Queensland Clinical Guidelines

Translating evidence into best clinical practice

Maternity and Neonatal **Clinical Guideline**

Stabilisation for retrieval–neonatal

Queensland Government

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Acknowledgement

The Department of Health acknowledges the Traditional Custodians of the land, waters and seas across the State of Queensland on which we work and live. We also acknowledge First Nations peoples in Queensland are both Aboriginal Peoples and Torres Strait Islander Peoples and pay our respect to the Aboriginal and Torres Strait Islander Elders past, present and emerging.

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The guideline is not a substitute for clinical judgement, knowledge and expertise, or medical advice. Variation from the guideline, taking into account individual circumstances, may be appropriate.

This guideline does not address all elements of standard practice and accepts that individual clinicians are responsible for:

- Providing care within the context of locally available resources, expertise, and scope of practice
- Supporting consumer rights and informed decision making, including the right to decline intervention or ongoing management
- 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
- Ensuring informed consent is obtained prior to delivering care
- Meeting all legislative requirements and professional standards
- Applying standard precautions, and additional precautions as necessary, when delivering care
- Documenting all care in accordance with mandatory and local requirements

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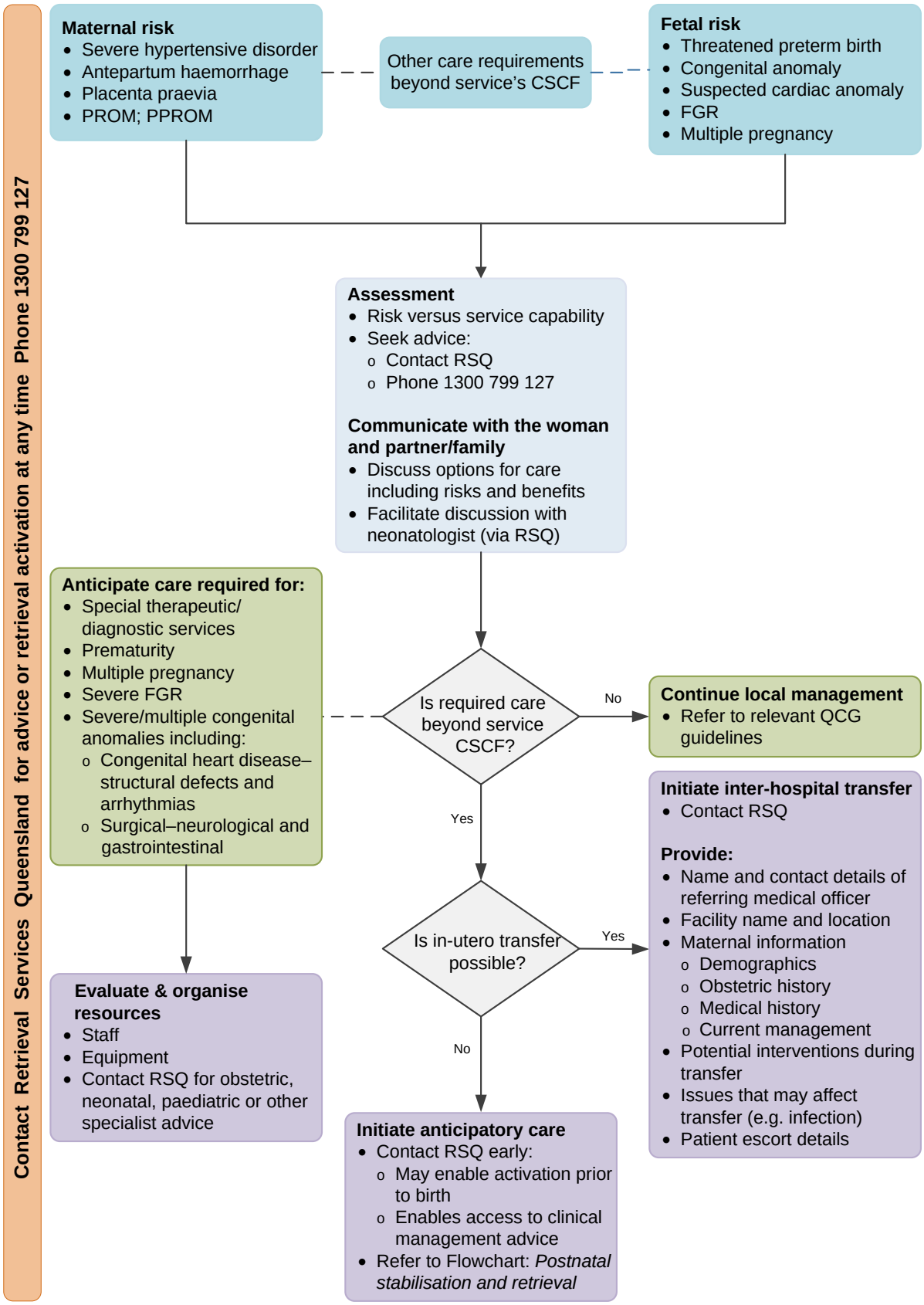
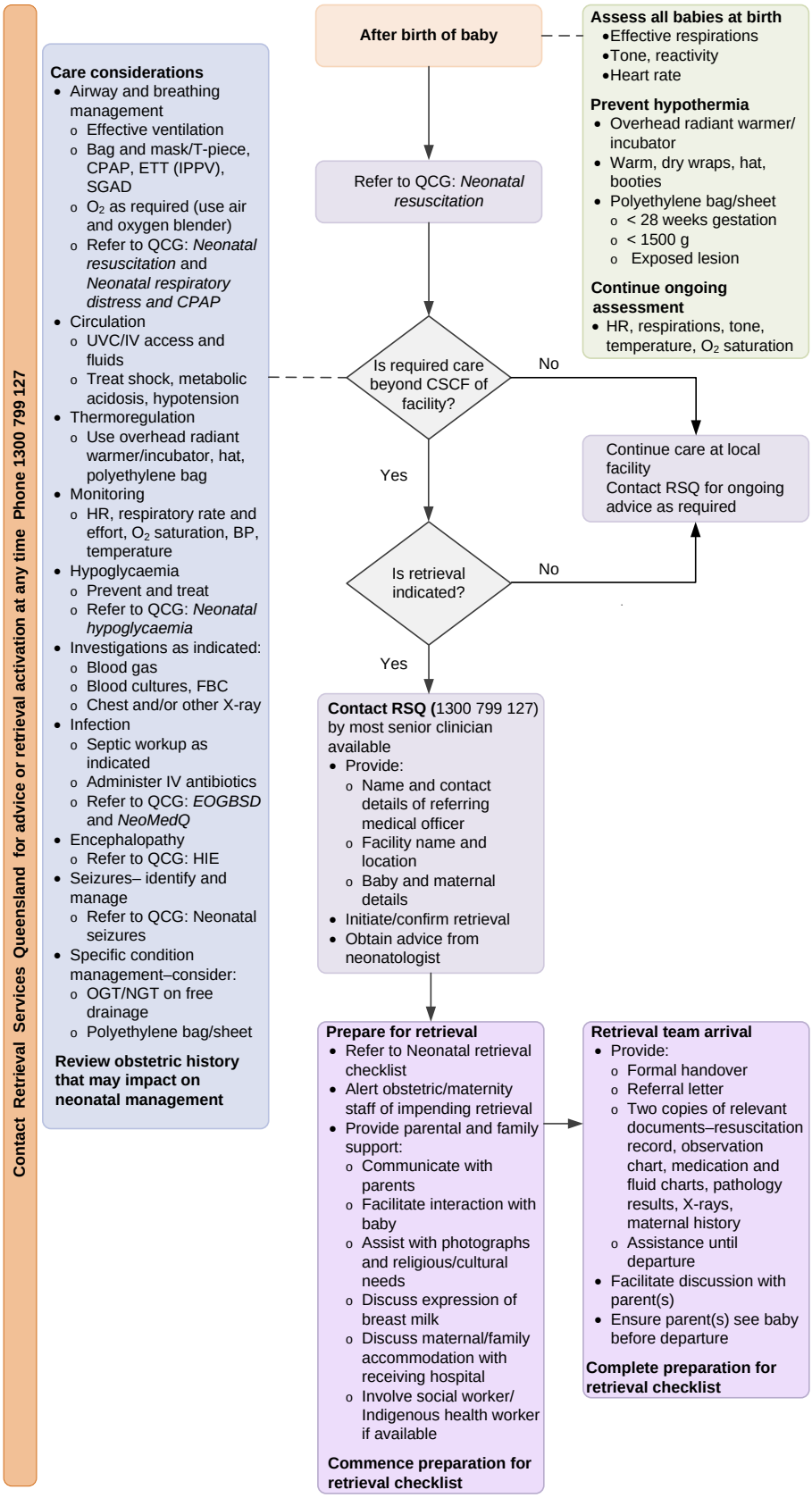
Flowchart: Antenatal transfer or retrieval



CSCF: Clinical Services Capability Framework; **FGR:** Fetal growth restriction; **PROM:** Prelabour rupture of membranes; **PPROM:** Preterm prelabour rupture of membranes; **QCG:** Queensland Clinical Guidelines; **RSQ:** Retrieval Services Queensland

Flowchart: F23.18-1-V4-R28

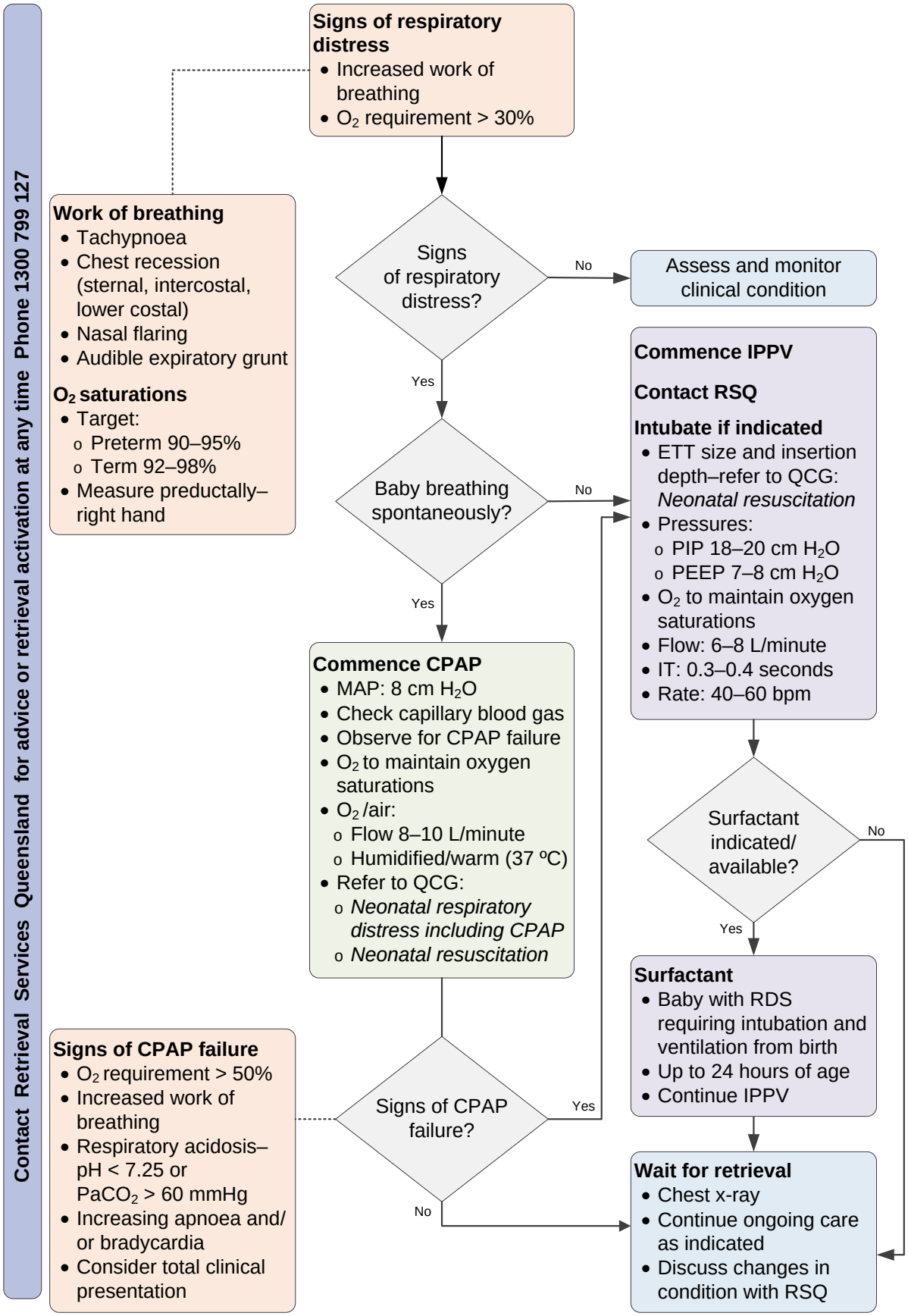
Flowchart: Postnatal stabilisation and retrieval



BP: blood pressure; **CPAP:** continuous positive airway pressure; **CSCF:** Clinical Services Capability Framework; **EOGBSD:** early onset Group B Streptococcal disease; **ETT:** endotracheal tube; **FBC:** full blood count; **HIE:** hypoxic ischaemic encephalopathy; **HR:** heart rate; **IPPV:** intermittent positive pressure ventilation; **IV:** intravenous; **NGT:** nasogastric tube; **OGT:** orogastric tube; **QCG:** Queensland Clinical Guidelines; **RSQ:** Retrieval Services Queensland; **SGAD:** supraglottic airway device; **UVC:** umbilical vein catheter

Flowchart: F23.18-2-V4-R28

Flowchart: Respiratory distress



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

Flowchart: 23.18-4-V5-R28

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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
ICC	Intercostal catheter
IM	Intramuscular
IPPV	Intermittent positive pressure ventilation
IV	Intravascular
LBW	Low birth weight
NBM	Nil by mouth
NGT	Nasogastric tube
NEC	Necrotising enterocolitis
OGT	Orogastric tube
OI	Osteogenesis imperfecta
PACS	Picture archiving communication system
PIP	Peak inspiratory pressure
PIVC	Peripheral intravenous access
RSI	Rapid sequence induction
QCG	Queensland Clinical Guidelines
RSQ	Retrieval Services Queensland
SGAD	Supraglottic airway device
SpO_2	Capillary peripheral oxygen saturation
TGA	Transposition of the great arteries
UVC	Umbilical vein catheter
VSD	Ventricular septal defect

Definitions

CHARGE association	**C**oloboma of the eye, **h**eart anomalies, **a**tresia of the choanae, **r**estricted growth, **g**enital anomalies and **e**ar anomalies.
Cold stress	Body temperature between 36 °C and 36.5 °C.
Early onset sepsis	Onset of symptoms before 72 hours of age (although may present up to 6 days after birth).
Hypothermia	Body temperature less than 36 °C.
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	**V**ertebral anomalies, **a**nal atresia, **c**ardiac anomalies, **t**racheo-o**e**sophageal fistula, **r**enal anomalies, **l**imb anomalies.
Woman/women	In QCG documents, the terms *woman* and *women* include people who do not identify as women but who are pregnant or have given birth.

1 Introduction

Antenatal transfer of the woman with a high-risk pregnancy reduces neonatal morbidity and mortality, and is the safest way to transport a high-risk fetus to a perinatal centre. Babies who unexpectedly require resuscitation outside a level 6 perinatal centre may require stabilisation and subsequent transfer or retrieval. If possible and in discussion with the parents, plan for the birth of a high-risk baby to occur in a facility with the anticipated level of neonatal service.[1] Despite best efforts, there will be times when in-utero transfer is not appropriate and a neonatal retrieval is required.[2]

If maternity services are provided within the facility's Clinical Service Capabilities Framework (CSCF) optimal outcomes for both the woman and her baby are more likely. Babies who are born outside of the local CSCF level may, be managed safely at the local level based on clinical decisions made in consultation with clinicians at higher CSCF levels.[1]

Regardless of CSCF level, clinicians require skills in neonatal resuscitation, stabilisation and examination.[1] Initial resuscitation and stabilisation prior to transfer or retrieval of babies is critical to their long term outcomes[2]. 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 level 6 perinatal centre.[2,3]

1.1 Clinical standards

Table 1. Clinical standards

Aspect	Consideration
Standard care	• Refer to Queensland Clinical Guideline: *Standard care*[4] for care considered 'usual' or 'standard' o Includes for example: hand hygiene, privacy, consent, decision making, sensitive communication, medication administration, staff education and support, culturally appropriate care
Clinical guidelines	• Refer to Queensland Clinical Guidelines: o *Early onset Group B Streptococcal disease*[5] o *Newborn hypoglycaemia*[6] o *Hypoxic-ischaemic encephalopathy*[7] o *Neonatal jaundice*[8] o *Neonatal medicines*[9] o *Newborn baby assessment (routine)*[10] o *Perinatal care of the extremely preterm baby*[11] o *Perinatal substance use: neonatal*[12] o *Respiratory distress and CPAP*[13] o *Neonatal resuscitation*[14] o *Neonatal seizures*[15]
Consumer information	• Refer to Queensland Clinical Guidelines consumer information including: o *Babies born very early*[16] o *Baby needing transfer*[17] o *Group B Streptococcus (GBS) in pregnancy*[18] o *Hypoxic ischaemic encephalopathy*[19] o *Jaundice in newborn babies*[20] o *Hypoglycaemia in newborn baby*[21] o *Neonatal abstinence syndrome (NAS)*[22] o *Newborn resuscitation*[23] o *Seizures in newborn babies*[24] o *Small baby born at term*[25]
CSCF	• Escalation for retrieval of baby is dependent on CSCF of birthing facility
Preparation	• Anticipate care from antenatal diagnosis or condition • Evaluate and organise resources—staff and equipment • Contact Retrieval Services Queensland (RSQ) 1300 799 127 as soon as possible[26] • RSQ will facilitate: o Discussion with neonatologist and other specialist (as indicated) for advice and to support the management of the baby o Retrieval activation (if required)

1.2 Indications for transfer or retrieval

Transfer or retrieval may be indicated when the required clinical care of the baby exceeds the CSCF of the birthing facility.[1] Where possible, transfer in-utero to a higher-level facility. If antenatal transfer of the woman is not possible, contact RSQ prior to birth for advice from a neonatologist. Early activation of the neonatal retrieval team can be made when indicated.

1.2.1 Antenatal considerations

Table 2. Antenatal

Aspect	Comment
Fetal[27,28]	• Known congenital anomaly including suspected cardiac anomaly • Multiple pregnancy • Fetal growth restriction
Maternal[27,28]	• Preterm labour • Antepartum haemorrhage; placenta praevia • Severe hypertensive disorder • Prolonged rupture of membranes

1.2.2 Postnatal considerations

Table 3. Neonatal

Aspect	Comment
Adaptation to extrauterine life	• An Apgar score of 6 or less at 5 minutes of age • Birth weight—low, very low or extremely low • Prematurity • Persistent hypothermia • Persistent hypoglycaemia [refer to Queensland Clinical Guideline: *Newborn hypoglycaemia*[6]]
Respiratory	• Conditions from any cause where the care exceeds CSCF capabilities [refer to Queensland Clinical Guideline: *Respiratory distress and CPAP*[13]] • Respiratory distress syndrome • Transient tachypnoea of the newborn (TTN) • Pneumonia • Persistent pulmonary hypertension of the newborn (PPHN) • Meconium aspiration syndrome • Air leaks (e.g. pneumothorax) • Recurrent apnoea • Mechanical ventilation
Other	• Infection or suspected sepsis • Bleeding from any site • Hyperbilirubinemia [refer to Queensland Clinical Guideline: *Neonatal jaundice*[8]] • Severe neonatal abstinence syndrome [refer to Queensland Clinical Guideline: *Perinatal substance use: neonatal*[12]]
Congenital anomaly	• Major congenital anomaly requiring specialist care and/or surgery (e.g. gastroschisis) • Suspected or confirmed congenital heart disease (excluding isolated ventricular septal defect (VSD))
Central nervous system disorder	• Seizures [refer to Queensland Clinical Guideline: *Neonatal seizures*[15]] • Neonatal encephalopathy including hypoxic-ischaemic encephalopathy (HIE) [refer to Queensland Clinical Guideline *Hypoxic-ischaemic encephalopathy*[19]] • Central hypoventilation syndrome
Specialist care	• Need for special diagnostic and/or therapeutic services • Conditions requiring specialty management (e.g. surgery) • Refer to Section 12 Specific conditions

1.3 Referral for retrieval

RSQ provides a single point of contact and assists the most senior clinician available at the referring hospital to consult with the neonatologist. The neonatologist and RSQ will facilitate consultation for advice and further management with the retrieval team, and if indicated the appropriate subspecialists. These include for example, endocrinologist, neurologist, surgeon or cardiologist. Telemedicine/teleconferencing supports the referring clinicians with decision making, diagnosis and advice, and can be used as indicated and available.[26]

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

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

Table 4. Information for Retrieval Services Queensland

Aspect	Consideration
General[26]	• Contact details of referring medical officer • Referring hospital • Parents' preference to travel with the baby if able [refer to Table 26. Parent considerations]
Maternal[26]	• 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/partner) if accompanying baby on flight • Father/partner's full name if accompanying baby • Other (e.g. cultural, social, family or religious considerations)
Neonatal[26]	• Demographic information: o Name o Date of birth o Gestation o Weight o Sex • Birth details: o Time of birth o Mode of birth • Apgar scores and resuscitation required • Current observations–heart rate, respiration rate, blood pressure, capillary peripheral oxygen saturation (SpO_2), temperature, colour, respiratory effort, tone and other (e.g. seizure activity, apnoea, hyperbilirubinemia) • Investigations–pathology, imaging • Current management (e.g. airway management, oxygen requirement, fluids, medications) • Any known provisional or antenatal diagnosis of congenital anomaly • If suspected HIE, time cooling commenced • Any information that may affect the transfer (e.g. general concerns, suspected infection, infectious disease status)

1.4 Initial management

Some babies require ongoing support after initial resuscitation. The level of support will depend on the clinical condition of the individual baby. Consider the need for therapeutic hypothermia to commence within six hours of birth. Refer to Queensland Clinical Guideline: *Hypoxic-ischaemic encephalopathy*.[7]

General principles of management include[29]:

- Identify immediate needs
- Stabilise the baby and prevent deterioration
- Identify and initiate diagnostic investigations
- Establish and maintain communication with the baby's parent(s)
- Contact RSQ for advice, support and to activate retrieval as required

1.5 Resuscitation

Anticipate and plan for the baby's resuscitation prior to the birth. At birth, assess the need for immediate and ongoing resuscitation. Consider that the need for resuscitation can be due to onset of sepsis.

Refer to Queensland Clinical Guideline: *Neonatal resuscitation*[14]

Table 5. Resucitation preparation

Aspect	Consideration
Staff	• Appropriate level of skill • Familiar with: o Equipment o Medications o Resuscitation trolley layout
Equipment	• Readily available for all births regardless of risk • Complete and operational • Refer to Queensland Clinical Guidelines: *Neonatal resuscitation equipment checklist*[30]
Environment	• Preheated overhead radiant warmer positioned in a draft free area • Prewarmed blankets and hat • Babies less than 32+0 weeks gestation or low birth weight (LBW) may require a combination of additional measures[31]: o Increase birthing room temperature (if possible) o A polyethylene bag or sheet up to the baby's neck ▪ Particularly babies less than 28+0 weeks gestation ▪ Do not dry baby prior to use ▪ Use appropriate size, food or medical grade and heat resistant

1.6 Thermoregulation

Table 6. Thermoregulation

Aspect	Good practice point
Context	• Avoid hypothermia or hyperthermia, as both are potentially harmful and associated with increased morbidity and mortality • Hypothermia or cold stress may increase oxygen consumption impeding effective resuscitation
Environment[32]	• Refer to Table 5. Resucitation preparation • Provide a warm and draft free environment • 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	• Maintain temperature 36.5–37.5 °C • Refer to Table 9. Vital signs • If therapeutic hypothermia indicated refer to Queensland Clinical Guideline: *Hypoxic-ischaemic encephalopathy*[7]
Preterm and LBW	• Preterm babies and those who require prolonged resuscitation are particularly susceptible to hypothermia and may require additional measures to reduce heat loss[31] • Leave baby from neck down in polyethylene bag or sheet (when used) until retrieval team arrival o Monitor baby's temperature o Monitor external heat source (e.g. incubator, overhead heater)[31] • Dry baby's head and keep covered with a hat • After initial resuscitation transfer the baby to a prewarmed incubator (if available)

1.7 Investigations

All unwell babies require initial investigations to identify underlying causes. Complete further investigations as indicated after discussion with neonatologist (via RSQ).

Table 7. Investigations

Aspect	Considerations
Initial	• Blood o Blood glucose level (BGL) [refer to Table 16. Glucose monitoring and management] o Full blood count (FBC) with differential o Blood culture—arterial or venous sample o Blood gas (include lactate if available)—if signs of respiratory distress or baby being ventilated • Imaging—chest (and abdominal if indicated) x-ray(s) o Exclude air leaks and other pathologies o Confirm umbilical line, endotracheal tube (ETT), orogastric tube (OGT)/nasogastric tube (NGT) placement
As indicated	• Electrolytes • Total serum bilirubin [refer to Queensland Clinical Guideline: *Neonatal jaundice*[8]] • Cerebrospinal fluid (CSF) • Nasopharyngeal aspirate • Imaging—if bowel perforation is suspected, left lateral decubitus abdominal x-ray

1.8 Clinical support

Table 8. Clinical support

Aspect	Good practice point
Respiratory support	• Maintain a patent airway [refer to Section 4 Respiratory support]
Clinical care of baby	• Observe unclothed (except for nappy) • Establish intravascular (IV) access–consider umbilical venous catheter (UVC) o Avoid multiple attempts for peripheral intravenous catheter (PIVC) or umbilical access • Commence maintenance fluids [refer to Table 19. Intravascular access] • Nil by mouth (NBM) as advised • Insert NGT—if respiratory distress insert OGT size 6–8 Fr and leave on free drainage o Aspirate 4–6 hourly (unless otherwise indicated)
Skin preparation solutions[31,33-36]	• No consensus and limited evidence for optimal skin preparation solution[36] • Can burn and damage sensitive newborn skin (e.g. when used for IV, UVC or intercostal catheter (ICC) procedures) • Use all solutions sparingly on the smallest skin area necessary o Apply caution with alcohol, detergent excipients or chlorhexidine in solution[31] o Dab on gently and allow solution to dry o Avoid pooling of solution on or under baby—remove wet bed linen • Babies less than or equal to 1000 grams or less than or equal to 28+0 weeks, are at increased risk of skin burns o Use aqueous chlorhexidine 0.1% o If not available, use other solutions with caution, gently wash skin with 0.9% sodium chloride[36] or sterile water after procedure completed o Change wet linen as indicated and place baby in dry polyethylene bag • If baby greater than 1000 grams or 28+0 weeks, follow local protocols
Developmental care[37]	• Positioning—provide flexion, containment and midline alignment • Handling—organise and coordinate care to minimise disturbance • Environmental—reduce noise and light • Encourage parental contact—touching and hand containment
Hygiene and comfort	• Assess pressure areas from temperature or SpO_2 sensors, or baby position—note SpO_2 sensor position • Perform 4–6 hourly—mouth care, nappy change, position change and pressure area care, repositioning of SpO_2 and temperature sensors o Record position of baby

2 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.

2.1 Vital signs

Table 9. Vital signs

Aspect	Good practice point
General	• Colour—pink, pale, acrocyanotic, cyanotic, jaundiced, mottled • Skin integrity—presence of bruising, rashes, skin breaks, lesions • Capillary refill time[38]: o Measure on sternum or head o Normal: less than or equal to two seconds • Activity—alert, lethargic • Tone—normal, hypotonic, hypertonic • Movement—normal, abnormal o Refer to Queensland Clinical Guideline: *Neonatal seizures*[15] • Abdomen—soft, distended, masses, bowel sounds, anus patent • Umbilicus—dry, ooze, clamp secure • IV site [refer to Table 19. Intravascular access] • Refer to Queensland Clinical Guideline: *Newborn baby assessment (routine)*
Temperature	• Normal temperature: 36.5–37.5 °C[31,32] • Monitor skin temperature continuously (if available)[39] • Monitor temperature per axilla at least 4 hourly • Recheck per axilla temperature one hour after implementing additional management for an abnormal temperature
Heart rate	• Normal resting heart rate: o Preterm—120–160 beats per minute[39] o Term—110–160 beats per minute • Monitor continuously
Respirations	• Normal respiratory rate: 30–60 breaths per minute • Monitor continuously • Assess work of breathing—nasal flaring, subcostal/intercostal/sternal recession, grunting, tracheal tug • Refer to Table 11. Respiratory support • Refer to Queensland Clinical Guideline: *Respiratory distress and CPAP*[13]
SpO_2	• In the absence of good quality evidence, Queensland Neonatal Services Advisory Group (QNSAG) endorse the following consensus recommendation for SpO_2 targets after 10 minutes of age[40] o Term baby 92–98% o Preterm baby 90–95% • Monitor continuously and record pre-ductal measurement from right hand or wrist o Simultaneous pre- and post-ductal measurements as indicated or advised • Monitor oxygen requirement
Blood pressure	• Acceptable minimum mean arterial pressure is equivalent to or greater than the baby's gestational age (weeks)[39] • Monitor hourly including mean arterial pressure using cuff appropriate to baby's size[41] • Significant elevation in mean arterial pressure may be 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

3 Fluids and medication

Table 10. Fluid and medication

Aspect	Good practice point
Fluid intake	• NBM • 10% glucose infusion rate [refer to Table 19. Intravascular access]
BGL	• Maintain BGL greater than or equal to 2.6 mmol/L (if baby is less than 48 hours of age) • Refer Table 16. Glucose monitoring and management • Refer to Queensland Clinical Guideline: *Newborn hypoglycaemia*[21]
Output	• Gastric aspirate—colour and volume • Urine—amount, frequency, colour • Bowel activity—colour, type, abnormalities (e.g. mucous plug, blood)
Medications	• Consider antibiotic treatment o Can be started if blood culture collection is unsuccessful o Refer to Queensland Clinical Guideline: *Early onset Group B Streptococcal disease*[5] o Refer to Table 18. Management of sepsis • Document time administered and response for any medication administered • Refer to Queensland Clinical Guidelines: *NeoMedQ*

4 Respiratory support

Additional respiratory support may be required when the baby has increased work of breathing with increased oxygen requirements to maintain SpO_2. Refer to Queensland Clinical Guidelines: *Respiratory distress and CPAP*[13] and *Neonatal resuscitation*[14].

Table 11. Respiratory support

Aspect	Good practice point
Airway	• Position supine with head in neutral or slightly extended position (sniffing position)[42] • If suctioning is required—use a large bore catheter o Term baby—size 8, 10 or 12 Fr o Preterm baby—size 8 or 10 Fr o Do not exceed 100 mmHg negative pressure[42] • If required, insert an oropharyngeal airway • If continuous positive airway pressure (CPAP) required: o Refer to Table 12. Continuous positive airway pressure o Refer to Queensland Clinical Guideline: *Respiratory distress and CPAP*[13] • Endotracheal intubation: o Refer to Table 14. Indications for IPPV • Supraglottic airway device (SGAD), (e.g. laryngeal mask airway™) may be required if intubation is not possible • Refer to Queensland Clinical Guideline: *Neonatal resuscitation*[14]
Mask ventilation	• Use to provide respiratory support—CPAP or intermittent positive pressure ventilation (IPPV) at initial resuscitation or 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 [refer to Queensland Clinical Guideline: *Respiratory distress and CPAP*[13]]
Oxygen administration	• If available, use an air/oxygen blender and humidify • Titrate oxygen concentration to maintain SpO_2 within normal range [refer to Table 9. Vital signs] • Document: o Mode of oxygen delivery (e.g. cot, nasal cannulas (high or low flow), mask, CPAP, ventilator) o Concentration and flow rate being delivered

4.1 Continuous positive airway pressure

Preterm babies are prone to atelectasis due to a lack of surfactant. Disparity between chest wall and lung compliance is heightened in babies with surfactant deficiency. CPAP works by maintaining expansion of the alveoli by providing a constant positive pressure to the lungs. This prevents atelectasis and allows gas exchange.[43]

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.[44]

Table 12. Continuous positive airway pressure

Aspect	Consideration
Indications	• Spontaneous respirations • Correct respiratory failure (e.g. respiratory distress syndrome (RDS) • Treat airway obstruction • Prevent respiratory failure (e.g. apnoea of prematurity) • Signs of respiratory distress: o Increased work of breathing—tachypnoea, apnoeic episode, sternal recession, nasal flaring, audible expiratory grunt o Oxygen requirement greater than 30% to maintain SpO_2 [Refer to Table 9. Vital signs]
Contraindications	• Specific congenital anomalies or surgical conditions o Refer to Queensland Clinical Guideline: *Respiratory distress and CPAP*[13]
CPAP	• CPAP may be delivered by: o Flow inflating bag and mask o T-piece device and mask o Bi-nasal prongs o Nasal mask o Single nasopharyngeal tube o Bubble device o Ventilator • For CPAP settings and other care refer to Queensland Clinical Guideline: *Respiratory distress and CPAP*[13]
Observations	• Record hourly o Type of CPAP delivery device (e.g. mask, bi-nasal prongs) o CPAP pressure o Oxygen concentration o Flow rate of oxygen/air mix o Humidifier temperature • Observe for signs of deterioration or CPAP failure [refer to Queensland Clinical Guideline: *Respiratory distress and CPAP*[13]]

4.2 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 soon after birth is known to reduce surface tension of the alveoli and improve lung expansion and gas exchange.

Table 13. Surfactant

Aspect	Considerations
Indications[45,46]	• Baby requiring intubation and ventilation from birth who is: o Less than 32 weeks gestation o Any gestation with respiratory distress syndrome
Medication	• Surfactant may be*:* o *Curosurf®* (Poractant alfa)*—refer to NeoMedQ: *Curosurf*[47] o *Survanta®* (Beractant)*—refer to NeoMedQ: *Survanta*[48]
Administration	• Give at time of intubation (if available) • May be given from birth up to 24 hours of life • Continue IPPV after administration of surfactant until the retrieval team arrives[49] • Observe for changes in lung compliance and adjust ventilation pressures accordingly

**Refer to current pharmacopeia*

4.3 Intermittent positive pressure ventilation

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

Refer to Queensland Clinical Guideline: *Neonatal resuscitation*.[14]

Table 14. Indications for IPPV

Aspect	Consideration
Deterioration[50,51]	• Respiratory distress not improving or worsening—increased work of breathing • Oxygen requirement—increasing over several hours, rapid increase over two hours or greater than 40% to maintain target SpO_2 • Apnoeic episodes • Blood gas showing increasing respiratory acidosis • Poor gas exchange evident by blood gas pH less than 7.25 and $PaCO_2$ greater that 60 mmHg • Baby agitated • Pneumothorax[52] [refer to Table 27. Air leaks] • Consider indications for surfactant o Refer to Table 13. Surfactant
CPAP	• Signs of continuing or increasing work of breathing [refer to Table 12. Continuous positive airway pressure] • Increasing respiratory distress whilst receiving CPAP of 8 cm H_2O o Oxygen requirement greater than 40% o Tachypnoea o Sternal recession o Nasal flaring o Audible expiratory grunt o Apnoea not responding to treatment

4.3.1 Intubation

Table 15. Intubation

Aspect	Consideration
Sedation	• Consider rapid sequence induction (RSI) o Refer to NeoMedQ: *Morphine sulfate*[53], *Atropine*[54] and *Suxamethonium*[55] • Alternatively, consider sedation[50] o Refer to NeoMedQ: *Morphine sulfate*[53] and *Midazolam*[56]
Intubation	• Consider plan for difficult airway management[57] (e.g. SGAD) • Use size and insertion length/depth according to baby's weight[58] [refer to Queensland Clinical Guidelines: *Neonatal resuscitation reference chart*][59] • Assess correct position—refer to Queensland Clinical Guideline: *Neonatal resuscitation*[14] • 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[58,60,61] o Correct position of ETT tip ▪ Visible just below the medial ends of the clavicles ▪ Approximately at the level of the first to second thoracic vertebrae ▪ 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 SpO_2 [refer to Table 9. Vital signs] • Ventilator flow rate of 8 L per minute (air/oxygen mix) • Provide warmed humidified air/oxygen[62] at 37 °C
ETT suction	• Only suction if required[58] • For suction catheter sizes no more than half the internal diameter of ETT[63]—refer to Queensland Clinical Guidelines: *Neonatal resuscitation reference chart*[59] • If flow sensor is attached, remove prior to ETT suction • Use access port in ventilator circuit o If no access port, briefly disconnect manifold to suction • Insert suction catheter the length of the ETT plus the length of manifold (if in situ)

5 Glucose monitoring

Table 16. Glucose monitoring and management

Aspect	**Good practice point**
Hypoglycaemia prevention and management	• Commence 10% glucose IV infusion as soon as practical after birth to avoid hypoglycaemia [refer to Table 19. Intravascular access] • Usually, glucose 4–6 mg/kg/minute (60–90 mL/kg/day) is sufficient • Glucose concentrations greater than 12% require administration via UVC[64]
BGL monitoring	• Maintain BGL equal to or greater than 2.6 mmol/L • Refer to Queensland Clinical Guideline: *Newborn hypoglycaemia*[6]

6 Infection

Early onset of sepsis is generally acquired vertically from bacteria colonizing the mother's lower genital tract or from infected amniotic fluid.[65-67] 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.[65] Refer to Queensland Clinical Guideline: *Early onset Group B Streptococcal disease*[5]

6.1 Risk factors and signs of infection

Table 17. Risk factors and signs of sepsis

Aspect	Consideration
Risk factors[66]	• 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+0 weeks gestation o Birthweight less than 2500 grams o Birth asphyxia o Meconium liquor o Congenital anomalies (e.g. abdominal wall or spinal)
Signs[67,68]	• Temperature instability: o 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 o Lethargy o Irritability o Seizures o Hypotonia or hypertonia o Abnormal cry—high-pitched o Bulging fontanelle • Other: o Lethargy o Feed intolerance, abdominal distention o Rash, jaundice, pallor, petechiae, cool peripheries o Hepatomegaly, splenomegaly o BGL instability—hypoglycaemia or hyperglycaemia o Metabolic acidosis

6.2 Management of sepsis

Table 18. Management of sepsis

Aspect	Consideration
Investigations	• Collect blood culture first (1 mL if possible), then FBC with differential prior to commencing antibiotics[67] • Commence antibiotics as soon as possible o If unable to collect blood culture or FBC, do not delay administration • If IV/UVC access is not obtained and sepsis is clinically suspected administer antibiotics by intramuscular (IM) injection
Management	• Where local guidelines do not exist, suggested empirical antibiotic therapy includes: o Penicillin* **OR** amoxicillin/ampicillin* o **AND** gentamicin* ▪ For dosing regimens refer to NeoMedQ: *Benzylpenicillin*[69], *Amoxicillin*[70], *Ampicillin*[71], *Gentamicin*[72] • Consider maternal history (e.g. if *Herpes simplex* virus is suspected consider acyclovir*)[66] o For dosing regimens refer to NeoMedQ: *Aciclovir*[73] • If late onset (greater than 72 hours old) sepsis is suspected, consider Ampicillin* and gentamicin*, OR cefotaxime* o For dosing regimens refer to NeoMedQ: *Ampicillin*[71], *Gentamicin*[72] and *Cefotaxime*[74]

*Refer to pharmacopeia

7 Circulation

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

7.1 Fluid management

Table 19. Intravascular access

Aspect	Considerations
Indications	• Signs of infection [refer to Table 17. Risk factors and signs of sepsis] • Birthweight less than1800 grams • Less than 34+0 weeks gestation • Respiratory distress[75] • Gastrointestinal anomalies or obstruction[76] • Suspected congenital cardiac disease[77] • IV medication or fluid administration[78] • Avoid UVC if known or suspected transposition of the great arteries (TGA)
Insertion	• Skin preparation [refer to Table 8. Clinical support] • Peripheral IV cannulation—use a 24 gauge IV cannula if available o Splint and tape securely o Observe cannula site continuously for patency, redness, infiltration • Umbilical venous catheterisation—consider insertion if: o PIVC insertion is unsuccessful and/or o Baby is critically unwell or LBW o Use double lumen catheter (if available)—secure with suture and tape o Nurse supine—observe site for redness, leakage, dislodgement o Confirm position on x-ray prior to infusing fluids except when using for emergency resuscitation • Routine umbilical or peripheral arterial line insertion is not required
Maintenance fluids	• Day one requirements o Term baby 10% glucose 60 mL/kg/day (unless advised otherwise by neonatologist)[64,79] o Preterm baby 10% glucose 80 mL/kg/day • 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) o Consider baby's sodium level and weight gain/loss • Include all fluids infused—maintenance fluids and support medications (e.g. bolus glucose doses, dopamine)

7.2 Hypovolaemic shock

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

Table 20. Cardiovascular compromise

Aspect	Consideration
Clinical signs[80]	• Hypotension—mean arterial blood pressure measured in mmHg is less than the baby's gestational age in weeks • Pallor • Mottled skin • Tachycardia • Prolonged capillary refill (greater than two seconds) • Weak pulse • Metabolic acidosis • Blood loss • Decreased urine output
Causes	• Blood loss in-utero: o Placenta anomalies (e.g. umbilical cord rupture, placental abruption, placenta praevia) o Twin to twin transfusion syndrome • Acute blood loss (e.g. intracranial or pulmonary haemorrhage) • Plasma or fluid losses: o Congenital anomaly (e.g. gastroschisis or myelomeningocele) o Pleural effusion o Other body water loss (e.g. vomiting, gastric suctioning, evaporative via skin) • Ineffective cardiac output • Sepsis
Management	• Maintain adequate oxygenation[80] • Use isotonic crystalloid solution—0.9% sodium chloride 10 mL/kg IV/UVC[42] over 20 minutes o If no improvement in blood pressure, heart rate or capillary refill and repeat dose(s) are indicated discuss with neonatologist o Continue maintenance fluids (in addition to bolus 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)[81]] o Use cross matched, irradiated and cytomegalovirus (CMV) negative blood (if available) o For emergency transfusions, administer group O Rh D negative blood • Avoid rapid administration of fluids in preterm babies as this has been associated with an increased risk of intraventricular haemorrhage[82]
Inotrope support[83]	• If hypotension persists after fluid replacement, consider inotropic support (e.g. dopamine, dobutamine) • **Consult with a neonatologist prior to commencing** o For dosing and administration guidance refer to NeoMedQ: *Dopamine*[84] and *Dobutamine*[85] • Infuse through a UVC (preferable), or peripheral IV—observe site (e.g. 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

**Refer to current pharmacopeia*

8 Encephalopathy

Table 21. Encephalopathy

Aspect	Consideration
Context	• Characterised by disturbed neurological function in the early days of life • Often presents as:[86,87] o Reduced level of consciousness o Seizures [refer to Section 8.2 Seizures] o Difficulty in initiating and maintaining respiration o Depression of tone and reflexes
Neurological assessment	• Assess baby's neurological status o Refer to Queensland Clinical Guideline: *Neonatal seizures*[15] • If abnormal neurological assessment, contact RSQ for neonatologist advice
Hypoxic ischaemic encephalopathy (HIE)	• Neonatal encephalopathy resulting from acute peripartum or intrapartum event[88] • Therapeutic hypothermia (TH) 33–34 °C commenced within 6 hours of birth, improves babies long term outcome where there has been moderate or severe injury[89] • TH requires concurrent good supportive care (e.g. assisted ventilation and cardiovascular support)
Criteria for TH	• Commence encephalopathy assessment, including hourly SARNAT scoring for six hours from birth o Refer to Queensland Clinical Guideline: *Encephalopathy severity (modified Sarnat) assessment*[90] • If HIE is suspected, contact RSQ promptly for discussion with a neonatologist • If criteria for therapeutic hypothermia (TH) is met this is started before six hours of age when the baby: o Has evidence of perinatal/intrapartum hypoxia o Is greater than or equal to 35+0 weeks gestation o Is greater than or equal to 1800 grams birth weight • If criteria is not met (e.g. signs of mild encephalopathy, birthweight is less than 1800 grams, less than 35+0 weeks gestation, greater than six hours of age) discuss management with a neonatologist • Refer to Queensland Clinical Guideline: *Hypoxic-ischaemic encephalopathy*[7]

8.1 Seizures

Table 22. Seizures

Aspect	Consideration
Context	• Clinically, a seizure is a sudden paroxysmal alteration in neurological function or behavioural, motor or autonomic function[91] • Neonatal seizures are classified as:[92] o Motor—automatisms, clonic, myoclonic, tonic o Epileptic spasm o Non-motor—autonomic, behavioural arrest o Sequential
Assessment	• Commence assessment of abnormal movements o Refer to Queensland Clinical Guidelines: *Flowchart Abnormal movements in newborn baby*[93] o Refer to Queensland Clinical Guidelines: *Neonatal seizure and neurological observation chart*[94]
Management	• Contact RSQ for neonatologist advice if baby has: o Seizure (confirmed or suspected) o Other abnormal movements (e.g. jitteriness, excessive startles, tremor, hyperekplexia, clonus, benign neonatal sleep myoclonus) • Refer to Queensland Clinical Guideline: *Neonatal seizures*[15]

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).[95]

Table 23. Pain

Aspect	Consideration
Signs[95-98]	• Physiological: o Increased heart rate, blood pressure, respiratory rate, muscle tension, oxygen consumption (increased oxygen requirements or falling SpO_2) o Pallor or flushing o Dilated pupils o Decrease in respiration rate and depth o Apnoea o Bradycardia (or tachycardia with bradycardic episodes) • Behavioural: o Crying, whimpering or moaning o Grimacing, quivering chin 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 [95, 99-102]	• Indications—prior to procedures (e.g. heel prick, cannula insertion, eye examination, IM injection, tape removal, NGT insertion) • Breast milk—give few drops slowly and directly onto the tongue two minutes prior to the procedure • Skin to skin contact[96] • Non-nutritive sucking o Provide a pacifier for baby to suck with parental consent • Swaddling/containment o Hold the baby's extremities flexed and close to their trunk • Reduce environmental stimuli[96] (e.g. noise, lighting) • Limit the number of procedures performed at the same time
Pharmacological	• Oral sucrose*[95,103] o Effective for reducing procedural pain (e.g. heel prick, venepuncture, cannula insertion, tape removal, NGT insertion, IM injection) o Refer to NeoMedQ: *Sucrose*[104] • Morphine sulphate*[95] o Prior to intubation [refer to Table 15. Intubation] o During mechanical ventilation (as indicated) o Pre and post ICC insertion o Other (e.g. necrotising enterocolitis (NEC), bowel perforations) o Refer to NeoMedQ: *Morphine sulfate*[105] • Local anaesthetic—1% lignocaine* (e.g. prior to ICC insertion)[96] o Refer to NeoMedQ: *Lidocaine*[106]

**Refer to current pharmacopeia*

10 Preparation for retrieval

Provide clinical care and management to maintain normal SpO_2, temperature and BGL, and reduce the risk of deterioration while waiting for the arrival of the retrieval team. Additionally, initiate any other treatment or care the baby requires as able within the facility's service capability.

Table 24. Preparation for retrieval

Aspect	Consideration
Communication	• If there are changes in the baby's condition which may influence ongoing management, contact RSQ again for further discussion and advice • Initiate local protocol regarding internal communication (e.g. security services, nurse manager) • If telehealth is required, contact RSQ for further support • Discuss with parents: o Planned retrieval, including receiving hospital location o Any changes in baby's condition o Importance of breast milk (if indicated, assist with expressing)
Documentation[26]	• Prepare two copies of documentation—one for retrieval service and one for tertiary facility • Provide copies of: o Maternal history—pregnancy health record o Antenatal history o Perinatal data form o Resuscitation record o Observation charts (e.g. vital signs, seizures and neurological observation, assessment of encephalopathy) o Medication and fluid charts o Progress notes • Newborn bloodspot screening test (NBST) card signed by parent
Other	• Confirm two identification bands are securely attached to the baby • X-rays: o Transferred on medical imaging software (e.g. picture archiving and communication system (PACS)) or o Hard copies • Baby's Queensland Health *Infant Personal Health Record (red book)* or if applicable, New South Wales *My Personal Health Record* (*blue book*)

10.1 Retrieval team

The retrieval team will require assistance with ongoing stabilisation.

Table 25. Retrieval team

Aspect	Consideration
Environment	• Space and power points for retrieval cot • Air and oxygen outlets • Procedure trolley(s)
Clinical handover	• Maternal history • Neonatal history: o Resuscitation o Investigations o Management o Changes in clinical condition • Parental plans for travelling to receiving facility • Parental contact information
Provide assistance	• Procedures (e.g. use of dressing trolley) • Organisation of services (e.g. imaging, security) • Refreshments and amenities for retrieval team
Expressed breast milk (EBM)	• Labelled and packaged in a container with ice to keep cold o Refer to Queensland Clinical Guideline: *Establishing breastfeeding*[107]

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 woman may be transferred separately if medically unwell)
- Space or weight restrictions
- Baby's clinical condition

Table 26. Parent considerations

Aspect	Good practice points
Photographs	• Provide opportunities for the parent(s) to take photographs o If required, provide photographs for parent(s)
Communication[26,108]	• Encourage early contact between parent(s) and baby • Outline the proposed plan of care for the baby • Gain parental consent for the retrieval/transfer • Encourage and facilitate parental interaction with baby • Keep the parents informed about their baby's condition • Support ongoing communication with the receiving facility • Offer parents debrief (if appropriate) o May also occur once the family has returned to home facility • Refer to support services (e.g. social worker, Aboriginal and/or Torres Strait Islander health worker)
Information	• Provide parent information about baby's condition (if available)[109] • Refer to Queensland Clinical Guidelines consumer information • 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, parents may need assistance with arranging their own accommodation o Refer to social work services

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. Refer to Queensland Clinical Guideline: *Respiratory distress and CPAP*[13]

The differential diagnosis of neonatal respiratory distress includes[110]:

- Pulmonary disorders (e.g. respiratory distress syndrome (RDS), transient tachypnoea of the newborn (TTN), meconium aspiration syndrome (MAS), air leak syndromes)
- Systemic disorders (e.g. hypothermia, hypoglycaemia, congenital heart disease)
- Structural anomalies (e.g. choanal atresia, Pierre Robin sequence, congenital diaphragmatic hernia (CDH), congenital lung anomalies)
- Sepsis

12.1.1 Air leaks—presentation and management

Table 27. Air leaks

Aspect	Good practice point
Context	• Can occur at any gestation • May be associated with other lung pathology (e.g. RDS, MAS) • Refer to Queensland Clinical Guideline: *Respiratory distress and CPAP*[13]
Presentation[52]	• Consider if: o Increasing respiratory effort o Decreased breath sounds on affected side o Tachycardia o Bradycardia o Hypotension o Skin mottling o Increasing oxygen requirements
Pneumothorax[52]	• If causing significant respiratory distress and cardiopulmonary compromise, requires urgent treatment (tension pneumothorax)[111] • Needle aspiration use 23 gauge non-retractable butterfly needle or 24 gauge IV cannula (with two-way flow) • ICC insertion: o Administer analgesia [refer to Section 9 Pain management] o Prepare skin [refer to Table 8. Clinical support] o Connect to a one-way valve drain or a one-way flutter valve drain and tape securely (do not suture) o Position baby supine o Observe catheter and document for fluttering, swinging and drainage o Confirm position on x-ray • Consider antibiotics [refer to Section 6 • Infection] • General management [refer to Table 8. Clinical support]
Pneumo-mediastinum[52]	• Conservative management is recommended • Continue to observe for other air leaks
Pneumo-pericardium[52]	• Conservative management is usually recommended • Observe for signs of cardiac tamponade

12.1.2 Choanal atresia

Table 28. Choanal atresia

Aspect	Consideration
Overview[112]	• Congenital narrowing of the nasal airway at the posterior choanae (nares) • Can be unilateral or bilateral
Presentation[112-114]	• Depends on if the obstruction is unilateral or bilateral • Obvious airway obstruction • Inability to insert an NGT • 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 • If using binasal CPAP—baby's condition not improving
Management[114]	• Insert oropharyngeal airway • Position baby prone • Intubate as required [refer to Table 14. Indications for IPPV] • Establish IV access [refer to Table 19. Intravascular access] • General management [refer to Table 8. Clinical support]

12.1.3 Pierre Robin sequence

Table 29. Pierre Robin sequence

Aspect	Consideration
Overview	• The association of micrognathia, glossoptosis, cleft palate and airway obstruction[115]
Presentation[116,117]	• Upper airway obstruction • May occur during wakefulness, sleep or feeding • Snoring • Apnoea • Stridor
Management	• Position baby prone or on side[115] • If airway is compromised, insert oropharyngeal airway or single nasopharyngeal tube[115] • If CPAP is required, use single nasopharyngeal tube (soft ivory ETT)[115] o Insertion distance—measure from nasal tip to tragus of the ear o Positioned behind the tongue just above the larynx • If unable to maintain airway—endotracheal intubation may be required • If intubation is unsuccessful—consider using SGAD in babies greater than 2000 grams or greater than or equal to 34+0 weeks gestation • Establish IV access [refer to Table 19. Intravascular access] • General care [refer to Table 8. Clinical support]

12.2 Gastrointestinal disorders

Some gastrointestinal disorders may be diagnosed antenatally, and others may not be obvious or suspected until after birth. These may be a life-threatening surgical emergency.

12.2.1 Bowel anomalies

Table 30. Bowel anomalies

Aspect	Consideration
Overview	• Narrowing or occlusion (e.g. duodenal atresia, malrotation, volvulus, meconium ileus, Hirschsprung's disease[76]) • Absence of a normal opening (e.g. imperforate anus[118]) • An inflammation of the bowel (e.g. NEC)[118]
Antenatal diagnosis from antenatal scan[119]	• Dilated intestinal loops • 'Double bubble' (duodenal atresia)[76] • 'Triple bubble' (jejunal atresia)
Pathology	• Metabolic acidosis, thrombocytopenia, leukopenia, leucocytosis, glucose instability, hyponatraemia[2]
Imaging[76,119]	• X-rays o Abdominal spine antero-posterior view o Lateral decubitus view—baby side lying with left side down if bowel perforation suspected • Signs of bowel abnormality o Dilated loops of bowel o Intestinal dilatation o Thickened intestinal wall o Pneumatosis intestinalis o Double bubble or triple bubble appearance o Air in the portal venous system or pneumoperitoneum o Intraperitoneal calcification o Absence of air in rectum
Presentation[76,119]	• Vomiting o Bilious or non-bilious • Abdominal distention and tenderness • Abdominal wall discolouration • Stool o Fresh or occult blood • Failure to pass meconium by 24–48 hours of age • Passage of a meconium plug • Non-specific signs o Apnoea o Increasing oxygen requirement o Bradycardia or tachycardia o Poor perfusion o Hypotension o Lethargy o Temperature instability
Management[76]	• NBM[39] • Insert large bore (size 8 Fr) NGT on free drainage[39] o Hourly aspiration—measure gastric losses • Establish IV access • Commence empirical antibiotics [refer to Table 17. Risk factors and signs of sepsis] o Consider adding metronidazole IV*–refer to NeoMedQ: *Metronidazole*[120] • Consider analgesia and sedation [refer to Section 9 Pain management] • Monitor urine output • General management [refer to Table 8. Clinical support]

**Refer to current pharmacopeia*

12.2.2 Abdominal wall anomalies

The majority of abdominal wall anomalies present on antenatal ultrasound.[119]

Table 31. Abdominal wall anomalies

Aspect	Consideration
Overview[119,121]	• Gastroschisis: o Abdominal contents herniate through a cleft in the abdominal wall o Usually to the right of the umbilicus • Exomphalos: o Abdominal wall anomaly 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 • Bladder exstrophy o Open abdominal wall, bladder and urethra[122]
Presentation[119,122]	• Obvious herniation or evisceration of abdominal contents
At birth	• Position the cord clamp well above the lesion • Leave at least 15–20 cm length of cord
Airway management	• If gastroschisis: o Avoid bag and mask ventilation[31] o If respiratory distress present—intubate and ventilate o Avoid non-invasive ventilation modes—CPAP and high flow[31]
At birth	• Protect the protruding abdominal contents[121] o NOTE: **Do not** cover with a dressing or saline soaked gauze o Bowel bag not preferred • Cover the anomaly with cling film[123] (food grade): o Lie the baby supine, slide a large piece of cling film under the buttocks and back o Using sterile latex free gloves, place the exposed bowel to the centre of the abdomen o Observe that the bowel remains pink, and loosely encircle the abdomen and anomaly with the cling film o Ensure the cling film is not too tight and the bowel edges are not exposed to the air

12.2.3 Abdominal wall anomalies continuing care

Table 32. Continuing care

Aspect	Consideration
Positioning baby[123,124]	• Position baby supine or towards right side o Ensure baby is not lying on protruding abdominal contents • Aim to prevent pressure on the mesentery o Optimal position of bowel is midline o If midline position compromises the bowel—lay exposed abdominal contents on the side of the abdominal opening in relation to the umbilical cord (more commonly the right side) • Avoid undue tension on the abdominal contents or twisting of the bowel on itself 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
Investigations	• FBC • Blood culture • BGL • Chest and abdominal x-ray
Management	• NBM[123,124] • Insert large bore (size 8 Fr) NGT on free drainage o Hourly aspiration—measure gastric losses[76,119,121] • Observe perfusion to lower limbs • Maintain normal thermogenesis[76,119]—transfer baby to warmed incubator (if available) o Avoid heat and evaporative heat loss from abdominal contents • General management [refer to Table 8. Clinical support]
Fluid and medication management	• Establish peripheral IV access[123] • Commence maintenance fluid[121] at 80 mL/kg/day o May require an increase of daily requirements after discussion with neonatologist o Refer to Table 19. Intravascular access • Commence prophylactic antibiotics at empirical doses and regimens[76,119,123] [refer to Table 17. Risk factors and signs of sepsis] o Follow local protocols for empirical antibiotics or o Refer to Table 18. Management of sepsis • Administer analgesic and sedation [refer to Section 9 Pain management] • Monitor urine output

12.2.4 Oesophageal anomalies

Table 33. Oesophageal atresia and trachea-oesophageal fistula

Aspect	Consideration
Overview[125,126]	• Tracheo-oesophageal fistula o Abnormal connection or fistula tract between the trachea and the oesophagus • Oesophageal atresia o Oesophagus terminates in a blind-ending pouch with or without fistula to the trachea • May be associated with other congenital anomalies or may occur as part of a recognised syndrome o VATER/VACTERL association o CHARGE association o Trisomy 21
Antenatal	• USS[76,125] o Polyhydramnios o Small or absent stomach
Presentation	• Postnatal:[76,125] o Excessive oral secretions o Cyanosis or coughing when feeding o Respiratory distress o Abdominal distension • Unable to pass NGT/OGT to anticipated depth[125] • If oesophageal atresia on x-ray—NGT/OGT may be coiled in the oesophageal pouch in the upper mediastinum at T3[76,119]
Management	• Airway o Do not use CPAP • IPPV is usually only required if respiratory distress, severe pneumonia or other associated malformation requiring respiratory support[125] • Insert Replogle® tube[76,125] (if staff experienced with use are available) 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 0.9% sodium chloride at least hourly or as required to clear secretions • If Replogle® tube or experienced staff not available—insert a large bore (8– 10 Fr) NGT/OGT o Leave on free drainage o Gently aspirate at least every 15 minutes and as required ▪ Excessive suctioning may cause damage to oesophagus o Do **not** instil 0.9% sodium chloride (or any other fluids) • Position baby at 30–45 °—elevate head of incubator/cot[76,125] • NBM • Establish IV access and commence maintenance fluids [refer to Table 19. Intravascular access] • Commence prophylactic antibiotics at empirical doses and regimens [refer to Table 17. Risk factors and signs of sepsis] • Pacifier not recommended as increases production of saliva • General management [refer to Table 8. Clinical support]

12.2.5 Diaphragmatic hernia

Table 34. Diaphragmatic hernia

Aspect	Consideration
Overview	• An anomaly in the diaphragm that allows herniation of the abdominal contents into the chest[127] • Impedes fetal lung development that leads to varying degrees of pulmonary hypoplasia and pulmonary hypertension[76]
Antenatal	• Polyhydramnios, mediastinal shift absence of intra-abdominal stomach bubble[127]
Imaging[127]	• Chest and abdominal x-ray: o Bowel loops evident in chest cavity o Paucity of gas in abdomen o Mediastinal shift to opposite side o Absent diaphragm o Hypoplastic lung on same side (commonly left)[76]
Presentation[76,127]	• Respiratory distress—cyanosis, tachypnoea and grunting • Cyanosis • Pulmonary hypertension • Decreased air entry on the affected side with bowel sounds heard in the chest • Flat or scaphoid abdomen • Auscultation of bowel sounds in lung fields • Increased anteroposterior diameter of thorax • Respiratory acidosis
Management[76]	• Airway: o Intubate and ventilate baby [refer to Table 14. Indications for IPPV] o Bag and mask ventilation or CPAP not recommended as can cause gastrointestinal distension and lung compression o Commence morphine infusion [refer to NeoMedQ: *Morphine sulfate*[53]] • Insert large bore (size 8 Fr) NGT on free drainage o Hourly aspiration—measure gastric losses • NBM • Establish peripheral IV access and commence maintenance fluids [refer to Table 19. Intravascular access] • Cardiovascular support to maintain normal BP [refer to Table 20. Cardiovascular compromise] • General management [refer to Table 8. 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 anomaly, the effects on the fetus in-utero and alterations in cardiovascular physiology during transitional circulation such as closing of the duct.[128]

The Queensland Maternal and Perinatal Quality Council (QMPQC) recommends all newborn babies are offered pulse oximetry screening for critical congenital heart disease (CCHD).[129] Refer to Queensland Clinical Guideline: *Newborn baby assessment (routine)*[10]

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 35. Duct dependent cardiac lesions

Aspect	Consideration
Overview[80,130-132]	• Systemic blood flow: o Severe left-sided obstructive anomalies where systemic blood flow is dependent on right to left blood flow through patent ductus arteriosus (PDA) o Hypoplastic left heart syndrome, critical aortic stenosis, coarctation of aorta and interrupted aortic arch • Pulmonary blood flow: o Pulmonary atresia with intact VSD, critical pulmonary stenosis, pulmonary stenosis, right ventricular hypertrophy, overriding aorta • Systemic and pulmonary mixing between circulations: o Transposition of the great arteries (TGA)
Specific signs[80,130,132-134]	• Presentation may be gradual or rapid as the ductus arteriosus begins to constrict • Cyanosis not improving despite supplemental oxygen o If critical aortic stenosis, critical coarctation of the aorta—upper half of body is pink and lower half is cyanosed ▪ SpO_2 may be normal in lower body due to the left to right shunting of blood • Acute cardiorespiratory collapse with cardiogenic shock and/or hypoxia • Signs of heart failure (e.g. tachycardia, tachypnoea, hepatomegaly) • Heart murmur • Increased precordial activity; diminished or bounding femoral pulses • Blood pressure—greater than 20 mmHg difference between upper and lower extremities may indicate an obstruction such as coarctation of aorta • Chest x-ray—cardiomegaly, dextrocardia, abnormal cardiac silhouette (e.g. boot shaped heart with tetralogy of Fallot, egg on a string with TGA), abnormal pulmonary vascular markings, abnormal aortic arch
Non-specific signs[80,130]	• Hypotension—cardiogenic shock as the PDA closes; lack of improvement or clinical deterioration despite volume resuscitation • Cardiomegaly on chest x-ray • Differential pulses • Poor peripheral perfusion—elevated lactate • Signs of respiratory distress (e.g. tachypnoea, apnoea, grunting) • Lethargy—feeding difficulties
Management	• Initial management—refer to Table 19. Intravascular access and Table 8. Clinical support • Record SpO_2 pre-ductally on right hand **and** post-ductally on either foot [refer to Queensland Clinical Guideline: *Newborn baby assessment (routine)*[10]]—specific targets may be identified • Establish vascular access [refer to Table 19. Intravascular access] • Commence antibiotics [refer to Table 17. Risk factors and signs of sepsis] • After discussion with neonatologist and paediatric cardiologist: o Commence IV Alprostadil (prostaglandin E1)* infusion as advised[135] [refer to NeoMedQ: *Alprostadil*]

**Refer to pharmacopeia*

12.3.2 Non-duct dependent cardiac lesions

Table 36. Non-duct dependent cardiac lesions

Aspect	Consideration
Overview[130]	• Not dependent on duct for blood to mix o Tetralogy of Fallot (some) o VSD o Atrioventricular canal anomaly o Truncus arteriosus • Symptoms are related to excessive pulmonary blood flow
Presentation[136]	• Signs may develop gradually • May present with signs of congestive heart failure o Pulmonary oedema o Pulmonary rales o Hepatomegaly o Heart murmur o Tachycardia o Tachypnoea o Poor feeding o Diaphoresis o Irritability
Management[133]	• Chest x-ray o Abnormal cardiac silhouette (e.g. boot shaped heart in tetralogy of Fallot) • Monitor blood pressure—record on all four limbs • Record SpO_2 pre-ductally on right hand **and** post-ductally on either foot o Refer to Queensland Clinical Guideline: *Newborn baby assessment (routine)*[10] • Commence maintenance fluids [refer to Table 16. Glucose monitoring and management] • Commence antibiotics [refer to Table 17. Risk factors and signs of sepsis] • General care [refer to Table 8. Clinical support]

12.3.3 Cardiac arrhythmias

Table 37. Cardiac arrhythmias

Aspect	Consideration
Overview	• Supraventricular tachycardia is the most common requiring treatment[137] • May have congenital cardiac anomaly or heart may be structurally normal
Presentation	• Tachycardia • Electrocardiogram (ECG) shows a narrow complex tachycardia greater than 220 beats per minute[136]
Management	• **Discuss all management with neonatal retrieval coordinator and paediatric cardiologist via RSQ** • Record ECG during any treatment • Apply ice over the forehead: o Cover cool/gel packs with sheet prior to application • Do **not** use carotid massage or orbital pressure • Do **not** immerse baby's head/face in iced water • Send copy of the baby's 12 lead ECG to paediatric cardiologist • Adenosine*—**discuss with neonatologist or paediatric cardiologist prior to administration for dosing regimen and other considerations** o Refer to NeoMedQ: *Adenosine*[138]

**Refer to current pharmacopeia*

12.4 Neural tube anomalies

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

Table 38. Neural tube anomalies

Aspect	Consideration
Overview	• Occur when there is incomplete closing of the vertebrae and the membranes around the spinal cord[139] • Spina bifida occulta: mildest form with skin covering the opening in the spinal column[140] • Meningocele: a midline anomaly in which the meninges herniate through the posterior vertebral arch[140] • Myelomeningocele: a midline anomaly in which the meninges, fragments of bone, cartilage and spinal cord herniate through the vertebral arches and the skin[140]
Presentation	• Obvious or subtle dermal lesion in the lumbosacral region such as cutaneous dimples, cutaneous anomalies or masses or abnormal collections of hair[140] • Herniation may or may not have a skin covering[140]
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/capillary blood sampling (e.g. BGL) • Use non-latex gloves[140] when handling baby • Establish IV access [refer to Table 19. Intravascular access] o Avoid scalp veins for IV access • Commence maintenance fluids [refer to Table 16. Glucose monitoring and management] • NBM • Commence prophylactic antibiotics at empirical doses and regimens [refer to Table 17. Risk factors and signs of sepsis] • General care [refer to Table 8. Clinical support]

12.5 Other

Newborn babies may present with a variety of conditions and the appropriate treatment and management will be dependent on each specific condition. Contact RSQ for advice from a neonatologist.

12.5.1 Bone fractures

Table 39. Bone fractures

Aspect	Consideration
Overview	• Rare occurrence caused by: o Birth trauma o Metabolic bone disease • Clavicle fracture most often caused from birth trauma (e.g. shoulder dystocia)[141] • Osteogenesis imperfecta (OI): o Inherited bone fragility conditions[142,143] o Very rare o Clinical presentation of fracture(s) during prenatal period or at birth
Presentation[144]	• History of difficult birth (e.g. shoulder dystocia) • Clinical signs: o Swelling/oedema o Crepitus o Bony prominence o Restricted movement o Limb deformity o Pain/discomfort • Clavicle fracture can result in restricted Moro reflex • X-ray to confirm diagnosis
Specific management	• Administer pain relief [refer to Table 23. Pain] • Clavicle fracture o Avoid elevation of the affected arm[144] • Limb fracture (e.g. femur, humerus) o Seek urgent advice from neonatologist regarding management (e.g. splinting) • If concerns of metabolic bone disease minimal handling • If managed locally, consider orthopaedic review

12.5.2 Skin conditions

Table 40. Skin conditions

Aspect	Consideration
Context[145]	• Neonatal skin integrity conditions can be a medical emergency o Early assessment and diagnosis aids management and prevention of complications
General management	• If available, organise clinical photography to aid diagnosis • **Do not** apply tapes or adhesive products to the skin • Attach identification bands to cot • Consider potential complications (e.g. hypothermia, hypernatraemia and sepsis) • Use silk sheets (if available) o Avoid bedding with loose fibres (e.g. bunny rugs) • Avoid skin breaching interventions • Insert umbilical catheter for fluids and medication administration o Suture catheter (do **not** secure with tape)
Epidermolysis bullosa (EB)	• Rare inherited group of blistering disorders o Ask about family history • Presentation:[146] o Extreme skin fragility and blister formation • Management:[145] o Avoid friction and shearing forces ▪ Avoid drying and unnecessary handling of the baby o Administer pain relief [refer to Table 23. Pain] o If open wounds/broken skin or blisters apply suitable foam dressing (e.g. Mepilex™ or Polymem™) ▪ If suitable dressings not available, cover open wounds/broken skin or blisters with cling film o Nurse in standard cot/bassinette—avoid overhead radiant heater o Ensure cord clamp is not in direct contact with skin o Avoid NGT o If blood pressure is required, do not place cuff directly on skin ▪ Line with soft non-adhesive non-shearing padding (e.g. Webril™) o If SpO_2 monitoring is required, apply low-adherent skin protection under the sensor (e.g. Mepitel one™) ▪ Secure probe with dressing suitable for fragile and sensitive skin (e.g. Mepitac™ or Siltape™) o Do not use adhesive skin temperature sensors o Monitor temperature using axillary thermometer
Collodion	• Presentation:[145] o Generalised taut thick tethered skin o Unyielding skin at birth which does not shed • Management:[145,147] o Check blood gas and provide respiratory support as indicated o Liberally apply emollient to skin ▪ If available, use 50% liquid paraffin/50% soft paraffin (e.g. Dermeze™) ▪ Alternatively, use soft white paraffin o Nurse in incubator (if available) ▪ Provide humidification (follow manufacturer's instructions for use)
Ichthyoses	• Presentation:[148,149] o Hyperkeratosis and thick, diamond-shaped scales present from birth o Dry skin causing skin splitting • Management:[147,149] o Liberally apply emollient to skin ▪ If available, use 50% liquid paraffin/50% soft paraffin (e.g. Dermeze™) ▪ Alternatively, use soft white paraffin o Nurse in incubator (if available) ▪ Provide humidification (follow manufacturer's instructions for use)

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Appendix A Checklist: Preparation for retrieval

Contact RSQ (phone 1300 799 127) immediately if there is significant deterioration in the baby's clinical status, or if additional or unplanned interventions or treatment are required.

Prior to the retrieval team arriving check:

- **Airway safety maintained**
- **Oxygenation optimised**
- **IV access secure**
- **Medications and fluids managed**
- **Thermoregulation maintained**
- **Patient documentation completed**
- **Parents communicated with and have written parent information**

❑ **1. Parents:**

- ❑ Consent to retrieval
- ❑ Informed of possible complications
- ❑ Advised of initial plan of care
- ❑ Have photos of baby

❑ **2. Preparation of the baby:**

- ❑ Identification bands secured on baby: name (baby of [mother's name]), patient record number, date/time of birth, sex
- ❑ Document baby's first name if known
- ❑ Nil by mouth
- ❑ OGT/NGT
  - ❑ Inserted (OGT if respiratory distress/CPAP)
  - ❑ Position checked on x-ray if possible
  - ❑ Gastric contents emptied
  - ❑ Free drainage
- ❑ ETT
  - ❑ Secured at correct insertion depth
  - ❑ Position checked on x-ray (if possible)
  - ❑ Length documented
- ❑ Intravascular lines:
  - ❑ Labelled (PIVC, umbilical)
  - ❑ IV cannula securely taped
  - ❑ Maintenance IV therapy (10% glucose) in progress
  - ❑ Umbilical:
    - ❑ Sutured and securely taped
    - ❑ Position checked on x-ray (if possible)
- ❑ IV antibiotics administered (IM if unable to obtain IV access) after collection of blood culture (if possible)
- ❑ Continuous monitoring (cardiorespiratory and SpO_2)
- ❑ Analgesia and/or sedation administered as indicated
- ❑ Appropriate care initiated:
  - ❑ Neurodevelopment (positioning, lighting and noise reduction)
  - ❑ Skin
- ❑ Retrieval service advised of changes to baby's condition that may affect ongoing care or transport logistics

Checklist: Preparation for retrieval (continued)

❑ **3. Documentation (2 copies):**

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

❑ **4. Additional requirements:**

- ❑ PACS imaging made available to receiving hospital or x-ray hard copies provided
- ❑ Baby's *Infant Personal Health Record*
- ❑ Directions and contact details of the receiving hospital for parent(s)
- ❑ Social worker or Aboriginal and/or Torrs Strait health worker contact
- ❑ Assistance with accommodation
- ❑ Interpreter (if required) to explain care and treatment to parents

❑ **5. Send with baby:**

- ❑ Any pathology specimens (if required)
- ❑ Expressed breast milk (if available)
- ❑ Other consents (e.g. pacifier use)

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