Approved by Quality & Patient Care Committee
16/3/17

NEONATAL RESUSCITATION AT DELIVERY

This LOP is developed to guide clinical practice at the Royal Hospital for Women. Individual patient circumstances may mean that practice diverges from this LOP.

1. AIM

- To provide appropriate resuscitation of the neonate correctly and safely

2. PATIENT

- Neonate requiring resuscitation:
  - Extremely preterm (<28^{+0} weeks)
  - Very preterm (28^{+0} to 31^{+6} weeks)
  - Moderate to late preterm (32^{+0} to 36^{+6} weeks)
  - Term (37^{+0} weeks and over)

3. STAFF

- Medical, midwifery and nursing staff

4. EQUIPMENT

- **General**
  - Infant resuscitaire with radiant heat source
  - Light for the area
  - Clock with timer in seconds
  - Warmed towels or blankets
  - Polyethylene bag and bonnet for neonate <32 weeks gestation
  - Stethoscope
  - Pulse oximeter with neonatal probe
  - Blood gas syringes/needles and analyser

- **Airway**
  - Mechanical suction/tubing – negative pressure source not to be >100mmHg
  - Suction catheter – minimum of two of each size (8 French (F), 10F or 12F)
  - Oropharyngeal airways (size 0 and 00)
  - Laryngoscopes with infant blades - at least one each of size 00,0,1
  - Spare laryngoscope batteries
  - Endotracheal tubes (ETT)- minimum of two of each size (2.5, 3.0, 3.5, 4.0 mm, uncuffed, no eye)
  - Endotracheal stylet or introducer
  - Supplies for fixing endotracheal tubes (e.g. scissors, tape)
  - End-tidal carbon dioxide detector (Pedicap)
  - Meconium aspirator
  - Magills forceps
  - Laryngeal mask airway (LMA), size 1 for neonate ≥34 weeks' gestation and ≥2kg

- **Breathing**
  - Positive-pressure ventilation device including:
    - T piece resuscitator (Neopuff)
    - Self-inflating bag (approximately 240 mLs)
  - Appropriate size mask. Please BE AWARE, small masks (e.g. 35mm) for extreme preterm neonates are not routinely available on resuscitaires and need to be brought from the Neonatal Intensive Care Unit (NICU) if required

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- Blended oxygen/gas supply
- Size 8 F feeding tubes and 10mL syringe for gastric decompression

- **Circulatory**
  - Peripheral cannulation insertion pack
  - Umbilical catheter pack
  - Umbilical venous catheter (UVC) size 3.5F or size 5F feeding tube
  - 3-way tap
  - Intraosseous needles – 50mm length
  - Tapes to secure UVC/intravenous cannula (IVC)
  - Syringes and needles (assorted sizes)
  - Skin preparation solution

- **Medication and fluids**
  - Adrenaline 1:10,000 concentration (0.1 mg/mL)
  - 0.9% normal saline

5. CLINICAL PRACTICE

- Recognise high risk delivery where neonate may require resuscitation
- Summon appropriate level of assistance (Appendix 1)
- Prepare equipment for resuscitation
- Remember effective ventilation is the key to successful resuscitation of the neonate
- **DO NOT DRY** neonate **<32 weeks' gestation**. Place the neonate **<32 weeks' gestation** in a polyethylene bag up to neck immediately after birth. Put a bonnet on head
- Dry the neonate **≥32 weeks' gestation** and keep warm (skin temp 36.5-37.5^{0}C)
- Assess the neonate within 30 seconds of birth for respiration, heart rate (HR) (using auscultation with stethoscope) and tone. (see Appendix 2)
- Provide routine care if **respirations are regular** and **HR is >100 beats per minute(bpm)**

Respirations are irregular but **HR >100bpm**

- Position neonate in a neutral position
- Ensure open airway
- Provide positive pressure ventilation (PPV) with 21% oxygen (O2) using appropriate sized face mask. Start at peak inspiratory pressure (PIP) of 30cmH2O (term neonate), PIP of 20-25cmH2O (preterm neonate), and positive end expiratory pressure (PEEP) of 5, at 40-60 breaths/min
- Consider increasing PIP if there is minimal chest movement during inflation
- Consider continuous positive airway pressure (CPAP)
- Use pulse oximetry by applying probe onto neonate's right wrist, prior to connecting to monitor

Respirations are irregular and/or **HR <100bpm**

- Reposition the head to maintain open airway and adjust face mask to ensure seal
- Provide PPV with 21% O2. Start at PIP of 30cmH2O (term neonate), PIP of 20-25cmH2O (preterm neonate), and PEEP of 5, at 40-60 breaths/min
- Assess chest movement and adjust pressure to achieve adequate ventilation
- Assess mask fit
- Use pulse oximetry by applying probe onto neonate's right wrist, prior to connecting to monitor

NEONATAL RESUSCITATION AT DELIVERY cont'd

- Provide blended O2 and titrate it to maintain neonatal preductal O2 saturations as per Appendix 2
- Consider CPAP
- Consider intubation or LMA if adequate ventilation not achieved with mask ventilation

HR is persistently <60bpm despite adequate assisted ventilation

- Start cardiac compressions (90 chest compressions to 30 breaths per minute [3:1])
- Use two thumb-encircling hands method
- Increase blended O2 to 100%
- Consider endotracheal (ET) intubation or LMA if adequate ventilation not achieved with mask ventilation
- **Activate a CODE BLUE Call (Dial 2222) if there is no improvement of HR within 1 minute of adequate ventilation with chest compressions.**

HR is still <60bpm after 30 seconds of effective PPV and chest compressions

- Ensure neonate intubated
- Administer adrenaline via ETT:
  - Solution: 1 in 10,000
  - 0.5 – 1.0 mL/kg
- Insert UVC for medication administration. Insert to approximately 5cm from stump for term neonate, and approximately 3cm for preterm neonate
- Ensure blood returns freely upon aspiration of UVC
- Secure UVC to abdomen of neonate with adhesive tape
- Administer adrenaline:
  - Solution: 1 in 10,000
  - 0.1 – 0.3 mL/kg intravenously (IV)
  - Ensure UVC is flushed with 0.9% normal saline after administration of medication
- Continue chest compressions after administration of adrenaline to ensure circulation of medication
- Consider volume expansion (0.9 % normal saline or whole blood if indicated)

Presence of meconium-stained liquor

- Provide routine care if neonate is vigorous with good respiratory effort, normal tone and HR>100bpm
- Consider intubation and brief tracheal suctioning using a meconium aspirator by a skilled clinician, if neonate is not vigorous at birth
- Provide PPV with 21% O2 within the first 30 seconds after birth in the non-breathing, or ineffectively breathing neonate with poor muscle tone
- Do not perform endotracheal suction at this stage as it may delay intervention

Blended Oxygen Use

- Aim for O2 saturation that resembles that of a healthy term neonate regardless of gestation (Appendix 2)
- Use supplemental oxygen judiciously and be guided by pulse oximetry
- Use 21% O2 at the commencement of resuscitation for **term neonate**
- Apply pulse oximetry on the right wrist (for preductal saturations) at the commencement of resuscitation
- Use either 21% O2 or a low concentration O2 (up to 30 %) for **preterm neonate or those with lung pathology**

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- Consider higher concentration of O2 if oxygenation (ideally guided by oximetry) remains unacceptable despite effective ventilation
- Use blended O2 if required, guided by pulse oximetry. Target blended O2 concentration every minute according to clinical response

Tracheal Intubations

- Calculate ETT size by using gestational age in weeks divided by 10
- Use laryngoscope straight blade (Refer to table 1)

Table 1: Determination of laryngoscope blade size in relation to neonate's gestational age

Gestation (weeks)	Laryngoscope Blade size
23-24	00
25-26	00
27-29	00
30-32	0
33-34	0
35-37	0
38-40	1
41-43	1

- Identify depth of insertion of ETT by calculating weight in kg plus 6cm
- Check signs of successful intubation:
    - ESSENTIAL
        - Visualisation of tube passing through vocal cords
        - Colour change towards yellow on carbon dioxide (CO^2) detector ("Gold is Good")
        - Auscultation of equal breath sounds
    - DESIRABLE
        - Condensation mist within ETT
        - Chest movement with each breath
        - Improved HR and oxygen saturations

Medications for Resuscitation

- Use:
    - **Adrenaline (1:10,000 solution; 0.1 ml contains 10 micrograms (mcg) of adrenaline)** when the HR remains <60 after 30 seconds of adequate ventilation and chest compressions
        - Administer undiluted adrenaline via ETT:
            - Solution: 1 in 10,000
            - 0.5 – 1.0 mL/kg
        - Administer undiluted adrenaline via UVC:
            - Solution: 1 in 10,000
            - 0.1 – 0.3 mL/kg IV
            - Ensure line is flushed with 1 mL 0.9% normal saline after administration
            - Repeat intravenously in 3 minute cycles where the HR remains < 60bpm

NEONATAL RESUSCITATION AT DELIVERY cont'd

- **Naloxone** for reversal of respiratory depression in a neonate whose mother received narcotics within 4 hours of birth. Ensure adequate ventilation and circulation before administration
  - **Dose: 0.1 mg/kg of a 0.4 mg/mL** solution given intramuscularly (IM) or IV
  - **DO NOT administer Naloxone to neonate born to woman suspected of narcotic dependence. This may cause abrupt withdrawal and seizures**
- **Sodium Bicarbonate** in the case of prolonged resuscitation and/or unresponsive to other therapy. It should be given only after all attempts to establish ventilation and circulation. Treatment of persistent metabolic acidosis should be guided by arterial blood gas level or serum chemistries.
  - **Dose: 1-2 mEq/kg of a 0.5 mEq/mL** solution. Dilute in equal volume with water for injection. Give by slow IV push over at least 2 minutes
  - **DO NOT give via ETT**

- Be aware that Naloxone and Sodium Bicarbonate are not routinely stocked in the resuscitation trolley. It is kept in the medication room of each respective ward/NICU

Volume expanders

- Use where there is suspected blood loss or the neonate appears pale, poorly perfused, has a weak pulse and not responded adequately to other resuscitative measures
- **Give 0.9% normal saline 10mL/kg** by slow IV push over 5-10 minutes
- Use O negative blood if available in the setting of massive blood loss. Emergency O Neg blood is stored in the fridge in Randwick Campus Operating Suite (RCOS)

Post Resuscitation Care

- Report and record events accurately using the neonatal resuscitation record (top drawer of resuscitaire)
- Obtain cord pH (ideally arterial) for neonate needing active resuscitation. Paired cord sampling is recommended in any delivery requiring paediatric attendance.
- Report immediately to neonatal registrar/paediatric RMO if arterial pH is $\leq$7.10
- Identify neonate requiring admission to Newborn Care Centre (NCC):
  - intubated and extubated at delivery
  - arterial cord pH <7.0. Admit for formal observations for at least 4 hours and consider discharge after documented review by the medical staff
  - if received Naloxone at birth. Admit for observation for at least 4 hours
- Insert an orogastric tube (Size 8 F) to aspirate and decompress the stomach of any neonate that required prolonged ventilation
- Invite the relevant support person (if present) of the neonate to accompany the resuscitation team and neonate to NCC
- Consult with the Fellow/Consultant and consider discontinuation of resuscitative efforts if the neonate with cardiorespiratory arrest does not result in spontaneous circulation (measurable heart rate) by 15 minutes of adequate resuscitation

6. DOCUMENTATION

- Integrated Clinical Notes
- Paediatric Medication Chart
- Resuscitation record
- Standard Neonatal Observation Chart (SNOC)
- ObstetriX
- Partogram
- PACE form
- NICUS database

NEONATAL RESUSCITATION AT DELIVERY cont'd

7. EDUCATIONAL NOTES

- Temperature: The temperature of a non-asphyxiated neonate should be maintained between 36.5°C and 37.5°C after birth. The admission temperature should be recorded as a predictor of outcome as well as a quality indicator.
- Maintenance of temperature: At < 32 weeks' gestation, placing the neonate in a plastic bag and placing a bonnet on the head has been shown to be effective in reducing hypothermia.
- Meconium: Tracheal intubation should not be routine in the presence of meconium and should only be performed for suspected tracheal obstruction. The emphasis should be on initiating ventilation within the first minute of life in non-breathing or ineffectively breathing neonates and this should not be delayed.
- Air/O2: Ventilatory support of term neonates should start with air. For preterm neonates, either air or a low concentration of O2 (up to 30 %) should be used initially. If, despite effective ventilation, oxygenation (ideally guided by oximetry) remains unacceptable, use of a higher concentration of O2 should be considered.
- CPAP: Initial respiratory support of spontaneously breathing preterm neonates with respiratory distress may be provided by CPAP rather than intubation.
- It is mandatory for all health care professionals involved in the direct care of neonates to attend a teaching and assessment session annually.
- The 2016 Newborn Life Support Flow diagram has renewed focus on the first minute after birth. (Refer Appendix 2). The emphasis is on rapid assessment and prompt initiation of first response interventions. It is imperative to ensure that each step is being performed well.
- Medications are rarely indicated in resuscitation of the neonate as bradycardia is usually the result of inadequate lung inflation or profound hypoxia. Adequate ventilation is the most important step in correcting bradycardia.
- The umbilical vein is the most accessible IV route for volume expansion and administration of medication. Consider UVC when chest compressions are required.
- Endotracheal route may be used for administration of adrenaline only.
- Recommendation from ILCOR guidelines: Appropriate to consider stopping resuscitation in a neonate with no detectable heart rate for 10 minutes. Decision to continue resuscitation for longer than 10 minutes may be influenced by neonate's gestation, aetiology of arrest, potential reversibility of situation and parental wishes about acceptable risk of morbidity. There is insufficient evidence to guide duration of continued resuscitation for neonate with heart rate <60bpm persisting after 10 or 15 minutes.

8. RELATED POLICIES/PROCEDURES/CLINICAL PRACTICE LOP

- Neonatal Observations
- Admission of the neonate to postnatal services
- Admission of a neonate to newborn care centre (NCC)

9. RISK RATING

- Medium

10. NATIONAL STANDARD

- Standard 9 – Clinical Deterioration

NEONATAL RESUSCITATION AT DELIVERY cont'd

11. REFERENCES

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- Weiner GM, Zaichkin JG (2016) *Textbook of Neonatal Resuscitation (NRP*), 7th Ed: retrieved from http://reader.aappublications.org/textbook-of-neonatal-resuscitation-nrp-7th-ed/1
- Wyckoff MH, Aziz K & Escobedo MB et al. (2015) American Heart Association. Part 13: Neonatal Resuscitation. 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation.* 132 (suppl 2): S543-S560

REVISION & APPROVAL HISTORY

Change 777 to 2222 February 2019
Amendments under Equipment General, Post Resuscitation Care and Appendix 1 July 2017
Reviewed and endorsed Maternity Services LOPs 14/3/17

Replaced :
Neonatal Resuscitation Guidelines at Delivery:
Approved Quality & Patient Safety Committee 16/2/12
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Approved Patient Care Committee 4/9/08
Reviewed November 2006 / Approved Quality Council 18/12/06
Reviewed March 2006 / Approved Quality Council 19/6/06
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Neonatal Resuscitation Guidelines:
Approved Patient Care Committee 4/9/08
Reviewed and endorsed Neonatal Clinical Committee 16/7/08
Reviewed March 2006 / Approved Quality Council 19/6/06
Reviewed Novembe 2006 / Approved Quality Council 18/12/06
Approved Quality Committee 16/5/05

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APPENDIX 1

Level of paediatric attendance at birth

Risk Factor	Minimum Level of Assistance Required
Antepartum and/or intrapartum haemorrhage	Paediatric Registrar
Abnormal amniotic fluid index and/or abnormal Doppler flow studies	Paediatric RMO
Anaemia or isoimmunisation	Paediatric Registrar
Cardiotocograph (CTG) suspicious or pathological	Paediatric RMO/Paediatric Registrar
Chorioamnionitis	Paediatric RMO
Chronic maternal illness	Attending Midwife
Eclampsia	Paediatric Registrar
Elective Caesarean, regional anaesthetic	Resuscitation Nurse/Midwife
Emergency caesarean according to risk factor	Depends on indication for caesarean – at least Paediatric RMO
Fetal abnormality	Paediatric RMO/Registrar
Fetal blood sampling; pH <7.20 or lactate >4.8	Paediatric Registrar
General anaesthetic	Paediatric RMO/Paediatric Registrar
Hydrops fetalis	Paediatric Registrar and Fellow/Consultant
Hypertension	Attending midwife
Instrumental delivery	Paediatric RMO
Intrauterine growth restriction	Paediatric RMO
Malpresentation	Paediatric RMO
Maternal diabetes	Attending midwife
Maternal drug therapy e.g. Magnesium Sulphate	Attending midwife
Maternal substance abuse	Attending midwife
Meconium	Paediatric Registrar experienced in intubation
Multiple gestation	Paediatric RMO and Paediatric Registrar +/- Neonatal Intensive Care Nurse if other risk factors
Narcotics administered to mother within 4 hours of birth	Attending Midwife
No antenatal care	Attending Midwife
Placental and cord accidents (e.g. cord prolapse or placental abruption)	Paediatric Registrar
Pre-eclampsia	Attending Midwife
Prematurity <32 weeks	Neonatal Consultant or Fellow and Paediatric Registrar and Neonatal Intensive Care Nurse
Prematurity 32 weeks to 37 weeks	Paediatric Registrar and Paediatric RMO
Prolonged (>18 hours) rupture of membranes at term	Attending Midwife
Prolonged second stage of labour (>2 hours)	Attending Midwife
Shoulder dystocia	Paediatric Registrar

APPENDIX 2

Algorithm for resuscitation of the newborn infant (ILCOR 2015)