonary dysplasia, the review could not rule out benefit or harm.[42]

The review also found that later cord clamping probably improves haematologic measures including haemoglobin and haematocrit values during first week after birth, reduces the risk of needing inotropic support for hypotension during the first 24 hours of life, reduces the number of infants who receive a blood transfusion and the total number of blood transfusions per infant hospital course. [42] The review found no increase in risk of adverse maternal outcomes, including postpartum haemorrhage, infection or manual removal of the placenta. [42]

A physiology-based approach to timing of cord clamping, where cord clamping is performed after the onset of breathing, based on specific vital signs or after cessation of pulsation of the cord may have advantages over time-based clamping of the cord, but there is insufficient evidence to draw

strong conclusions.

For infants born at less than 34 weeks' gestational age who do not require immediate resuscitation after birth, ANZCOR suggests deferring clamping the cord for at least 30 seconds. [42] [Weak recommendation, low certainty of evidence]

In infants born at less than 34 weeks' gestational age who require immediate resuscitation, there is insufficient evidence to make a recommendation with respect to cord management. [42]

Although on theoretical grounds, the depressed newborn might receive greater benefit from deferred cord clamping,[43] constriction of uterine arteries normally occurs immediately after birth. Therefore, it is unclear whether the placenta can be relied upon to provide compensatory gas exchange in the newborn who does not begin breathing soon after birth. Furthermore, a depressed newborn may have experienced impaired placental gas exchange even before birth. Small and sick newborns who received immediate resuscitation were generally excluded from the randomised trials conducted to date. Therefore, there is insufficient evidence to recommend the optimal timing of cord clamping in the compromised newborn. [41, 42] The more severely compromised the newborn, the more likely it is that resuscitation measures need to take priority over delayed cord clamping. The efficacy of cardiac compressions in improving the systemic and coronary perfusion if the cord remains unclamped and the low resistance placenta is still connected is unknown.

There is insufficient evidence to make recommendations on cord management for maternal, fetal, or placental conditions that were considered exclusion criteria in many studies (in particular, multiple fetuses, congenital anomalies, placental abnormalities, alloimmunization and/or fetal anemia, fetal compromise, and maternal illness). In these situations, ANZCOR suggests individualized decisions based on severity of the condition and assessment of maternal and neonatal risk. [41, 42] [Weak recommendation; very low certainty of evidence]

6.1 | Cord Milking

Milking of the umbilical cord from the placental side to the newborn either before (intact cord milking) or after clamping and cutting the umbilical cord (cut cord milking) have been studied as alternatives to immediate or delayed cord clamping without cord milking.

While cord milking may achieve a transfusion of blood from the cord (and in the case of intact cord milking, also from the placenta), it is uncertain whether it achieves the same improvements in the postnatal cardiovascular transition as later (delayed) cord clamping.

For term and late preterm infants ≥34 weeks' gestation, a systematic review found insufficient evidence to draw strong conclusions about the role of either intact or cut cord milking when compared to early cord clamping. [41]

For term and late preterm infants, when comparing delayed cord clamping to cut cord milking, no differences were found for neonatal mortality, admission for neonatal intensive or special care, or

jaundice treated with phototherapy. Cut cord milking resulted in slightly higher haemoglobin concentrations and haematocrit values in the first week. [41]

There is insufficient evidence to recommend milking of the intact or cut cord for term and late preterm infants. [41]

A systematic review of studies of preterm infants (<34 weeks' gestation) found that when compared to early cord clamping, intact cord milking probably results in little to no difference in survival and major neonatal morbidities but may improve haemoglobin and haematocrit within the first week after birth. [42] There was insufficient evidence to determine the role of cut cord milking.

One large clinical trial comparing intact-cord milking with later (delayed) cord clamping closed recruitment before completion because of an increased rate of severe intraventricular haemorrhage in infants born at <28 weeks gestational age who received intact-cord milking.[44] However, for this outcome, meta-analysis of 4 trials involving 761 infants could not exclude benefit or harm from later (delayed) cord clamping compared to intact-cord milking (RR 0.60, 95% CI 0.32 to 1.12; I^2=23%).[44-47]

ANZCOR suggests against intact cord milking for infants born at less than 28+0 weeks' gestational age. [42] [Weak recommendation; very low certainty of evidence]

7.0 | Checking Resuscitation Equipment

ANZCOR guidelines should be considered in conjunction with accepted National Standards and local policies. ANZCOR is aware of cases where equipment failure (e.g., oxygen pipes being incorrectly connected resulting in hypoxic gases being administered, and resuscitation bag valve devices incorrectly assembled) has led to adverse outcomes.

The checking and maintenance of hospital and resuscitation equipment is covered by National Standards and local policies. Practitioners involved in resuscitation should always be alert to errors of assembly or use and have checking processes to minimise these risks before equipment is used. They should also respond to unexpected situations with further checking procedures, and in the case of unexplained hypoxia change gas supply and circuits, and include removing the patient from ventilators and gas supplies by using a self-inflating bag with room air. In this situation oxygen analysis of delivered gases should be considered and an oxygen analyser should be available. [Good Practice Statement]

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About this Guideline

Search date/s	ILCOR literature search details and dates are available on the CoSTR page of the ILCOR website (https://costr.ilcor.org) and the relevant CoSTR documents. [1, 2]
Questions/PICOs:	Are described in the CoSTR documents (https://costr.ilcor.org)
Method:	Mixed methods including ARC NHMRC methodology before 2017 and ILCOR GRADE methodology described in ILCOR publications since 2017.

Principal reviewers:	Helen Liley, Lindsay Mildenhall, Marta Thio and Callum Gately
Main changes	Update to include suggestion for role allocation in anticipation of need for newborn resuscitation. No major changes to other clinical recommendations. Updating of review evidence, references, and terminology to increase consistency with GRADE terminology.
Approved:	April 2021

Referencing this guideline

When citing the ANZCOR Guidelines we recommend:

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https://www.anzcor.org/home/neonatal-resuscitation/guideline-13-1-introduction-to-resuscitation-of-the-newborn