Queensland Clinical Guidelines

Translating evidence into best clinical practice

Maternity and Neonatal **Clinical Guideline**

Neonatal stabilisation for retrieval

Queensland Government

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- Advising consumers of their choices in an environment that is culturally appropriate and which enables comfortable and confidential discussion. This includes the use of interpreter services where necessary
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- Documenting all care in accordance with mandatory and local requirements

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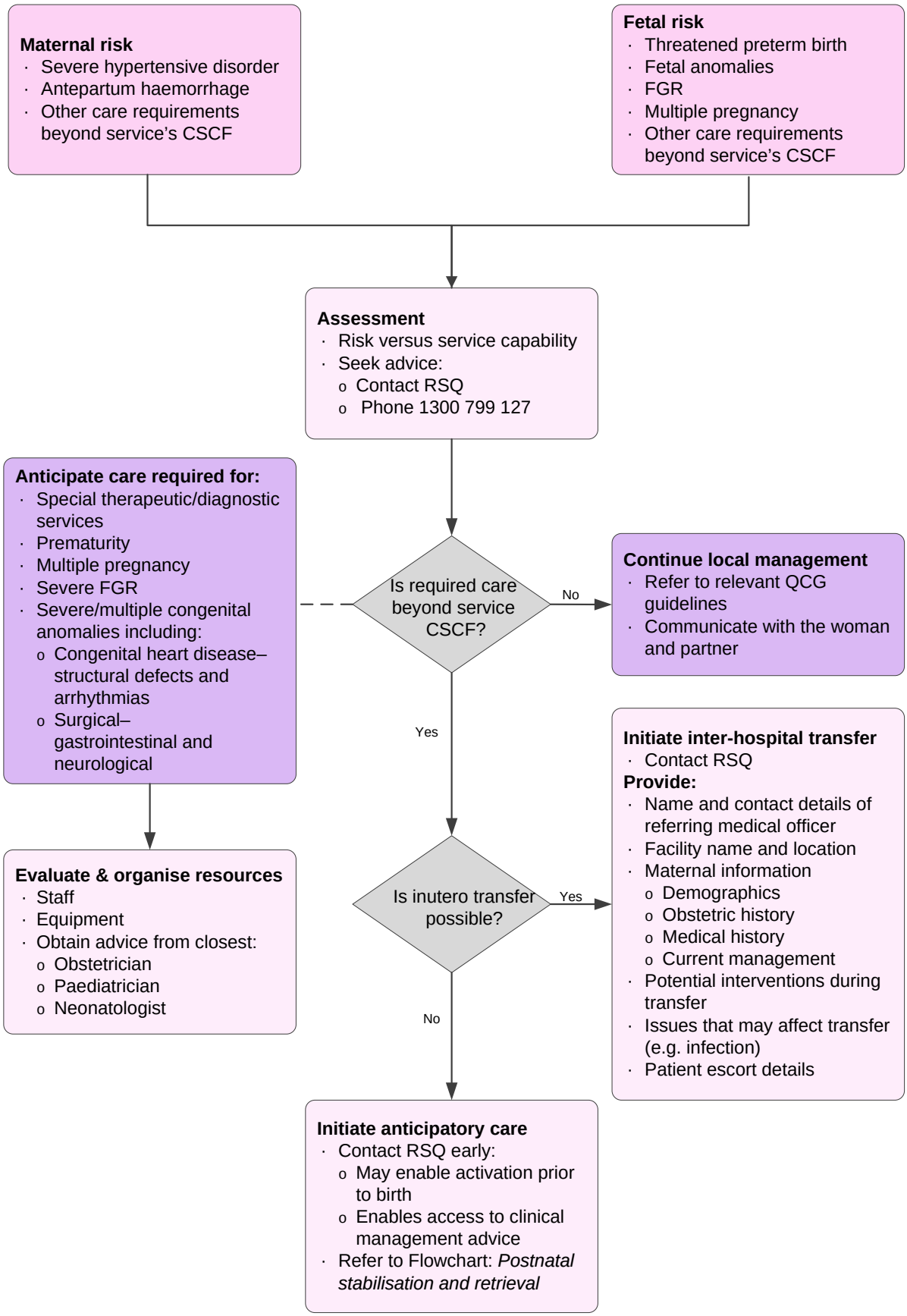
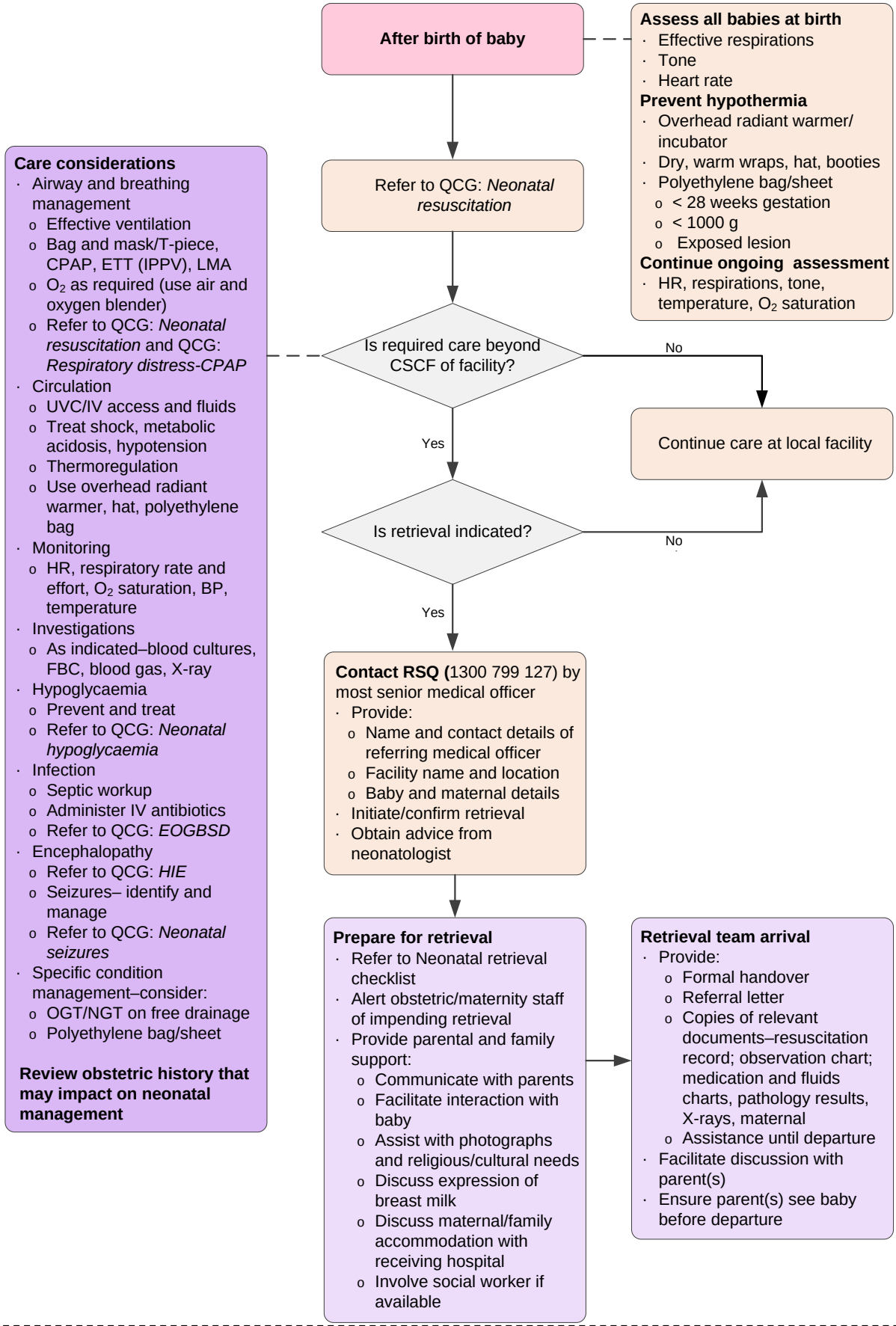
Flow Chart: Antenatal transfer or retrieval



CSCF: Clinical services capability framework; **FGR:** Fetal growth restriction; **QCG:** Queensland Clinical Guidelines; **RSQ:** Retrieval Services Queensland

Flowchart: F18.18-1-V3-R23

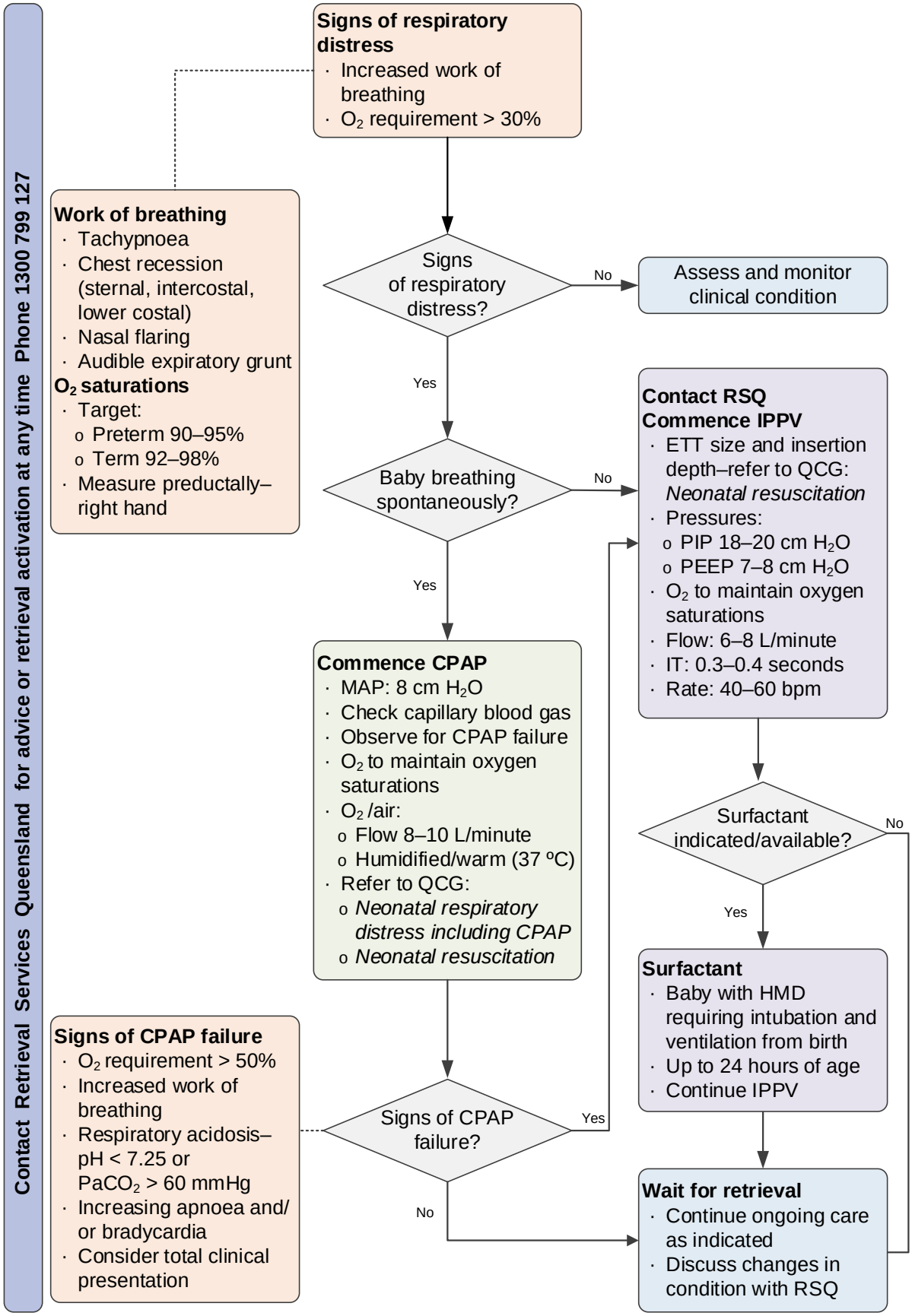
Flow Chart: Postnatal stabilisation and retrieval



BP: Blood pressure; **CPAP:** Continuous positive pressure airway pressure; **CSCF:** Clinical services capability framework; **EOGBSD:** Early onset Group B Streptococcal disease; **ETT:** Endotracheal tube; **FBC:** Full blood count; **LMA:** Laryngeal mask airway; **HIE:** Hypoxic ischaemic encephalopathy; **HR:** Heart rate; **IPPV:** Intermittent positive pressure ventilation; **IV:** Intravenous; **NGT:** Nasogastric tube; **O_2:** oxygen; **OGT:** Orogastric tube; **QCG:** Queensland Clinical Guidelines; **RSQ:** Retrieval Services Queensland; **UVC:** Umbilical vein catheter

Flowchart: F18.18-2-V3-R23

Flow Chart: Respiratory distress



<: less than; **>:** more than; **bpm:** breaths per minute; **cm H_2O:** centimetres of water; **CPAP:** continuous positive airway pressure; **ETT:** endotracheal tube; **HMD:** Hyaline membrane disease; **IPPV:** intermittent positive pressure ventilation; **MAP:** mean airway pressure; **IT:** inspiratory time; **O_2:** oxygen; **$PaCO_2$:** partial pressure of carbon dioxide; **PEEP:** positive end expiratory pressure; **PIP:** peak inspiratory pressure; **QCG**: Queensland Clinical Guidelines; **RSQ**: Retrieval Services Queensland

Flowchart: F18.18-4-V4-R23

Abbreviations

BGL	Blood glucose level
CPAP	Continuous positive airway pressure
ECG	Electrocardiogram
EOGBSD	Early onset Group B Streptococcal disease
ETT	Endotracheal tube
FBC	Full blood count
HIE	Hypoxic ischaemic encephalopathy
IM	Intramuscular
IPPV	Intermittent positive pressure ventilation
IV	Intravascular
LBW	Low birth weight
NBM	Nil by mouth
NEC	Necrotising enterocolitis
PIP	Peak inspiratory pressure
RSQ	Retrieval Services Queensland
UVC	Umbilical vein catheter
VSD	Ventricular septal defect

Definitions

Replogle tube	Double lumen tube inserted through the baby's mouth or nares into the blind ending oesophageal pouch and used to drain secretions.
VATER/VACTERL association	Vertebral defects, anal atresia, cardiac anomalies, tracheo-oesophageal fistula, renal anomalies, limb anomalies.
CHARGE association	Coloboma of the eye, heart defects, choanal atresia, growth restriction, genital anomalies and ear anomalies.

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1 Introduction

Antenatal transfer of the woman with a high risk pregnancy reduces neonatal morbidity and mortality.[1] Babies who unexpectedly require resuscitation outside a perinatal tertiary centre may require stabilisation and subsequent transfer or retrieval.

Maternity services that work within their service capabilities ensure optimal outcomes for both the woman and her baby. Babies who are born outside of the expected gestational age and weight for the level of service capability may, based on clinical decision-making, be managed safely at the local level. These decisions are made in consultation with clinicians at higher level service.[2]

Initial resuscitation and stabilisation prior to transfer or retrieval of babies is critical to their long term outcomes.[3] The risk of mortality and major morbidity increases with decreasing gestational age and is higher among out born babies compared with those born in a perinatal tertiary centre.[3-5]

1.1 Indications for transfer or retrieval

Transfer or retrieval may be indicated when the required clinical care of the baby exceeds the Clinical Services Capability Framework (CSCF) of the birthing facility.[6] Where possible, transfer the woman to a higher level facility prior to delivery. If antenatal transfer of the women is not possible contact the Retrieval Service Queensland (RSQ) for advice regarding management prior to the baby's birth. Early activation of the retrieval team prior to the baby's birth can be made when indicated.

Table 1. Indications for transfer

Aspect	Comment
Antenatal[7,8]	· Known congenital anomaly · Multiple birth · Suspected cardiac anomaly · Fetal growth restriction · Preterm labour (as relevant to CSCF) · Placenta praevia · Pre-eclampsia · Prolonged rupture of membranes
Neonatal[8,9]	· Birth weight: o Low birthweight (LBW) o Very low birth weight (VLBW) o Extremely low birth weight (ELBW) · Prematurity · Respiratory conditions [refer to Queensland Clinical Guideline: *Respiratory distress including CPAP*[10]] o Respiratory distress syndrome o Transient tachypnoea of the newborn (TTN) o Pneumonia o Persistent pulmonary hypertension of the newborn (PPHN) o Meconium aspiration syndrome o Air leaks—pneumothorax · Recurrent apnoea · Mechanical ventilation · Hypoxic-ischaemic encephalopathy (HIE) [refer to Queensland Clinical Guideline: *Hypoxic-ischaemic encephalopathy (HIE)*[11]] · Seizures [refer to Queensland Clinical Guideline: *Neonatal seizures*[12]] · Severe neonatal abstinence syndrome [refer to Queensland Clinical Guideline: *Perinatal substance use–neonatal*[13]] · Hyperbilirubinemia [refer to Queensland Clinical Guideline *Neonatal jaundice*[14]] · Persistent hypoglycaemia [refer to Queensland Clinical Guideline *Newborn hypoglycaemia*[15]] · Sepsis · Conditions requiring specialty management (e.g. surgery) · Congenital heart disease · Refer to Section 12 Specific conditions

1.2 Referral for retrieval

RSQ provides a single point of contact and assists the most senior clinician at the referring hospital to consult with appropriate clinicians for example, neonatologist, surgeon, cardiologist and retrieval teams for advice and further management.

A variety of transport modes including ambulance, fixed wing or helicopter are used. The mode of transport used depends on:

- Clinical condition of the baby
- Urgency
- Transport availability
- Distance
- Weather conditions

Table 2. Information for Retrieval Services Queensland

Aspect	Consideration
General[16]	· Contact details of referring medical officer · Referring hospital · Parents' intention to travel with the baby [refer to Table 20. Parent considerations]
Maternal[16]	· Demographic information (name, date of birth, address, phone number) · Maternal history—antenatal and any pre-existing medical conditions · Perinatal history · Weight of parent (mother or father) if accompanying baby · Father's full name if accompanying baby · Other (e.g. social, family or religious)
Neonatal[16]	· Name · Date of birth · Time of birth · Gestation · Weight · Gender · Birth details · Apgar scores and resuscitation required · Current observations—heart rate, respiration rate, blood pressure, oxygen saturations, temperature, colour, respiratory effort, other (e.g. seizure activity, apnoea, hyperbilirubinemia) · Investigations—pathology, imaging · Current management (e.g. ventilation, oxygen requirement, fluids, medications) · Any information that may affect the transfer (e.g. general concerns, suspected infection)

2 Initial management

Some babies require ongoing support after initial resuscitation and the level of support will depend on the clinical condition of the individual baby.

General principles of management include[17]:

- Identify immediate needs
- Stabilise the baby and prevent deterioration
- Identify and initiate diagnostic investigations
- Establish and maintain communication with the baby's parent(s)

2.1 Resuscitation

Anticipate and plan for the baby's resuscitation prior to the birth. At birth assess the need for immediate and ongoing resuscitation.

Refer to Queensland Clinical Guideline: *Neonatal resuscitation*[18]

Table 3. Resucitation preparation

Aspect	Good practice point
Staff	· Appropriate level of skill · Familiar with the equipment, medications and resuscitation trolley layout
Equipment	· Readily available for all births regardless of risk · Complete and operational
Environment	· Preheated overhead radiant warmer positioned in draft free area · Prewarmed blankets and hat · Babies less than 32 weeks gestation or LBW may require a combination of additional measures: o Increase birthing room temperature (if possible) o A polyethylene bag or sheet up to the baby's neck § Particularly babies less than 28 weeks gestation § Do not dry baby prior to use § Use appropriate size, food or medical grade and heat resistant[19,20]

2.2 Thermoregulation

The normal axilla temperature for a baby is 36.5–37.5 °C.[21] Avoid hypothermia or hyperthermia as both are potentially harmful and associated with increased morbidity and mortality.[22] Preterm babies and those who require prolonged resuscitation are particularly susceptible to hypothermia and may require additional measures to reduce heat loss.[22,23]

Table 4. Thermoregulation

Aspect	Good practice point
Resuscitation	· Refer to Queensland Clinical Guideline: *Neonatal resuscitation*[18]
Environment[9]	· Provide a warm and draft free environment · Use sheets, towels and blankets prewarmed in a temperature controlled blanket warmer · Prewarm overhead radiant warmer or incubator o Use servo-control (if available) o Consider reducing set temperature when baby's axilla temperature is greater than or equal to 37.2 °C o Avoid covering baby with blankets—(especially over temperature sensor)
Observations	· Refer to Table 7. Observations and monitoring · If passively cooling baby refer to Queensland Clinical Guideline *Hypoxic-ischemic encephalopathy (HIE)*[11]
Preterm and low birth weight	· Leave baby in polyethylene bag (when used) · Keep baby's head covered with a hat · After initial resuscitation transfer baby to warmed humidified incubator (if available)

2.3 Clinical support

Table 5. Clinical support

Aspect	Good practice point
Respiratory support	· Maintain a patent airway [refer to Section 4 Respiratory support]
Clinical care	· Establish intravascular (IV)access · Commence maintenance fluids [refer to Table 14. Intravascular access] · Nil by mouth (NBM) · Insert nasogastric tube size 6–8 Fg: o If respiratory distress, insert orogastric tube o Leave on free drainage o Aspirate 4–6 hourly
Skin preparation solutions	· No consensus and limited evidence for optimal skin preparation solution[24] · Can burn and damage sensitive newborn skin (e.g. when used for IV, umbilical venous catheter (UVC) or intercostal catheter (ICC) procedures) · For all babies: o Use all solutions sparingly on the smallest skin area necessary o Dab on gently and allow solution to dry o Avoid pooling of solution on or under baby o Remove bedlinen that has been soiled with solution · For babies less than or equal to 1000 grams or less than or equal to 28 weeks[25,26] take particular care to avoid skin burns o Use aqueous chlorhexidine 0.1% (if available) § Containing no dyes, stabilisers or detergents o If aqueous chlorhexidine 0.1% is not available, use other solutions with caution and gently wash skin with normal saline 0.9% after procedure completed[24] · For babies greater than 1000 grams or greater than 28 weeks, follow local protocols for skin preparation solution use
Developmental care[16]	· Positioning—provide flexion, containment and midline alignment · Handling—organise and coordinate care to minimise handling · Environmental—reduce noise and light · Encourage parental contact—touching and hand containment
Hygiene and comfort	· Perform four to six hourly—nappy change, mouth care, position change and pressure area care, oxygen saturation sensor reposition

2.4 Investigations

All unwell babies require initial investigations to identify underlying causes. Further investigations are completed as indicated after discussion with neonatal medical coordinator via RSQ and as able within the facility's CSCF.

Table 6. Investigations

Aspect	Good practice point
Initial	· Blood o Blood glucose level (BGL) [refer to Table 12. Glucose monitoring and management] o Full blood count (FBC) with differential o Blood cultures—arterial or venous samples o Blood gas (include lactate if possible) § When signs of respiratory distress present § If baby being ventilated · Chest X-ray—ensure gastric tube is insitu
As indicated	· Electrolytes · Serum bilirubin o Refer to Queensland Clinical Guideline *Neonatal jaundice*[14] · Urine · Cerebrospinal fluid (CSF) · Nasopharyngeal aspirate · Imaging o If bowel perforation is suspected—lateral decubitus (left side down) abdominal X-ray o Chest and abdominal X-ray to confirm umbilical line, endotracheal tube (ETT), oro/naso gastric tube placement

3 Observations and monitoring

Unwell babies require continuous monitoring and observation as their condition may change rapidly. Document observations hourly unless they become abnormal then increase the frequency as indicated.

Table 7. Observations and monitoring

Aspect	Good practice point
Temperature	· Normal temperature: 36.5–37.5 °C[21] · Monitor skin temperature continuously (if available) · Monitor temperature per axilla at least 4 hourly[9] · Recheck per axilla temperature one hour after implementing additional treatment for an abnormal temperature
Heart rate	· Monitor continuously · Normal resting heart rate: o Preterm: 120–160 beats per minute o Term: 95–160 beats per minute[27]
Respirations	· Monitor continuously · Normal respiratory rate: 30–60 breaths per minute[27,28] · Assess work of breathing—nasal flaring, subcostal/intercostal/sternal recession, grunting, tracheal tug · Refer to Table 8. Respiratory support
Oxygen saturation	· Monitor continuously and record pre-ductal measurement from right hand or wrist · In the absence of good quality evidence, Queensland Neonatal Services Advisory Group (QNSAG) endorse the following consensus recommendation for oxygen saturation targets after 10 minutes of age o Term baby 92–98% o Preterm baby 90–95% · Note position of sensor · Monitor oxygen requirement
Blood pressure	· Monitor hourly including mean arterial pressure using cuff appropriate to baby's size—two thirds of the limb length[29] · Acceptable minimum mean arterial pressure is equivalent to or greater than the baby's gestational age (weeks)[30,31] · Significant elevation in mean arterial pressure maybe pathological and indicative of a central nervous system event o Discuss with neonatologist regarding investigation and management · If suspected congenital cardiac condition refer to Section 12.3 Cardiac disorders
Observation	· Colour—pink, pale, acrocyanotic, cyanotic, jaundiced, mottled · Skin integrity—presence of bruising, rashes, skin breaks, lesions · Capillary refill time: o Measure on sternum or head[32] o Normal: less than or equal to two seconds[32] · Activity—alert, lethargic · Tone—normal, hypotonic (floppy), hypertonic · Movement—normal, abnormal o Refer to Queensland Clinical Guideline: *Neonatal seizures*[12] · Abdomen—soft, distended, masses, bowel sounds · Umbilicus—dry, ooze, clamp secure · IV site [refer to Table 14. Intravascular access]
Fluid intake	· NBM · Glucose 10% infusion rate [refer to Table 14. Intravascular access]
BGL	· Maintain BGL greater than or equal to 2.6 mmol/L · Refer Table 12. Glucose monitoring and management · Refer to Queensland Clinical Guideline: *Newborn hypoglycaemia*[15]
Output	· Gastric aspirate—colour and volume · Urine—amount, frequency, colour · Bowel activity—colour, type, abnormalities (e.g. mucous plug, blood)
Medications	· Time administered and response

4 Respiratory support

Additional respiratory support may be required when the baby has increased work of breathing with increased oxygen requirements to maintain oxygen saturations.

Refer to Table 9. Continuous positive airway pressure and Table 10. Intermittent positive pressure ventilation.

Table 8. Respiratory support

Aspect	Good practice point
Airway	· Positioning—head in neutral position[21] · If oropharyngeal suctioning required: o Use a large bore catheter[21] § Term baby—size 8, 10 or 12 Fg § Preterm baby—size 8 or 10 Fg o Do not exceed 100 mmHg negative pressure[21] · If required insert an oropharyngeal airway · If continuous positive airway pressure (CPAP) required: o Refer to Table 9. Continuous positive airway pressure o Refer to Queensland Clinical Guideline *Neonatal respiratory distress including CPAP*[10] · Endotracheal intubation: o Refer to Table 10. Intermittent positive pressure ventilation o Refer to Queensland Clinical Guideline *Neonatal resuscitation*[18] · Laryngeal mask airway o Refer to Queensland Clinical Guideline *Neonatal resuscitation*[18]
Mask ventilation	· Use to provide respiratory support—CPAP or intermittent positive pressure ventilation (IPPV)) o At initial resuscitation o For short term use · Deliver using any of: o T-piece device—IPPV and CPAP o Self-inflating bag—IPPV only o Flow-inflating bag with manometer attached—IPPV and CPAP · Use an appropriate size mask
Oxygen administration	· Use an air/oxygen blender (if available) · Titrate oxygen concentration to maintain oxygen saturations within normal range [refer to Table 7. Observations and monitoring] · Humidify if possible · Document: o Mode of delivery (e.g. cot, nasal cannulae—high, low flow, CPAP, ventilator) o Amount being delivered
Respiratory support	· Refer to Queensland Clinical Guideline: o *Neonatal resuscitation*[18] o *Neonatal respiratory distress including CPAP*[10]

4.1 Continuous positive airway pressure

Continuous positive airway pressure (CPAP) provides a continuous distending airway pressure that facilitates the maintenance of increased transpulmonary pressure during the entire respiratory cycle. It assists to maintain functional residual capacity and assists with gas exchange.[33]

Table 9. Continuous positive airway pressure

Aspect	Consideration
Indications	· Spontaneous respirations · Signs of respiratory distress: o Increased work of breathing § Tachypnoea § Apnoeic episodes § Sternal recession § Nasal flaring § Audible expiratory grunt o Oxygen requirement greater than 30% to maintain oxygen saturations § Refer to Table 7. Observations and monitoring
CPAP	· Commence at 8 cm H_20 · Oxygen to maintain oxygen saturations · CPAP may be delivered by: o Bag and mask o Mask and T-piece device o Bubble o Ventilator · Provide warmed humidified gases[34] at 37°C · Refer to Queensland Clinical Guideline: *Neonatal respiratory distress including CPAP*[10]
Record	· Type of CPAP delivery device, (e.g. mask, bi-nasal prongs) · Mean airway pressure · Oxygen percent · Flow rate of oxygen/air mix · Humidifier temperature
Signs of requiring increased support	· Oxygen requirement greater than 50% · Increased work of breathing · Respiratory acidosis (e.g. pH less than 7.25 or partial pressure of carbon dioxide ($PaCO_2$) greater than 60 mmHg) · Increasing apnoeic episodes · Increasing bradycardic episodes · Refer to Table 10. Intermittent positive pressure ventilation
Care[33]	· Observe nares and nasal septum for redness · If CPAP or bubble not being maintained: o Check circuit—set up, patency o Reposition CPAP delivery device o Reposition the baby o Maintain seal o Reassess prong size o Place chin strap to assist with maintaining seal · Provide care every 4–6 hours or as required: o Reposition the baby o Reposition CPAP device to prevent pressure areas · Insert orogastric tube—free drainage, aspirate 4–6 hourly · General management [refer to Table 5. Clinical support]

4.2 Intermittent positive pressure ventilation

Following intubation, intermittent positive pressure ventilation (IPPV) will be required. Connect the baby to a neonatal ventilator. If a neonatal ventilator is not available it may be necessary to provide IPPV via T-piece device, self-inflating bag or flow-inflating bag.

Refer to Queensland Clinical Guideline: *Neonatal resuscitation.*[18]

Table 10. Intermittent positive pressure ventilation

Aspect	Consideration
Indications	· Increasing respiratory distress whilst receiving CPAP of 8 cm H_2O o Oxygen requirement greater than 50% o Tachypnoea o Sternal recession o Nasal flaring o Audible expiratory grunt o Apnoea not responding to treatment · Poor gas exchange evident by blood gas pH less than 7.25 and $PaCO_2$ greater that 60 mmHg
Intubation	· Consider sedation [refer to Section 9.1.1 Morphine sulphate] · Use size and insertion length/depth according to baby's weight[35] · Assess position o Condensation on inside of ETT during exhalation o Equal chest wall movement o Symmetrical air entry over lung fields o Colour change on a colorimetric end tidal CO_2 detector o Improved oxygenation · Tape securely o Apply hydrocolloid dressing to cheeks and use adhesive tape to secure ETT o Secure to middle of upper lip · Check ETT position on X-ray: o Correct position of ETT tip § Visible just below the medial ends of the clavicles[36,37] § Approximately at the level of the first to second thoracic vertebrae[38] § Mid trachea above the carina (1–2 cm)
Ventilator settings	· Peak inspiratory pressure (PIP)18–20 cm H_2O o May need adjustment § To achieve physiological chest wall movement § After blood gas analysis · Positive end expiratory pressure (PEEP) 6–8 cm H_2O · Inspiratory time 0.3–0.4 seconds · Ventilator rate 40–60 breaths per minute · Oxygen to maintain oxygen saturations [refer to Table 7. Observations and monitoring] · Ventilator flow rate of 8 L per minute (air/oxygen mix) · Provide warmed humidified gases[34] at 37°C
ETT suction	· Only suction if required · Use suction catheter size no more than half the internal diameter of ETT[39] o ETT size 2.5 or 3.0 use suction catheter size 5 or 6 Fg[39] o ETT 3.5 or 4.0 use catheter size 6 or 8 Fg[39] · Use access port in ventilation circuit · Insert suction catheter length of the ETT plus the length of manifold

4.3 Surfactant

Respiratory distress syndrome (also known as hyaline membrane disease) is caused by surfactant deficiency in the preterm baby. The administration of exogenous surfactant to the baby at birth is known to reduce surface tension of the alveoli thus improving lung expansion and adequate gas exchange.[40]

Table 11. Surfactant

Aspect	Considerations
Indications[40]	· Baby requiring intubation and ventilation from birth who is: o Less than 32 weeks gestation[41] o Any gestation with hyaline membrane disease
Administration	· Given at time of intubation if available · May be given from birth up to 24 hours of life · Warm to room temperature prior to administration[42,43] · Continue IPPV after administration of surfactant until the retrieval team arrives[44] · After administration o Observe ventilation—may require decrease in PIP and oxygen requirement
Medication	· *Survanta** [Beractant] 4 mL/kg via ETT six hourly up to four doses[43] · *Curosurf** [Poractant alfa] 2.5 mL/kg via ETT at birth then 1.25 mL/kg 12 hourly up to two doses[42]

**Refer to current pharmacopeia*

5 Glucose monitoring

Table 12. Glucose monitoring and management

Aspect	Good practice point
BGL monitoring	· Maintain BGL equal to or greater than 2.6 mmol/L · Commence maintenance fluids [refer to Table 14. Intravascular access[45]] · Measure BGL: o When IV access is obtained preferably by one hour of age o Repeat at two and four hours of age · If greater than 2.6 mmol/L continue to monitor four hourly · If less than 2.6 mmol/L recheck 30 minutes after commencing maintenance fluids · Refer to Queensland Clinical Guideline: *Newborn hypoglycaemia*[15]
Hypoglycaemia prevention	· Commence glucose 10% IV infusion as soon as practical after birth to avoid hypoglycaemia [refer to Table 14. Intravascular access] · Usually glucose 4–6 mg/kg/minute is sufficient[46]
Hypoglycaemia Treatment	· If blood glucose level is less than 2.6 mmol/L refer to Queensland Clinical Guideline: *Newborn hypoglycaemia* for management and further investigation[15,45] · If giving a IV bolus of glucose o Also increase maintenance fluids[47] [refer to Table 14. Intravascular access] o Avoid large bolus doses of glucose (greater than 100–200 mg/kg) o Note: 1 mL glucose 10% contains 100 mg glucose · Glucose concentrations greater than 12% require administration via UVC[48]

6 Infection

Early onset of sepsis is generally acquired vertically from bacteria colonizing the mother's lower genital tract or from infected amniotic fluid.[49] Consider sepsis in any baby who is unwell or has signs of respiratory distress. Group B *Streptococcus* is recognised as the most frequent cause of early onset neonatal sepsis.[50] Refer to Queensland Clinical Guideline *Early onset Group B Streptococcal disease (EOGBSD).*[51]

Table 13. Sepsis

Aspect	Consideration
Risk factors[49,50]	· Maternal: o Intrapartum fever o Chorioamnionitis o Prolonged rupture of membranes o Group B *Streptococcal* colonisation or bacteriuria o Other infections—herpes, hepatitis B, syphilis · Neonatal: o Prematurity—less than 37 weeks gestation o Birthweight less than 2500 grams o Birth asphyxia o Meconium liquor o Congenital anomalies (e.g. abdominal wall or spinal defects)
Signs[49]	· Temperature instability—hypothermia or hyperthermia · Respiratory: o Tachypnoea, grunting, nasal flaring o Increasing oxygen requirement o Apnoea o Respiratory acidosis o Radiologic evidence—pneumonia or plural effusion · Cardiovascular: o Tachycardia, bradycardia or arrhythmias o Hypotension or hypertension o Mottled skin, delayed capillary refill—greater than two seconds, pallor · Neurological: o Abnormal movements—jitteriness, lethargy o Irritability o Seizures o Hypotonia or hypertonia o Abnormal cry—high-pitched o Bulging fontanelle · Other: o Feed intolerance, abdominal distention o Rash, jaundice, pallor, petechiae, cool peripheries o Hepatomegaly, splenomegaly o BGL instability—hypoglycaemia or hyperglycaemia o Metabolic acidosis
Management[49]	· Collect FBC with differential and blood cultures prior to commencing antibiotics · Commence antibiotics as soon as possible o Don't delay antibiotics if unable to collect FBC or blood cultures · If IV/UVC access is not obtained and sepsis is clinically suspected administer antibiotics by intramuscular (IM) injection · Where local guidelines do not exist, suggested empirical antibiotic therapy includes: o Penicillin* OR amoxicillin/ampicillin* o AND gentamicin* o For dosing regimens refer to Queensland Clinical Guideline *Early onset Group B Streptococcal disease (EOGBSD)*[51] · Also consider maternal history (e.g. if *Herpes simplex* virus is suspected consider acyclovir*) · If late onset (greater than 72 hours old) sepsis is suspected consider Ampicillin* and gentamicin* OR cefotaxime*

*Refer to current pharmacopeia

7 Circulation

Premature and unwell babies require intravenous access for administration of fluids and medications.

7.1 Fluid management

Table 14. Intravascular access

Aspect	Good practice point
Indications	· Baby (unwell or preterm) requiring transport to higher level facility · Baby less than1800 grams[52] · Baby less than 34 weeks gestation[53] · Respiratory distress[52] · Gastrointestinal anomalies or obstruction · Suspected congenital cardiac disease[54] · Unwell baby · IV medication or fluid administration
Insertion[23]	· Skin preparation [refer to Table 5. Clinical support] · Use a 24 gauge IV cannula if available o Splint and tape securely o Observe cannula site hourly for patency, redness and infiltration · Use UVC o Consider insertion if: § Peripheral IV cannulation is unsuccessful § Baby is critically unwell or LBW o Use double lumen catheter (if available) o Secure with suture and tape o Observe site for redness, leakage and dislodgement o Confirm position on X-ray prior to infusing fluids except when using for emergency resuscitation · Routine umbilical arterial catheter or peripheral arterial line insertion not required
Maintenance fluids	· Day one requirements[55] o Term baby 60 mL/kg/day o Preterm baby 80 mL/kg/day · Infusion: o Term baby glucose 10% IV infusion 60 mL/kg/day[55] o Preterm baby glucose 10% IV 80 mL/kg/day[56] · If baby is more than 24 hours of age increase by 20 mL/kg/day until a maximum 120 mL/kg/day (e.g. day 3 term baby requires 100 mL/kg/day · Include all fluids infused—maintenance and support medications (e.g. dopamine)

7.2 Maintaining circulation

Hypovolemic shock is based on a combination of clinical signs. The appropriate management will vary according to the underlying pathophysiology.

Table 15. Cardiovascular compromise

Aspect	Consideration
Clinical signs	· Hypotension—mean arterial blood pressure measured in mmHg less than the baby's gestational age in weeks[30] · Pallor · Mottled skin · Tachycardia · Prolonged capillary refill (greater than two seconds) · Metabolic acidosis · Blood loss · Decreased urine output
Causes[57]	· Blood loss—placenta abnormalities (umbilical cord rupture, placental abruption, placenta praevia), twin to twin transfusion syndrome · Acute blood loss (e.g. intracranial or pulmonary haemorrhage) · Plasma or fluid losses: o Congenital abnormality (e.g. gastroschisis or myelomeningocele) o Pleural effusion o Other body water loss (e.g. vomiting, gastric suctioning, evaporative skin) · Ineffective cardiac output · Sepsis
Management	· Use isotonic crystalloid solution—sodium chloride 0.9% 10 mL/kg IV or UVC[21] o May require repeat dose if no change in blood pressure, heart rate, capillary refill—discuss with medical retrieval co-ordinator o Continue maintenance fluids · If known blood loss from baby: o Follow critical blood loss protocol [refer to National Blood Authority (Australia) Patient Blood Management Guidelines Module 6: Neonatal and Paediatrics (2016)[58]] o Use cross matched, irradiated and cytomegalovirus (CMV) negative blood (if available) o For emergency transfusions administer group O RhD negative blood · Avoid rapid administration of fluids in preterm babies as this has been associated with an increase with intraventricular haemorrhage[59] · Continue to infuse maintenance fluids
Inotrope[48]	· If hypotension persists after fluid replacement, consider inotropic support · **Consult with a neonatologist prior to commencing** · Administer inotropes via: o UVC (preferable)—check position on X–ray o Peripheral IV—observe site for patency, blanching · Do not infuse through a peripheral arterial line or an umbilical arterial line · Do not infuse bolus fluids or medications through an inotrope infusion line · Continuous infusion o Dopamine* 10 micrograms per kg per minute o Dobutamine* 10 micrograms per kg per minute · Infusion preparation o Add 30 mg per kg of dopamine* OR dobutamine* to glucose 10% to make a total volume of 50 mL in the syringe § 1 mL per hour of the above preparation equals 10 micrograms per kg per minute

**Refer to current pharmacopeia*

8 Encephalopathy

Neonatal encephalopathy is characterised by disturbed neurological function in the early days of life that often presents as[60]:

- Reduced level of consciousness
- Seizures [refer to Section 8.2 Seizures]
- Difficulty in initiating and maintaining respiration
- Depression of tone and reflexes

Contact RSQ for advice when a baby has an abnormal neurological assessment.

8.1 Hypoxic-ischaemic encephalopathy

Hypoxic-ischaemic encephalopathy (HIE) is due to an injury to the brain that has occurred around the time of birth.[61] It has been demonstrated that therapeutic hypothermia 33 °C to 34 °C commenced within 6 hours of the birth, improves babies long term outcome where there has been moderate or severe injury.[62]

If HIE is suspected contact RSQ promptly for advice regarding commencing cooling before 6 hours of age when the baby:

- Has evidence of perinatal/intrapartum hypoxia
- Is greater than or equal to 35 weeks gestation
- Is greater than or equal to 1800 grams birth weight

Refer to Queensland Clinical Guideline *Hypoxic-ischaemic encephalopathy (HIE).*[11]

8.2 Seizures

Clinically a seizure is a paroxysmal alteration in neurological function or behavioural, motor or autonomic function.[63] Clinical seizures can be classified as clonic, tonic, myoclonic, subtle and can be focal, multifocal or generalised.[64]

- Refer to Queensland Clinical Guideline *Neonatal seizures*[12]

9 Pain management

Untreated pain may have physiological and behavioural effects on some babies. Pain management includes minimising pain and stress during procedures and treatments while supporting the baby to cope and recover. Administer analgesia, sedation and comfort measures appropriate for the intervention(s).[65,66]

Table 16. Pain

Aspect	Consideration
Signs[67]	· Physiological o Increased heart rate, blood pressure, respiratory rate, muscle tension, oxygen consumption (increased oxygen requirements or falling oxygen saturations) o Pallor or flushing o Dilated pupils o Decrease in respiration rate and depth o Apnoea o Bradycardia · Behavioural o Crying, whimpering or moaning o Grimacing, quivering chin o Eye squeeze o Nasal flaring o Facial twitching o Flexing or extending extremities o Limb withdrawal, swiping or thrashing o Tone changes—hypertonic or hypotonic o Touch aversion o Activity—irritable or lethargic o Feeding difficulties o Difficult to comfort, soothe or quiet
Non-pharmacological	· Indications—heel prick, cannula insertion, eye examination, IM injection, tape removal, nasogastric insertion · Breast milk—give two mL slowly and directly onto the tongue two minutes prior to the procedure[68] · Skin to skin contact—if clinically indicated · Non-nutritive sucking o Provide a pacifier for baby to suck[65,66,68] with parental consent · Swaddling/containment o Hold the baby's extremities flexed and close to their trunk[65,66,68] · Reduce environmental stimuli[65,68] o Noise o Lighting · Limit the number of procedures performed at the same time[65]
Pharmacological	· Oral sucrose*[69] o Consider administration two minutes prior to procedure (e.g. heel pricks, cannula insertion, eye examination, IM injection, tape removal, nasogastric insertion) o Follow local protocols—dosing, contraindications o Example dosing regimen using 24% sucrose* solution[70,71] § 32 to 40 weeks gestational age—administer 0.2–0.5 mL per procedure; maximum 2.5 mL in 24 hours[70,71] § 40 weeks gestational age to one month postnatal age—administer 0.5–1 mL per procedure to a maximum 5 mL in 24 hours[70,71] o Give slowly and directly to the anterior tongue[70,71] · Paracetamol*: o Used for analgesia for discomfort (e.g. bruising) o Oral dose—follow local protocols · Morphine sulphate* [refer to Table 17. Morphine sulphate · Local anaesthetic—lignocaine 1%* (e.g. prior to chest drain insertion)

**Refer to current pharmacopeia*

9.1 Morphine sulphate

Table 17. Morphine sulphate

Aspect	Good practice point
Indications	· Morphine sulphate* o Prior to intubation o During IPPV o Before (if possible) chest drain insertion o Other—bowel perforations, necrotising enterocolitis (NEC)
Morphine sulphate*	· Suggested preparation (if local protocol not available) o Add 1 mg per kg of morphine sulphate* to glucose 10% to make a total volume of 50 mL in the syringe o 1 mL equates to 20 microgram/kg · Dose o Continuous IV infusion:10–20 micrograms/kg/hour[72] § 0.5–1.0 mL/hour of above preparation o IV stat dose: 50–100 micrograms/kg [72] § 2.5–5 mL of above preparation · May be combined with midazolam* · Continue to infuse maintenance fluids
Precautions	· Monitor for apnoea and hypotension[72]

**Refer to current pharmacopeia*

10 Preparation for retrieval

Provide clinical care and management while waiting for the arrival of the retrieval team to maintain normal oxygen saturations, temperature and BGL and reduce the risk of any deterioration. Additionally, initiate any other treatment or care the baby requires as able within the facility's service capability.

Table 18. Preparation for retrieval

Aspect	Consideration
Communication	· If there are changes in the baby's condition which may influence ongoing management—recontact RSQ · Discuss importance of breast milk with parents and assist with expressing · Discuss changes in baby's condition or planned retrieval with the parents · Encourage parental interaction with baby · Initiate local protocol regarding internal communication (e.g. security services, nurse manager)
Documentation	· Prepare two copies of documentation—one for retrieval service and one for tertiary facility o Provide copies of: § Maternal history—pregnancy health record § Antenatal history § Perinatal data form § Resuscitation record § Observation chart § Medication and fluid chart § Progress notes · Signed neonatal screening card
Other	· X-rays transferred on medical imaging software (e.g. picture archiving and communication system (PACS) or hard copies if available) · Baby's Queensland Health *Infant Personal Health Record*

10.1 Retrieval team

The retrieval team will require assistance with ongoing stabilisation. Refer to Appendix A Checklist: Preparation for neonatal retrieval

Table 19. Retrieval team

Aspect	Consideration
Environment	· Space and power points for retrieval cot · Air and oxygen outlets · Procedure trolley
Clinical handover	· Maternal history · Neonatal: o Resuscitation o Investigations o Management o Changes in clinical condition · Parental plans for travelling to receiving facility · Parental contact information
Assistance	· Procedures (e.g. use of dressing trolley) · Organisation of external services such as imaging, security
Expressed breast milk (EBM)	· Labelled and packaged in a container with ice to keep cold o Refer to Queensland Clinical guideline *Establishing breastfeeding*[73]

11 Parents

If retrieval or transfer is required, it is desirable but not always possible for one parent to travel with the baby. This will depend on:

- Type of transport
- Maternal medical condition (the women may be transferred separately if medically unwell)
- Space or weight restrictions
- Baby's clinical condition

Table 20. Parent considerations

Aspect	Good practice points
Photographs	· Provide opportunities for the parents to take photographs o Provide photographs to parents if possible
Communication[74]	· Encourage early contact between parent(s) and baby · Keep the parents informed about their baby's clinical condition · Outline the proposed plan of care for the baby · Gain parental consent for the retrieval/transfer · Support ongoing communication with the receiving facility · Offer parents debrief · Refer to support services (e.g. social worker, Indigenous health worker)
Information	· Provide brochures about baby's condition (if available)[75,76] o Refer to Queensland Clinical Guidelines *Information for parents and carers* https://www.health.qld.gov.au/qcg · Retrieval team will provide information about the admitting hospital
Maternal transfer	· Neonatal retrieval team is unable to care for the woman · If the woman requires continuing inpatient care: o Refer to RSQ for a separate transfer o Organise a medical referral to the accepting facility o Confirm approval from accepting facility bed manager
Accommodation	· Contact receiving facility to arrange accommodation—as soon as receiving facility is known · If no accommodation available then parents may need to arrange own accommodation · Refer to social worker if available

12 Specific conditions

12.1 Respiratory disorders

Respiratory distress in the newborn can be caused by a variety of underlying conditions and the appropriate treatment and management will be dependent on each specific condition.[77]
For ventilation [refer to Section 4.3 Respiratory support].

12.1.1 Air leaks—overview

Table 21. Overview

Aspect	Consideration
Overview	· Pneumothorax—presence of air in the pleural cavity between the visceral and parietal pleura[78] · Pneumomediastinum—presence of air into the mediastinal space diagnosis usually[78] not requiring treatment[79] · Pneumopericardium—air collection in the pericardial space[78] that may cause cardiac tamponade[79]
Predisposing factors[79]	· Can occur at any gestation[80] · Male · LBW · Prematurity · Born by caesarean section · Presence of respiratory distress syndrome · Meconium aspiration syndrome · Requiring resuscitation at delivery · Prolonged rupture of membrane · Hypoplastic lungs

12.1.2 Air leaks—presentation and management

Table 22. Presentation and management

Aspect	Good practice point
Presentation	· Spectrum of severity[78] o Asymptomatic—noticed incidentally on X-ray o Life threatening—tension pneumothorax: the air collection interferes with ventilation and circulation[78] · Increasing respiratory effort[81] · Decreased breath sounds on affected side[82] · Tachycardia[81] · Bradycardia[82] · Hypotension[82] · Skin mottling[82] · Increasing oxygen requirements[81]
Diagnostic signs	· Chest X-ray: o Pneumothorax § Air in the pleural space outlining the visceral pleura with partial collapse of the lung; atelectasis with flattening of the diaphragm on the affected side; mediastinal shift away from the pneumothorax; affected side may appear hyperluscent[79]; widened intercostal spaces; decreased or absent pulmonary vascular markings[83] § Large pneumothorax seen on antero-posterior X-ray[79] § Lateral decubitus X-ray (with affected side up) improves detection of smaller pneumothorax[79] o Pneumomediastinum—hyperlucent areas around the heart border and between the sternum and the heart border[78] · Pneumopericardium—air shadow surrounding the heart · Transilluminate chest—using a high-intensity light (fibre optic or 'cold' light) on the baby's chest[81] (if available)
Management	· Refer to Queensland Clinical Guideline *Neonatal respiratory distress including CPAP*[10] · Pneumothorax o Requires urgent treatment if causing significant respiratory distress and cardiopulmonary compromise (tension pneumothorax)[84] § Needle aspiration use 23 gauge butterfly or 24 gauge IV cannula (with two way flow) o Intercostal catheter o Administer analgesia [refer to Section 9 Pain management] o Skin preparation [refer to Table 5. Clinical support] o Connect to a one way valve drain or a one way flutter valve drain § Tape securely—suturing generally not required § Position baby supine § Observe catheter and document for fluttering, swinging and drainage · Confirm position on X-ray · Commence antibiotics [refer to Section 6 Infection] · Pneumomediastinum o Management is conservative[78] · Pneumopericardium o Management is conservative[78] · General management [refer to Table 5. Clinical support]

12.1.3 Structural defects

Table 23. Choanal atresia

Aspect	Consideration
Overview[85]	· Congenital narrowing of the nasal airway at the posterior choanae (nares) · Can be unilateral or bilateral
Presentation[85]	· Depends if the obstruction is unilateral or bilateral · Obvious airway obstruction · Inability to insert a nasogastric tube[80] · Stridor · Apnoea · Paradoxical cyanosis o Cyanotic when settled—as babies obligatory breathe through their nose o Pink when crying as breathing through an open mouth
Management[85]	· Insert oropharyngeal airway · Position baby prone · Intubate as required [refer to Table 10. Intermittent positive pressure ventilation] · Establish IV access [refer to Table 14. Intravascular access] · General management [refer to Table 5. Clinical support]

Table 24. Pierre Robin sequence

Aspect	Consideration
Overview[86]	· The association of micrognathia, glossoptosis and airway obstruction
Presentation	· Upper airway obstruction · May occur during wakefulness, sleep or feeding[86] · Snoring[86] · Apnoea[86] · Stridor[87]
Management	· Position baby prone or side lying[86,88,89] · Insert oropharyngeal or nasopharyngeal airway if required[86,88,89] · Administer CPAP if required[86,89] o May require as single nasal prong to deliver CPAP § Use a soft (ivory) ETT § Insertion distance—measure from nasal tip to tragus of the ear § Positioned behind the tongue just above the larynx[86,90] · Endotracheal intubation may be required if unable to maintain airway · If intubation is unsuccessful consider using a laryngeal mask airway in babies greater than 2000 grams or greater than or equal to 34 weeks gestation[88,90] · Establish IV access [refer to Table 14. Intravascular access] · General care [refer to Table 5. Clinical support]

12.2 Gastrointestinal disorders

Some gastrointestinal disorders may be diagnosed antenatally and others may not be obvious or suspected until after birth when the baby presents with clinical signs.

12.2.1 Bowel abnormalities

Table 25. Bowel abnormalities

Aspect	Consideration
Overview	· Narrowing or occlusion (e.g. duodenal atresia, malrotation, volvulus, meconium ileus, Hirschsprung's disease[91]) · Absence of a normal opening (e.g. anal atresia or imperforate anus[91,92]) · An inflammation of the bowel (e.g. NEC[93])
Presentation	· Antenatal history o Polyhydramnios[91] o Dilated intestinal loops seen on antenatal scan[91] · After birth [91] o Vomiting: § bilious or non bilious[92] o Abdominal distention and tenderness[3,91] o Abdominal wall discolouration o Abdominal X-ray[91] § Dilated loops of bowel[91] § Intestinal dilatation[3] § Thickened intestinal wall § Pneumotosis intestinalis § Double bubble appearance[91] § Air in the portal venous system or pneumoperitoneum § Intraperitoneal calcification[94] § Absence of air in rectum o Blood in stool—occult or fresh[3,93] o Failure to pass meconium by 24–48 hours of age[3,95,96] o Passage of a meconium plug · Non-specific signs[93] o Apnoea o Increasing oxygen requirement o Bradycardia or tachycardia o Poor perfusion o Hypotension o Lethargy o Temperature instability · Pathology—metabolic acidosis, thrombocytopenia, leukopenia, leucocytosis, glucose instability, hyponatraemia[3]
Specific management	· NBM[92] · Insert a large bore NGT size 8 with hourly aspiration and free drainage[91] o Measure gastric losses · Establish IV access · Commence antibiotics [refer to Table 13. Sepsis[92]] o Consider metronidazole IV* · Consider analgesia [refer to Section 9 Pain management] · Monitor urine output · X-rays o Abdominal spine antero-posterior view o Lateral decubitus view—baby side lying with left side down if bowel perforation suspected · General management [refer to Table 5. Clinical support]

**Refer to current pharmacopeia*

12.2.2 Abdominal wall defects

The majority of abnormal abdominal wall defects present on antenatal ultrasound.

Table 26. Abdominal wall defect

Aspect	Consideration
Overview[97]	· Gastroschisis: o Abdominal contents herniate through a cleft in the abdominal wall § Usually to the right of the umbilicus · Exomphalos: o Abdominal wall defect consisting of an evisceration the internal organs in a sac o Covered by a three-layered sac made up of peritoneum, Wharton's jelly and amnion
Presentation	· Obvious herniation or visceration of abdominal contents
At birth	· Position the cord clamp well above the lesion · Leave at least 15–20 cm length of cord
Management	· If respiratory distress present intubate and ventilate · Avoid bag and mask ventilation · Avoid CPAP · Protect the protruding abdominal contents[98]: o If available, cover lesion with two polyethylene draw string bags (bowel bags) § First bag covers legs and abdomen up to the defect § Second bag covers the first bag and the defect o If bowel bag not available, cover with food grade polyethylene plastic wrap o NOTE: **DO NOT** cover with a dressing or saline soaked gauze · Nurse supine or on right side[98,99] o Aim to prevent pressure on the mesentery o Bowel may require support and/or elevation to relieve pressure (e.g. position bowel on covered IV fluid bag) · If discolouration of the bowel is noted: o Reposition the baby o Reposition exposed bowel · NBM[95,97,98] · Insert a large bore NGT size 8 with hourly aspiration and free drainage o Measure and document the amount of gastric losses · Establish peripheral IV access[98] o Commence maintenance fluids [refer to Table 14. Intravascular access] o May require an increase of daily requirements after discussion with neonatal retrieval coordinator · Administer prophylactic antibiotics o Refer to Queensland Clinical Guidelines *Early onset Group B Streptococcal disease* for empirical antibiotic doses and regimens[95,98] · Administer analgesic and sedation [refer to Section 9 Pain management] · Monitor urine output · Observe perfusion to lower limbs · Transfer to warmed incubator (if available) · General management [refer to Table 5. Clinical support]
Investigations	· FBC · Blood cultures · BGL · Chest and abdominal X-ray

12.2.3 Oesophageal defects

Table 27. Oesophageal atresia and trachea-oesophageal fistula

Aspect	Consideration
Overview	· Tracheo-oesophageal fistula o Abnormal connection or fistula tract between the trachea and the oesophagus[100] · Oesophageal atresia o Oesophagus terminates in a blind-ending pouch[100] · May be associated with other congenital anomalies or may occur as part of recognised syndrome[101] o VATER/VACTERL association o CHARGE association o Trisomy 21
Presentation[100]	· Antenatal: o Polyhydramnios o Small or absent stomach on ultrasound scan (USS) · Postnatal: o Excessive oral secretions o Cyanosis or coughing when feeding o Respiratory distress o Abdominal distension · Unable to pass naso/orogastric tube to anticipated depth · On X-ray the naso/orogastric tube may be coiled in the oesophageal pouch[102]
Management[100]	· Do not use CPAP[103] · Insert Replogle tube[104] o Insert nasally or orally until resistance then withdraw 0.5–1 cm § Document insertion depth o Connect to continuous negative pressure of minus 25–30 mmHg o Instil 0.5–1 ml of sodium chloride 0.9% at least hourly or as required to clear secretions o If Replogle tube not available insert a large bore (8 to 10 Fg) naso/orogastric tube and aspirate at least every 15 minutes and as required o Elevate head of the incubator or cot[103] · NBM · Establish IV access · Commence antibiotics [refer to Table 13. Sepsis[92]] · Commence maintenance fluids [refer to Table 14. Intravascular access] · Do not use pacifier as increases production of saliva · General management [refer to Table 5. Clinical support]

12.2.4 Diaphragmatic hernia

Table 28. Diaphragmatic hernia

Aspect	Consideration
Overview	· A defect in the diaphragm that allows herniation of the abdominal contents into the chest[105] · Impedes fetal lung development that leads to varying degrees of pulmonary hypoplasia and pulmonary hypertension[105]
Presentation[106]	· Respiratory distress · Cyanosis · Decreased air entry on the affected side · Flat or scaphoid abdomen · X-ray—bowel loops evident in chest cavity, mediastinal shift · Auscultation of bowel sounds in lung fields
Management[106]	· At birth: o Avoid bag and mask ventilation or CPAP § Leads to gastrointestinal distension and lung compression o Intubate and ventilate baby [refer to Table 10. Intermittent positive pressure ventilation] o Commence morphine infusion [refer to Table 17. Morphine sulphate] o Insert a large bore nasogastric or orogastric tube—size 8 Fg § Hourly aspiration and free drainage § Measure gastric losses · NBM · Establish peripheral IV access · Commence maintenance fluids [refer to Table 14. Intravascular access] · Cardiovascular support [refer to Table 15. Cardiovascular compromise] · General management [refer to Table 5. Clinical support]

12.3 Cardiac disorders

Congenital cardiac disease may not be suspected until after birth when the baby presents with clinical signs. The timing of the presentation will depend on the severity of the defect, the effects on the fetus in-utero and alterations in cardiovascular physiology during transitional circulation such as closing of the duct.[107] If congenital cardiac disease is suspected, seek early specialist advice via RSQ.

12.3.1 Duct dependent cardiac lesions

Duct dependent lesions require the ductus arteriosus to remain patent to supply pulmonary or systemic blood flow or to allow mixing between parallel circulations until definitive care and treatment is provided.

Table 29. Duct dependent cardiac lesions

Aspect	Consideration
Overview[108]	· Lesions: o Systemic blood flow § Severe left-sided obstructive defects where systemic blood flow is dependent on right to left blood flow through a patent ductus arteriosus (PDA) § Hypoplastic left heart syndrome, critical aortic stenosis, coarctation of aorta and interrupted aortic arch o Pulmonary blood flow: o Pulmonary atresia, critical pulmonary stenosis, tetralogy of Fallot ventricular septal defect (VSD), pulmonary stenosis, right ventricular hypertrophy, overriding aorta) o Systemic and pulmonary mixing between circulations § Transposition of the great arteries
Presentation	· May be gradual or rapid as the duct begins to constrict[108]
Specific signs	· Cyanosis not improving despite supplemental oxygen[108] · Oxygen saturations maybe normal in lower body due to the left to right shunting of blood[54,108,109] · Acute cardiorespiratory collapse with cardiogenic shock and/or hypoxia · Signs of heart failure (e.g. tachycardia, tachypnoea, hepatomegaly) · Heart murmur · Increased precordial activity[108] · Cardiomegaly[110] · Diminished or bounding femoral pulses[109,111] · Blood pressure o Greater than 20 mmHg difference between upper and lower extremities may indicate an obstruction such as coarctation of aorta[54,57]
Non-specific signs	· Hypotension[109] · Poor peripheral perfusion[108] · Signs of respiratory distress (e.g. tachypnoea, apnoea, grunting[109]) · Hepatomegaly[109] · Lethargy[109] · Feeding difficulties[109] · Elevated lactate
Management	· Stabilise baby [refer to Section 3 Initial management] · Record oxygen saturations pre-ductally on right hand **and** post-ductally on either foot · Establish IV or UVC access [refer to Table 14. Intravascular access] · Commence antibiotics[54] [refer to Table 13. Sepsis] · Chest X-ray[54] · After discussion with neonatal retrieval coordinator and paediatric cardiologist o Commence IV prostaglandin E1* infusion § Refer to Table 30. Prostaglandin E1 infusion[54] o Specific oxygen saturations targets maybe identified · General management [refer to Table 5. Clinical support]

**Refer to current pharmacopeia*

12.3.2 Prostaglandin E1 infusion

Infusion may be required after discussion with the neonatal retrieval coordinator and the paediatric cardiologist.

Table 30. Prostaglandin E1 infusion

Aspect	Good practice point
Indications[54]	· Duct dependent cardiac lesions · Promotes dilation of the ductus arteriosus
Infusion	· Prostaglandin E1* dilution if local protocol not available: o Add 1 mL of 500 microgram/mL prostaglandin to 9 mL of sodium chloride 0.9% to give 50 microgram/mL solution **then** o Add 0.36 mL/kg of the 50 microgram/mL solution to glucose 10% or sodium chloride 0.9% to make a total volume of 30 mL in the syringe o Infuse at a rate of 1 mL per hour to give 10 nanograms/kilogram/minute · Note: 1 nanogram of the above solution equals 0.001 micrograms
Precautions	· Insert second IV cannula for prostaglandin infusion only o Do not administer maintenance, bolus fluids or medications with prostaglandin · Monitor for apnoea and hypotension · Ensure respiratory support is available prior to commencement

**Refer to current pharmacopeia*

12.3.3 Non-duct dependent cardiac lesions

Table 31. Non-duct dependent cardiac lesions

Aspect	Consideration
Overview	· Not dependent on duct for blood to mix o Tetralogy of Fallot (some) o VSD o Atrioventricular canal defect o Truncus arteriosus · Symptoms are related to excessive pulmonary blood flow
Presentation	· Signs may take time to develop[112] · Baby may present with signs of congestive heart failure[112] o Pulmonary oedema o Pulmonary rales o Hepatomegaly o Heart murmur o Tachycardia o Tachypnoea o Poor feeding o Diaphoresis o Irritability
Management[54]	· Chest X-ray · Monitor blood pressure—record on all four limbs · Record oxygen saturations pre-ductally on right hand and post-ductally on either foot · Commence maintenance fluids [refer to Table 12. Glucose monitoring and management] · Commence antibiotics [refer to Table 13. Sepsis] · General care [refer to Table 5. Clinical support]

12.3.4 Cardiac arrhythmias

Table 32. Cardiac arrhythmias

Aspect	Consideration
Overview	· Supraventricular tachycardia is the most common requiring treatment[109] · May have congenital cardiac defect or heart may be structurally normal
Presentation	· Tachycardia · Electrocardiogram (ECG) shows a narrow complex tachycardia greater than 220 beats per minute[112]
Management	· Discuss all management with neonatal retrieval coordinator and cardiologist via RSQ · Keep ECG recording during any treatment · Apply ice over the forehead: o Cover ice packs with sheet prior to application · Do **NOT** use carotid massage or orbital pressure · Send copy of the baby's ECG to paediatric cardiologist · Adenosine*: o Discuss with neonatologist or cardiologist prior to administration for dosing regimen and other considerations

**Refer to current pharmacopeia*

12.4 Neurological

The majority of neural tube defects are diagnosed antenatally and provide opportunity for the woman to be transferred to a tertiary facility for the baby's birth.

Table 33. Neural tube defects

Aspect	Consideration
Overview	· Occurs when there is incomplete closing of the vertebrae and the membranes around the spinal cord[113] · Spina bifida occulta: mildest form with skin covering the opening in the spinal column[63] · Meningocele: a midline defect in which the meninges herniate through the posterior vertebral arch[114] · Myelomeningocele: a midline defect in which the meninges, fragments of bone, cartilage and spinal cord herniate through the vertebral arches and the skin[114]
Presentation	· Obvious or subtle dermal lesion in the lumbosacral region such as cutaneous dimples, cutaneous abnormalities or masses or abnormal collections of hair[114] · Herniation may or may not have a skin covering[114]
Specific management	· Protect the lesion: o Cover with food grade polyethylene (plastic) wrap encircling the body o Do not use adherent dressings o Do not use saline soaked dressing or gauze on exposed lesion · Position baby side lying or prone to minimise injury to the lesion · Do not use feet for heel pricks (e.g. blood glucose or capillary blood sampling) · Use non-latex gloves[114] when handling baby · Establish IV access [refer to Table 14. Intravascular access] o Avoid scalp veins for IV access · Commence maintenance fluids [refer to Table 12. Glucose monitoring and management] · NBM · Commence antibiotics [refer to Table 13. Sepsis] · General care [refer to Table 5. Clinical support]

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Appendix A Checklist: Preparation for neonatal retrieval

You may not be able to do anything else to improve the baby's condition other than keeping the baby stable and preventing deterioration due to secondary factors. Prepare for the transfer while waiting for the retrieval team.

q 1. Parents: q Consent to retrieval q Informed of possible complications
q Advised of initial plan of care

q 2. Preparation of the baby:

- q Secure ID bands/labels on baby: Name (baby of [mother's name]), patient record number, date/time of birth, gender
- **q** Document first name if known
- q Nil by mouth
- q 6-8 F oro/nasogastric tube in situ (orogastric if transfer for respiratory distress):
  q Position checked on X-ray if possible q Gastric contents emptied q Free drainage
- q ETT: q Secured at correct insertion depth q Position checked on X-ray (if possible)
  q Length documented
- q Intravascular lines: q Labelled (IV, UVC, UAC)
  q IV cannula securely taped q Maintenance IV therapy (Glucose 10%) in progress
  q UVC/UAC: q Sutured and securely taped q Position checked on X-ray (if possible)
- q IV antibiotics administered (IM if unable to obtain IV access), after collection of blood culture if possible
- q Continuous monitoring (cardiorespiratory and oxygen saturation)
- q Analgesia and/or sedation administered either intravenous or oral as required
- q Appropriate care initiated: q Neurodevelopment (positioning, lighting and noise reduction) q Skin
- q Retrieval service advised of changes to baby's condition that may affect ongoing care or transport logistics

q 3. Documentation (2 copies):

- q Referral letter (including maternal obstetric history and reason for transfer)
- q Neonatal medical/nursing notes
- q Neonatal observation record
- q Neonatal medication record: q Konakion q Antibiotics q Hepatitis B vaccination
  q Analgesia and/or sedation q Other
- q Neonatal fluid administration record
- q Neonatal pathology results
- q Queensland Health perinatal data collection form
- q Maternal obstetric progress notes (relevant medical, obstetric, antenatal, intrapartum history)
- q Maternal choice for baby feeding (breastfeeding/formula) documented
- q Parent(s) contact details (names, address, phone numbers)

q 4. Additional requirements:

- q Copies of X-rays if not on PACS
- q Baby's Queensland Health *Infant Personal Health Record*
- q Photo(s) for parent(s)
- q Directions and contact details of the receiving hospital for parent(s)
- q Accommodation discussed
- q Interpreter if required to explain care and treatment to parents

ETT: endotracheal tube; **ID:** Identification, **IM** Intramuscular; **IV:** Intravenous, **PACS:** Picture archiving and communication system; **UAC:** Umbilical artery catheter, **UVC** Umbilical vein catheter

Checklist: F18.18-3-V3-R23

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