Neonatal resuscitation
### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tr>
<td>&lt;</td>
<td>Less than</td>
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<tr>
<td>&gt;</td>
<td>Greater than</td>
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<tr>
<td>bpm</td>
<td>Beats per minute</td>
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<tr>
<td>CDH</td>
<td>Congenital diaphragmatic hernia</td>
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<tr>
<td>CHD</td>
<td>Congenital heart disease</td>
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<tr>
<td>ETT</td>
<td>Endotracheal tube</td>
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<tr>
<td>FGR</td>
<td>Fetal growth restriction</td>
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<tr>
<td>Hb</td>
<td>Haemoglobin</td>
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<tr>
<td>HR</td>
<td>Heart rate</td>
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<tr>
<td>IVH</td>
<td>Intraventricular haemorrhage</td>
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Clinician skills

• All births
  ◦ At least one clinician responsible for baby with basic neonatal resuscitation skills present
  ◦ Clinician with advanced skills available

• High risk births
  ◦ Clinician with advanced skills present
  ◦ More than one clinician present

• Caesarean
  ◦ Same as vaginal births
Risk factors—maternal

- Prolonged ROM (>18 hours)
- Bleeding in second or third trimester
- Hypertension in pregnancy; diabetes mellitus; chronic illness
- Substance use; prescribed medication; heavy sedation
- Pyrexia; infection; chorioamnionitis
- Previous fetal or neonatal death; No/minimal antenatal care
Risk factors—fetal

- Multiple gestation
- Preterm; post term
- Fetal growth restriction; large for dates
- Polyhydramnios; oligohydramnios
- Haemolytic disease; hydrops fetalis
- Reduced fetal movements
- Congenital abnormalities
- Infection
Risk factors–intrapartum

- Abnormal CTG
- Abnormal fetal presentation; cord prolapse
- Prolonged labour; precipitate labour
- Antepartum haemorrhage
- Meconium in liquor
- Narcotic administration within 4 hours of birth
- Assisted vaginal birth; general anaesthesia
Preparation

• Staff—one person responsible only for baby
• Equipment and medications—available for all births
• Environmental temperature
  ◦ Warm, draft free, overhead radiant warmer
  ◦ Polyethylene bag for babies less than 28 weeks or very low birth weight
Communication and information sharing

• Maternal history–pre-existing or pregnancy related conditions, medication
• Fetal/neonatal–assessments of wellbeing, reason high risk
• Parents–discuss proposed plan, include in decision making, respond to questions
• Documentation–contemporaneous
Newborn Life Support

At all stages ask: do you need help?

- Term gestation?
  - Breathing or crying?
  - Good tone?
  - YES: Maintain normal temperature, Ensure open airway, Stimulate
  - NO: Maintain normal temperature, Ensure open airway, Stimulate

- HR below 100?
  - YES: Positive pressure ventilation, SpO2 monitoring
  - NO: Laboured breathing or persistent cyanosis?

- Ensure open airway
  - SpO2 monitoring
  - NO: Consider CPAP

- HR below 100?
  - YES: Ensure open airway, Reduce leaks, Consider: Increase pressure & oxygen, Intubation or laryngeal mask
  - NO: Post-resuscitation care

- HR below 60?
  - YES: Three chest compressions to each breath, 100% oxygen, Intubation or laryngeal mask, Venous access
  - NO: IV Adrenaline

- HR below 60?
  - YES: IV Adrenaline
  - NO: Consider volume expansion

Targeted pre-ductal SpO2 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
  - 27–38: 0.25 mL
  - 38–43: 0.5 mL
  - 10–30 mcg/kg (0.1–0.3 mL/kg)
Initial assessment & management at birth

• Tone
  ◦ Good tone, moving limbs and flexed position—less likely to require resuscitation
  ◦ Poor tone/floppy, not moving, extended position—more likely to need active resuscitation

• Breathing

• Heart rate
Oxygen saturation monitoring

- More accurate than visual assessment of colour by clinician
- HR and oximetry can be achieved within 90 seconds of birth
- Pre-ductal right hand or wrist:
  - Measures brain and coronary artery blood supply
  - Obtained more rapidly
    - Pre-ductal vessels better perfused, have higher blood pressure and higher oxygenation
Attaching the oximeter

• Use an oximeter designed to reduce movement artefact

• Use a neonatal sensor
  ◦ Attach to baby as soon as possible after birth

• Attaching the cable:
  ◦ Plug cable into machine without sensor lead attached and turn on
  ◦ Attach sensor to cable
# Target oxygen saturations

<table>
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<th>Time from birth</th>
<th>Target oxygen saturation</th>
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<tr>
<td>1 minute</td>
<td>60–70%</td>
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<tr>
<td>2 minutes</td>
<td>65–85%</td>
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<tr>
<td>3 minutes</td>
<td>70–90%</td>
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<tr>
<td>4 minutes</td>
<td>75–90%</td>
</tr>
<tr>
<td>5 minutes</td>
<td>80–90%</td>
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<tr>
<td>10 minutes</td>
<td>85–90%</td>
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After 10 minutes of age

- Term baby: 92–98%
- Preterm baby: 90–95%
Care of baby

• Support head in neutral position
• Careful handling and skin protection
  ◦ Preterm at greater risk of skin and internal organ damage
• Use alcohol containing solutions sparingly
Thermoregulation

• Target normal body temperature for all babies
  ◦ 36.5 ºC–37.5 ºC

• Oxygen consumption increased when:
  ◦ Cold stressed–temperature < 36.5 ºC
  ◦ Hypothermic–temperature < 36.0 ºC
Cord clamping

• Delayed cord clamping in non-compromised term baby for 60 seconds may result in:
  ◦ Increased placental transfusion
  ◦ Higher Hb and iron later
  ◦ Increased incidence of jaundice
Cord clamping

- Delayed cord clamping in non-compromised preterm baby may result in:
  - Stabilised BP at 4 hours of age
  - Reduced risk of intraventricular haemorrhage and periventricular leucomalacia
  - Increased blood volume
Airway management

• Effective ventilation is key to successful resuscitation

• Drying and stimulation are assessment and resuscitative measures

• Commence PPV if:
  ◦ Effective spontaneous respirations not established
  ◦ HR does not increase to above 100 bpm
Manual ventilation devices

• Facemask—appropriate size, seal around mouth and nose
• Laryngeal mask airway—size 1 for term or near term baby up to 5 kg
• T-piece device—requires pressurised gas source; have self-inflating bag available
• Self-inflating bag—cannot effectively deliver CPAP, PEEP or sustained inflation breath
• Flow inflating (anaesthetic bag)—requires pressurised gas source
Supplemental oxygen

- Commence PPV in air for term babies and use air to 30% oxygen for preterm babies
- Titrate oxygen requirements according to oxygen saturations
- Increase oxygen to 100% if chest compressions commenced
- Use a oxygen air blender if available
Positive pressure ventilation

• Rate:
  ◦ 40–60 breaths per minute

• Pressures:
  ◦ PEEP 5 cm H₂O
  ◦ Peak inspiratory pressure (PIP)
    ▪ Term: 30 cm H₂O
    ▪ Preterm: 20–25 cm H₂O
PPV effectiveness

• Confirmed by observing:
  ◦ HR >100 bpm
  ◦ Slight rise in chest and upper abdomen with each inflation
  ◦ Improvement on oxygen saturations
CPAP

• Indicated for baby:
  ◦ Breathing spontaneously with laboured breathing/respiratory distress
  ◦ Breathing but not meeting oxygen saturation targets

• Use 5–8cm H$_2$O via facemask or nasal prongs
Endotracheal intubation

• Indications:
  ◦ Unsuccessful face mask or LMA ventilation
  ◦ HR remains low
  ◦ Oxygen saturations falling or failing to rise
  ◦ Prolonged mask ventilation
  ◦ Special circumstances (e.g. diaphragmatic hernia)
  ◦ Baby has no detectable heart rate at birth
ETT position verification

- Chest moves with each inflation
- HR increases to above 100 bpm
- Oxygen saturations improve
- Other:
  - Visualisation of ETT passing through cord
  - Condensation on inside of ETT on exhalation
  - Colour change with paediatric end tidal CO₂ detector
  - Symmetrical air entry over lung fields on auscultation
Chest compressions

- Not a substitute for effective ventilation
- Increase oxygen to 100%
- Insert UVC or IV
- Ratio–3:1
- Rate 90 compressions to 30 breaths in one minute
Medications & fluids

• Rarely indicated for neonatal resuscitation
• Continue ventilations and chest compressions
• UVC preferable route
Adrenaline (epinephrine)

- **Indication:**
  - HR < 60 bpm

- **Route:**
  - UVC preferred

- **Dose:**
  - 1:10,000
  - 0.03 mg/kg or 0.3 mL/kg (vascular)
Volume expanding fluids

• Use isotonic crystalloid (0.9% sodium chloride or Hartmann’s solution)

• Indications:
  ◦ Suspected blood loss
  ◦ Shocked baby (pale, poor perfusion, weak pulses) and not responding to other resuscitative measures
Volume expanding fluids

• Blood products (Group O RhD negative)
  blood

• Indications:
  ◦ Critical blood loss
  ◦ Baby not responding to resuscitation (may be occult blood loss)
Preterm baby

Temperature management

• If < 28 weeks
  ◦ Do not dry
  ◦ Place in polyethylene/plastic bag (up to neck)
  ◦ Cover head with hat/bonnet
Preterm baby

Initiation of respiratory support

• Sustained inflation breath not recommended

• Commence CPAP in baby < 32 weeks
  ◦ If breathing spontaneously and showing signs of respiratory distress
  ◦ Use at least 5cm H$_2$O (no more than 8cm H$_2$O)

• Air or oxygen–air blend up to 30%
  ◦ Titrate to oxygen saturations
Other special circumstances

• Consider other special requirements for:
  ◦ Multiple pregnancy
  ◦ Pneumothorax
  ◦ Pleural effusion/ascites/fetal hydrops
  ◦ Pneumonia/sepsis
  ◦ Fetal haemorrhage
  ◦ Congenital anomalies
    ▪ Upper airway obstruction, CDH, CHD, abdominal wall defects
Cord blood gas sampling

- Cord blood gas sampling when:
  - Baby has required resuscitation
  - Apgar < 4 at one minute or < 7 at 5 minutes
  - Fetal blood sampling in labour

- Collect paired samples (umbilical vein and umbilical artery)

- Interpretation:
  - Relative risk of neonatal encephalopathy increased if cord arterial pH is low
Ethical considerations

• Initiating resuscitation:
  ◦ Consistent approach by all clinicians
  ◦ Discuss with parents and involve them in decision making

• Discontinuing resuscitation:
  ◦ Absent or very low HR at 10 minutes—poor prognosis for morbidity and mortality
  ◦ Apgar 1–3 at 20 minutes (babies < 34 weeks) —strong predictor of mortality or significant morbidity
Initiating resuscitation

• High rate of survival and acceptable morbidity—resuscitation usually indicated

• **Borderline survival and high rate of morbidity** with prognosis uncertain and burden to child high—support parents’ views

• **Almost certain death and unacceptable high morbidity** as indicated by gestation, birth weight or congenital anomaly—resuscitation not indicated

• Unexpected anomalies—offer full resuscitation until full clinical picture available and discussions occur with parents

• Clinicians and parents together decide to withhold or withdraw treatment based on futility and best interests of baby
Discontinuing resuscitation

• May be influenced by:
  ◦ Presumed diagnosis
  ◦ Gestation of baby
  ◦ Presence or absence of complications
  ◦ Parent(s) views regarding acceptable risk of morbidity
Withdrawal or withholding of resuscitation

• Focus on baby’s comfort if signs of life present

• Support parents