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Queensland Maternity and Neonatal **Clinical Guideline**

Neonatal jaundice: prevention, assessment and management

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Disclaimer

These guidelines have been prepared to promote and facilitate standardisation and consistency of practice, using a multidisciplinary approach.

Information in this guideline is current at time of publication.

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Clinical material offered in this guideline does not replace or remove clinical judgement or the professional care and duty necessary for each specific patient case.

Clinical care carried out in accordance with this guideline should be provided within the context of locally available resources and expertise.

This Guideline does not address all elements of standard practice and assumes that individual clinicians are responsible to:

- Discuss care with consumers in an environment that is culturally appropriate and which enables respectful confidential discussion. This includes the use of interpreter services where necessary
- Advise consumers of their choice and ensure informed consent is obtained.
- Provide care within scope of practice, meet all legislative requirements and maintain standards of professional conduct
- Apply standard precautions and additional precautions as necessary, when delivering care
- Document all care in accordance with mandatory and local requirements

Abbreviations

ABO	Blood groups A B O
ALP	Alkaline phosphatase
ALT	Alanine aminotransferase
AST	Aspartate aminotransferase
CMV	Cytomegalovirus
DAT	Direct antibody test
FBC	Full blood count
GGT	Gamma glutamyl transpeptidase
G6PD	Glucose-6-phosphate dehydrogenase
g	Gram
IVIG	Intravenous immunoglobulin
kg	Kilogram
L	Litre
LED	Light emitting diode
LFT	Liver function test
TFT	Thyroid function test
Rh	Rhesus
Rh D	Rhesus antibody type D
RSQ	Retrieval Services Queensland
TORCH	Toxoplasmosis, rubella, cytomegalovirus, herpes simplex, human immunodeficiency virus

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1 Introduction

During the first week of life all newborns have increased bilirubin levels by adult standards, with approximately 60% of term babies[1] and 85% of preterm babies having visible jaundice. Most of these cases are benign but it is important to identify those babies at risk (although rare) of acute bilirubin encephalopathy and kernicterus/chronic encephalopathy.[2,3] Jaundice may also be a sign of a serious underlying illness.

Acute bilirubin encephalopathy refers to the acute manifestations of bilirubin toxicity[1] seen in the first few weeks after birth.[2] Initial signs include[1]:

- lethargy
- hypotonia and poor suck progressing to:
  - hypertonia (opisthotonos and retrocollis)
  - high pitched cry and eventually to:
    - seizures and coma

Kernicterus is the pathogenic diagnosis characterised by bilirubin staining of the brain stem nuclei and cerebellum, but has also come to refer to chronic bilirubin encephalopathy.[1] Clinical findings include[1]:

- athetoid cerebral palsy with or without seizures
- developmental delay
- hearing deficit
- oculomotor disturbances including paralysis of upward gaze (Parinaud's sign)
- dental dysplasia
- intellectual impairment

2 Causes in relation to time from birth

2.1 Onset less than 24 hours

- Always pathological
- Usually due to haemolysis:
  - Rhesus disease
  - ABO incompatibility
- Exclude sepsis
- Rarer causes may include:
  - other blood group incompatibilities (Kell, Duffy, anti – E)
  - red cell enzyme defects (glucose-6-phosphate dehydrogenase deficiency (G6PD))
  - red cell membrane defects (hereditary spherocytosis)

2.2 Onset 24 hours to 10 days

- Sepsis
- Haemolysis
- Polycythemia
- Breakdown of extravasated blood due to:
  - cephalhaematoma
  - central nervous system haemorrhage
- Increased enterohepatic circulation which may be due to:
  - gut obstruction
- Physiological jaundice
- Breastfeeding jaundice:
  - early breastfeeding jaundice. Develops within 2 to 4 days of birth and is most likely related to infrequent breastfeeding with a limited fluid intake, although increased reabsorption of bilirubin from the bowel may also be a factor

2.3 Onset greater than 10 days (and especially greater than 2 weeks)

- Conjugated hyperbilirubinaemia due to:
  - idiopathic neonatal hepatitis
  - infections (Hepatitis B, TORCH, sepsis)
  - congenital malformations (biliary atresia, choledochal cyst, bile duct stenosis)
  - metabolic disorders (galactosaemia, hereditary fructose intolerance, Alpha-1 antitrypsin deficiency, tyrosinaemia, glycogen storage disease type IV, hypothyroidism)
- Sepsis
- Hypothyroidism
- Haemolysis
- Breast milk jaundice:
  - late breast milk jaundice is much less common and develops 4 to 7 days after birth with a peak at 7 to 15 days of age

3 Prevention

3.1 Pregnancy, labour and delivery

- Test all pregnant women for ABO, Rh (D) blood types and red cell antibodies,[1,2] during pregnancy
- If the mother has red blood cell antibodies noted antenatally then send cord blood for:
  - blood group[1] including Rhesus type
  - direct antibody test (DAT) also known as Coombs test[1,2]
  - FBC for haemoglobin and haematoctrit
  - total serum bilirubin and albumin
- If the mother has not had antenatal blood tests send:
  - maternal blood for blood group (ABO/Rh) **AND**
  - baby's cord blood for blood group[1], Rh type and DAT[1,2]
- Umbilical cord blood total serum bilirubin, haemoglobin or haematocrit measurements do not aid in the prediction of severe hyperbilirubinaemia[1]

3.2 Breastfeeding

- Encourage all mothers to breastfeed their babies 8 - 12 times a day in the first 2 - 3 days of life.[2,3] Consider referral to a midwife or Lactation Consultant (if available) to provide the mother with feeding support[1]
- Encourage the ingestion of colostrum to increase stooling which prevents reabsorption of bilirubin. Use of suppositories and enemas to increase stooling is of no clinical benefit and should be discouraged
- Supplementation with water does not affect bilirubin levels and is not recommended. If supplementation is necessary due to inadequate intake then give expressed breast milk and/or formula
- Educate parents regarding signs of adequate hydration, feeding and signs of jaundice

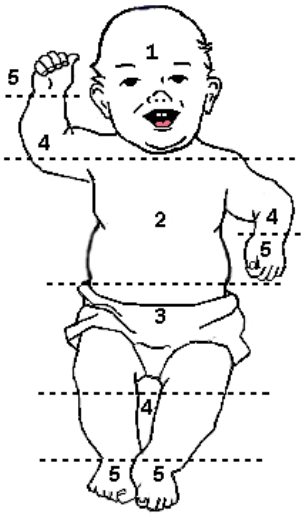
4 Assessment

4.1 Colour

Monitor all babies for jaundice development by assessing them whenever vital signs are measured or at least every 8 to 12 hours.[2]

Always assess jaundice in a well-lit room or in daylight at a window,[2,3] by blanching the baby's skin with a finger and observing the underlying skin colour.[2,3,4,5] Jaundice appears first in the face and progresses caudally to the trunk and extremities.[2,3]

Kramer recognised the cephalocaudal progression of jaundice with increasing total serum bilirubin levels and divided the baby into 5 zones, with a total serum bilirubin level measurement associated with each zone. This is known as Kramer's rule (see Figure 1) and has traditionally been used to visually assess the severity of jaundice.[6]



Zone	1	2	3	4	5
Definition	Head and neck	Upper trunk	Lower trunk and thighs	Arms and lower legs	Palms and soles
TSB (micromol/L)	100	150	200	250	>250

Figure 1. Kramer's Rule

Kramer's rule is inaccurate on a baby who has already commenced phototherapy.[1] Visual estimation of bilirubin levels can lead to errors,[2,3] especially in darkly pigmented babies.[1,4,5] A total serum bilirubin level should be used to assess response to phototherapy and may be necessary if clinical assessment is difficult in babies with darker skins.

4.2 Transcutaneous bilirubin level

Bilirubin levels can also be measured transcutaneously,[1] by a transcutaneous bilirubinometer. Available devices differ in accuracy, safe use of this device requires knowledge of the accuracy of the particular device being used.[1] **If a transcutaneous bilirubin level is approaching the threshold for phototherapy (greater than 200 micromoles/L) then a total serum bilirubin level measurement is recommended.**

Transcutaneous bilirubin levels are inaccurate on a baby who has already commenced phototherapy.[2] However transcutaneous bilirubin level measurements may be accurate when a photo-opaque patch is applied to the baby's skin (normally the forehead) whilst the baby is receiving light bank phototherapy and the transcutaneous bilirubin level measurement is performed on the skin that has not been exposed to phototherapy.[7] Due to individual variance, any clinical decision has to be taken on the basis of the transcutaneous trend more than on a single value.[7]

A transcutaneous bilirubinometer may be particularly useful in health care settings where total serum bilirubin level results are expected to take longer than 6 hours before becoming available. Point of care machines such as the iStat may be useful when cartridges are available, to measure total serum bilirubin.

4.3 Total serum bilirubin

Total serum bilirubin level measurements should be requested based on clinical observation and the following factors:

- visible jaundice in the first 24 hours[1]
- jaundiced baby whose mother has rhesus or other red blood cells antibodies
- term baby with estimated serum bilirubin levels greater than 250 micromoles/L
- preterm baby with estimated serum bilirubin levels greater than 150 micromoles/L
- any baby, if there is clinical doubt about the degree of jaundice
- any unwell baby with jaundice
- any baby with clinical signs of obstructive jaundice
- prolonged jaundice greater than 2 weeks in term babies and greater than 3 weeks in preterm babies

Plot the total serum bilirubin level on the appropriate graph and interpret according to the baby's age in hours from birth.[2,4,5] Commence treatment as appropriate.

Babies greater than 12 hours old with a total serum bilirubin level 1 – 50 micromoles/L below the line, should have a repeat total serum bilirubin level within 12 – 24 hours.

Treat venous and capillary total serum bilirubin levels the same.[1,2]

4.4 Hydration

Adequate intake can be determined by the baby's:

- weight
- elimination (number of wet nappies and stools)

4.5 Other illness

In association with other findings, jaundice may be a sign of serious illness. Assess each jaundiced baby to see whether the following danger signs are present:

- family history of significant haemolytic disease
- onset of jaundice within 24 hours
- pallor, bruising, petechiae
- lethargy
- poor feeding
- fever
- vomiting
- dark urine and light stools
- hepatosplenomegaly
- high pitched cry

5 Treatment

Hyperbilirubinaemia can be treated with[2,4,5,8]:

- phototherapy
- exchange transfusion
- pharmacological agents

Adequate hydration is also an important consideration in the baby with moderate to high bilirubin levels. It is important to also treat the underlying illnesses that may be causing jaundice (e.g. infection).

Management options will depend on the services available at each facility. Transfer or referral to a higher level facility for management and treatment options may be appropriate. All service levels should have a documented process for referral and transfer to higher level services.

5.1 Inter-hospital transfer

Once the decision has been made to transfer the baby to a higher level facility, this will be coordinated by Retrieval Services Queensland (RSQ) and a Neonatal medical coordinator, by calling 1300 799 127.

Babies requiring inter-hospital transfer for management of jaundice by phototherapy or exchange transfusion, require phototherapy (at least a biliblanket) and IV fluids en route (this can be provided by the retrieval team).

5.2 Phototherapy

5.2.1 Efficacy

There is no standardised method for delivering phototherapy.[2] The efficacy of phototherapy depends on[2,4,5,9]:

- the cause and severity of the hyperbilirubinaemia[9]
- the light source. Wavelengths in the blue-green spectrum are effective[1] with special blue the most effective
- the dose of phototherapy or irradiance administered[1]:
  - check phototherapy units regularly using the method recommended by the manufacturer, to ensure adequate irradiance is delivered
  - energy output which is usually measured in microwatts per cm^2 (µW/sq cm) and is normally marked on each phototherapy unit
- the distance from the light determined by manufacturers instructions
- the surface area of the baby exposed[1,4] which can be increased by:
  - placing fibre optic pads or a light emitting diode (LED) mattress below the baby[3]
  - removing the nappy, if bilirubin levels continue to rise despite treatment
- lining the sides of the cot with white material that reflects the phototherapy light[3]

Intensive phototherapy implies the use of high levels of irradiance delivered to as much of the baby's surface area as possible.[2,4,5,7,9] It usually requires at least 2 banks of phototherapy lights[1] or the use of a combination of methods (eg. phototherapy light bank plus biliblanket). Use special blue fluorescent tubes or specially designed LEDs[2] if available.

5.2.2 Phototherapy delivery

Table 1 Phototherapy delivery

	Light bank	Bilibed	Biliblanket
Equipment	Isolette/open cot according to unit policy. May be used in conjunction with a biliblanket.	Open cot or as per manufacturer's recommendation. Consider adding/changing to bank of lights if total serum bilirubin level continues to rise.	Open cot or in conjunction with light bank in isolette. May be used in conjunction with a bank of lights.
Clothing	Remove all clothing except disposable nappy. No lotions/lubricants on skin.	Remove all clothing except disposable nappy. Dress only in manufacturer's jumpsuit to maximise exposure to light. No lotions/lubricants on skin.	Remove all clothing except disposable nappy. Place fiberoptic pad between skin and singlet. No lotions/lubricants on skin.
Temperature	Hourly for first 4 hours then 3 – 4 hourly.[10] Phototherapy may lead to an elevated isolette temperature. Do not turn the isolette off, it is not safe to nurse a baby in an isolette that has been turned off as air no longer circulates. Cover temperature probe with reflective disc if servo control method is used to monitor temperature.	Hourly for first 4 hours then 3 – 4 hourly.[10]	Hourly for first 4 hours then 3 – 4 hourly.[10]
Other observations	As per clinical condition and/or maturity. Check for skin rashes. Report dark urine and/or light (pale) stools.		
Eye patches	Required to protect immature retina.[1,9] Monitor hourly to check for eye discharge. Remove with feeds/cares.[10] Replace after feeds/cares before commencing phototherapy.	Not required.	
Feeds	Demand feeds if breastfeeding or at least 3 - 4 hourly or as age appropriate. Observe breastfeeding. Document input output. Weigh daily. May need to increase daily fluid volume intake.	Demand feeds if breastfeeding or at least 3 - 4 hourly. Observe breastfeeding. Document input output. Weigh daily.	Demand feeds if breastfeeding or at least 3 - 4 hourly. Observe breastfeeding. Document input output. Weigh daily.
Position	Position babies under phototherapy supine at all times in accordance with safe Infant sleeping guidelines.[11] All babies nursed in neonatal units should only be placed in the prone position if continuous cardiorespiratory monitoring is used.[11]		
Bilirubin measurements	[see Appendix A for frequency]. Switch off light during blood collection.		

Assess the need for treatment by plotting the total serum bilirubin level on the appropriate graph [see Appendix A].

When assessing the need for phototherapy or exchange transfusion, do not subtract the direct reacting or conjugated bilirubin level from the total serum bilirubin level.[2]

The exception to this is babies who have significant conjugated hyperbilirubinaemia (conjugated bilirubin greater than 20 micromoles/L or greater than 10% of total bilirubin if total serum bilirubin level is greater than 200 micromoles/L). These babies all have pathological jaundice and their care needs to be discussed with a Neonatologist.

Commence phototherapy using the appropriate delivery method.

Check the total serum bilirubin level:

- 12 – 24 hourly but if the total serum bilirubin level is greater than 30 micromoles/L above the line, then check the total serum bilirubin level 4 – 6 hourly to monitor the rate of rise or fall8 [see Appendix A]

Phototherapy bleaches the skin making visual and transcutaneous bilirubin level measurement unreliable,[1] after the commencement of phototherapy. However transcutaneous bilirubin levels measurements may be accurate when:

- a photo opaque patch is applied to the baby's skin (normally the forehead) prior to commencing light bank phototherapy and the transcutaneous bilirubin level measurement is performed on this section of skin that has not been exposed to phototherapy[7]

Phototherapy may be used in conjunction with other forms of treatment for hyperbilirubinaemia such as:

- exchange transfusion
- pharmacologic measures

Exposure to sunlight is not recommended for the treatment of hyperbilirubinaemia[2,9] and should be discouraged.

5.2.3 Feeding

Breast fed babies who require phototherapy, should continue to breastfeed.[1] However monitor[2]:

- baby's attachment
- baby's sucking
- mother's milk supply

Increase feeding frequency to 8 - 12 feeds in 24 hours to meet the increased fluid needs due to insensible water and stool water loss from diarrhoea.

Phototherapy is discontinued whilst the baby is breastfed (the exception being the biliblanket which remains in-situ during feeds) but time out of phototherapy should be monitored and kept to a minimum.

Check the baby's weight to gauge his/her hydration. Supplementation with expressed breast milk and/or formula is appropriate if weight loss is excessive despite frequent feeds.[2]

Phototherapy is often started at about the same time that breast milk supply is increasing and so supplementation may not be necessary. Do not supplement with water or dextrose water.[1,2]

Increase formula fed babies feed volumes by 10% to meet increased fluid needs due to insensible water and stool water loss from diarrhoea.[12]

If oral intake is insufficient, intragastric feeds with expressed breast milk and/or formula may be required.[2] Intravenous therapy may be indicated in severe cases.

5.2.4 Complications of phototherapy

- Babies with congenital erythropoietic porphyria can develop severe blistering and photosensitivity during phototherapy. Congenital porphyria or a family history of porphyria is a contraindication to the use of phototherapy[2,9]
- Intestinal hypermotility, diarrhoea[1]
- Separation of mother and baby causing interference of mother baby interaction[1,2] (if facility is unable to keep mother and baby together while baby receives phototherapy)
- Parents find eye patching disturbing[2]
- Changes in the baby's thermal environment lead to increased peripheral blood flow and insensible water loss[9]
- Babies with cholestatic jaundice may development 'bronze baby syndrome'[3] and rarely purpura and bullous eruptions[2]
- Concomitant use of certain drugs or agents may cause photosensitivity[2,9]

5.3 Investigations

Review the history and perform a thorough physical examination[1] on a baby who requires phototherapy to treat jaundice.

Investigate the cause of jaundice if it is not explained by the history and examination.[2]

5.3.1 Early onset jaundice less than 24 hrs

Investigations should include:

- mother's and baby's blood group if not already known and DAT
- babies haemolytic screen which includes:
  - full blood count (FBC) and film with reticulocyte count (to help assess haemolysis)
  - total serum bilirubin level
  - G6PD if baby's family history or ethnic/geographic origin is suggestive of the possibility of deficiency (Mediterranean, middle Eastern, African, South East Asian)[1]
- review of sepsis risk as a cause for the jaundice[1]

5.3.2 Jaundice approaching exchange level

Investigations as per 5.3.1 and in addition:

- direct (conjugated) bilirubin
- liver function test (LFT)
- G6PD[1] and screen for Gilbert Syndrome

5.3.3 Prolonged jaundice

Babies with prolonged jaundice (obvious persisting clinical jaundice at greater than 2 weeks in term babies and greater than 3 weeks in preterm babies) require:

- clinical review including examination/enquiry regarding stool colour
- total serum bilirubin and conjugated bilirubin level:
  - conjugated hyperbilirubinaemia or a jaundiced baby with pale stools and dark urine requires urgent discussion with a Neonatologist
- thyroid function tests (TFT)
- FBC to check for anaemia or signs of haemolysis (and full haemolytic screen if not already done):
  - consider Heinz body count for oxidative causes of haemolysis
- review of results of newborn screening test, specifically thyroid and galactosemia screen
- review of any previous pathology results relevant to jaundice

5.3.4 Conjugated hyperbilirubinaemia

Conjugated hyperbilirubinaemia requires urgent discussion with a Neonatologist, however consider initiating investigations by requesting:

- FBC
- total serum bilirubin and conjugated bilirubin levels
- LFT (including: AST, ALT, GGT, ALP and albumin)
- coagulation screen
- blood gas
- blood group and DAT/Coombs test
- liver ultrasound
- ferritin
- TFT
- Alpha-1-antitrypsin phenotype
- urine:
  - CMV congenital infection serology
  - micro culture and sensitivity
  - reducing substances

Additional investigations to consider include:

- urine:
  - organic acids
  - amino acids
- serum amino acids
- plasma:
  - ammonia
  - pyruvate
  - lactate

5.4 Exchange transfusion

A total serum bilirubin level at or above the exchange transfusion level should be considered a medical emergency. Commence intensive (multiple light) phototherapy immediately[1,2] and discuss further care with a Neonatologist.

Immediate exchange transfusion is recommended even if the total serum bilirubin level is falling[2] if a baby is jaundiced and displays signs of intermediate to advanced stages of acute bilirubin encephalopathy which include[1,2]:

- lethargy, hypotonia, poor feeding with high pitched cry
- hyper alert or irritable
- hypertonia, arching, retrocollis-opisthotonos
- obtunded to comatose, apnoea, seizures

As blood collected after an exchange transfusion is of no value for investigating many of the rarer causes of severe hyperbilirubinemia, these investigations should be considered before performing exchange transfusion.[1]

Exchange transfusion should only be performed by trained personnel in a neonatal intensive care unit[1] with full monitoring and resuscitation capabilities.[2]

If immediate exchange transfusion is required discuss the management of this situation with a Neonatologist. Arrange transfer to an appropriate higher level facility as required.

5.5 Adjunct pharmacological therapy

Discuss pharmacologic options with a Neonatologist prior to treatment.

5.5.1 Intravenous Immunoglobulin (IVIG)

IVIG reduces bilirubin concentrations in babies with rhesus haemolytic disease[3] and other immune haemolytic jaundice.[1] Babies with a positive DAT who have predicted severe disease based on antenatal investigation or have an elevated risk of progressing to exchange transfusion based on the postnatal progression of total serum bilirubin levels, should receive IVIG.[1] The dose required is 1 g/kg[1] given intravenously over 2 hours. Discuss all such cases with a Neonatologist before administering IVIG.

The use of IVIG may be recommended in special circumstances such as[13]:

- parental refusal for exchange transfusion
- where appropriate blood components for exchange transfusion are unavailable

5.5.2 Phenobarbitone

May improve bile flow but is not recommended for treatment of hyperbilirubinaemia.[5]

5.5.3 Metalloporphyrins

Tin mesoporphyrin therapy is not established in Australia and should not be used outside of clinical trials.

5.5.4 Ursodeoxycholic acid

May improve bile flow and lower bilirubin concentrations.[4,5] Use only after discussion with a Neonatologist and/or gastroenterologist.

5.6 Cessation of phototherapy

Cease phototherapy when the total serum bilirubin level is greater than or equal to 50 micromoles/L below the phototherapy line for that baby.[12]

A rebound in total serum bilirubin levels can occur after phototherapy is discontinued.[2,9,12] Babies at increased risk of clinically significant rebound are those[7]:

- born at less than 37 weeks gestation
- with haemolytic disease
- treated with phototherapy during the birth hospitalisation

Discharge need not be delayed to observe the baby for rebound, but consider follow up total serum bilirubin level measurement within 12 - 24 hours after discharge.[2,9,12]

6 Discharge planning

All newborns who are visibly jaundiced in the first 24 hours of life should be investigated as per 5.3.1 and **must not be discharged**.

Never discharge a baby with conjugated hyperbilirubinaemia without attempting to find the cause.

Assess all babies for risk of developing severe hyperbilirubinaemia at hospital discharge.[2] This assessment is particularly important if discharge occurs before 72 hours of age, as these babies are likely to still have a rising total serum bilirubin level.[2]

Kramer's rule (see section 4.1) has traditionally been used to visually assess the severity of jaundice.[6] Visual estimation of bilirubin levels can lead to errors,[2,3] especially in darkly pigmented babies,[1,4,5] and in infants who have received phototherapy.

Transcutaneous bilirubinometers (see section 4.2) may be useful to more accurately assess bilirubin levels.

The best documented method for assessing the risk of subsequent hyperbilirubinaemia is to measure the total serum bilirubin level.[2,14]

Plot the estimated or measured bilirubin level against the graph in Appendix A. Babies greater than 12 hours old with a total serum bilirubin level 1 – 50 micromoles/L below the line should have a repeat total serum bilirubin level within 12 – 24 hours.

A simple pneumonic for additional risk factors is JAUNDICE:

- J – jaundice within the first 24 hours of birth[1]
- A – a sibling who required phototherapy as a baby
- U – unrecognised haemolysis
- N – non-optimal sucking/feeding
- D – deficiency of G6PD
- I – infection
- C – cephalhaematoma or bruising[1]
- E – Ethnicity (Asian heritage)

It is recommended that information be given to parents at the time of discharge. Parents should be advised to contact a healthcare professional if:

- their baby becomes jaundiced
- baby's jaundice is worsening
- jaundice is persisting beyond 14 days
- their baby is passing pale stools

Mothers of jaundiced breastfed babies should be encouraged to breastfeed frequently, and the baby woken to feed if necessary.

6.1 Follow-up

Advise parent(s) to have their baby examined by a qualified health care professional in the first few days after discharge to check that the baby is well and for the presence of jaundice.[2,3]
Timing and location of this assessment is determined by[2,3]:

- length of hospital stay
- presence of risk factors for hyperbilirubinaemia
- risk of other neonatal problems

Table 2. Recommended follow up[2,3]

Baby discharged	Should be seen by
Before 24 hours of age	72 hours of age
Between 24 and 47.9 hours of age	96 hours of age
Between 48 and 72 hours of age	120 hours of age

Babies discharged before 48 hours may need 2 follow up visits, the first visit between 24 - 72 hours and a second between 72 - 120 hours. Use clinical judgement to determine frequency of follow up. More frequent follow up may be required for babies with risk factors.[2]
If appropriate follow up cannot be arranged and there are risk factors it may be necessary to delay discharge until:

- follow up can be arranged
- until the greatest risk has passed (72 - 96 hours)[2]

Follow up assessment must include[2]:

- baby's weight and percentage change from birth weight
- adequacy of intake
- voiding and stooling pattern
- presence or absence of jaundice
- clinical judgement to determine the need for total serum bilirubin level measurement

If there is any doubt measure the total serum bilirubin level.[2]

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Appendix A: Phototherapy guidelines for all gestational ages

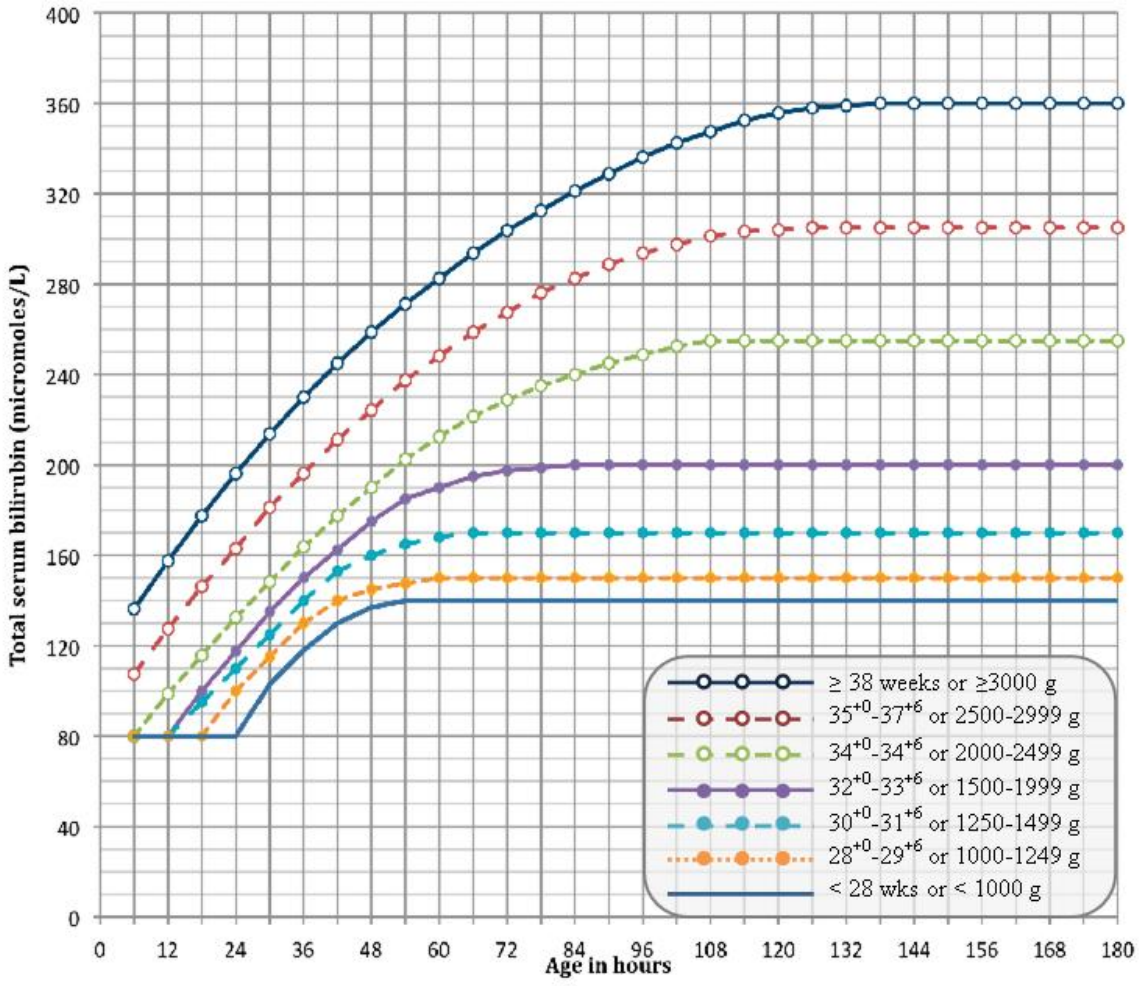
If the gestational age is accurate, use the gestational age (weeks) rather than the body weight.

In the presence of risk factors (sepsis, haemolysis, acidosis or asphyxia) use one line lower (the gestation below) until less than (<) 1000 g.

- Babies greater than (>)12 hours old with a total serum bilirubin level 1-50 micromoles/L below the line should have a repeat total serum bilirubin level within 12-24 hours

Babies under phototherapy:

- Check the total serum bilirubin level 12-24 hourly but if the total serum bilirubin level is greater than
  (>) 30 micromoles/L above the line, then check the total serum bilirubin level 4-6 hourly
- Stop phototherapy if the total serum bilirubin level is greater than (>) 50 micromoles/L below the line
  and consider rechecking the total serum bilirubin level in 12-24 hours



Adapted from:

- American Academy of Pediatrics Subcommittee on Hyperbilirubinaemia. Management of Hyperbilirubinaemia in the Newborn Infant 35 or more weeks of gestation. Pediatr 2004;114(1);297-316
- Horn AR, Kirsten GF, Kroon SM, Henning PA, Moller G, Pieper C et al. Phototherapy and exchange transfusion for neonatal hyperbilirubinaemia. SAMJ 2006;96(9):819-824

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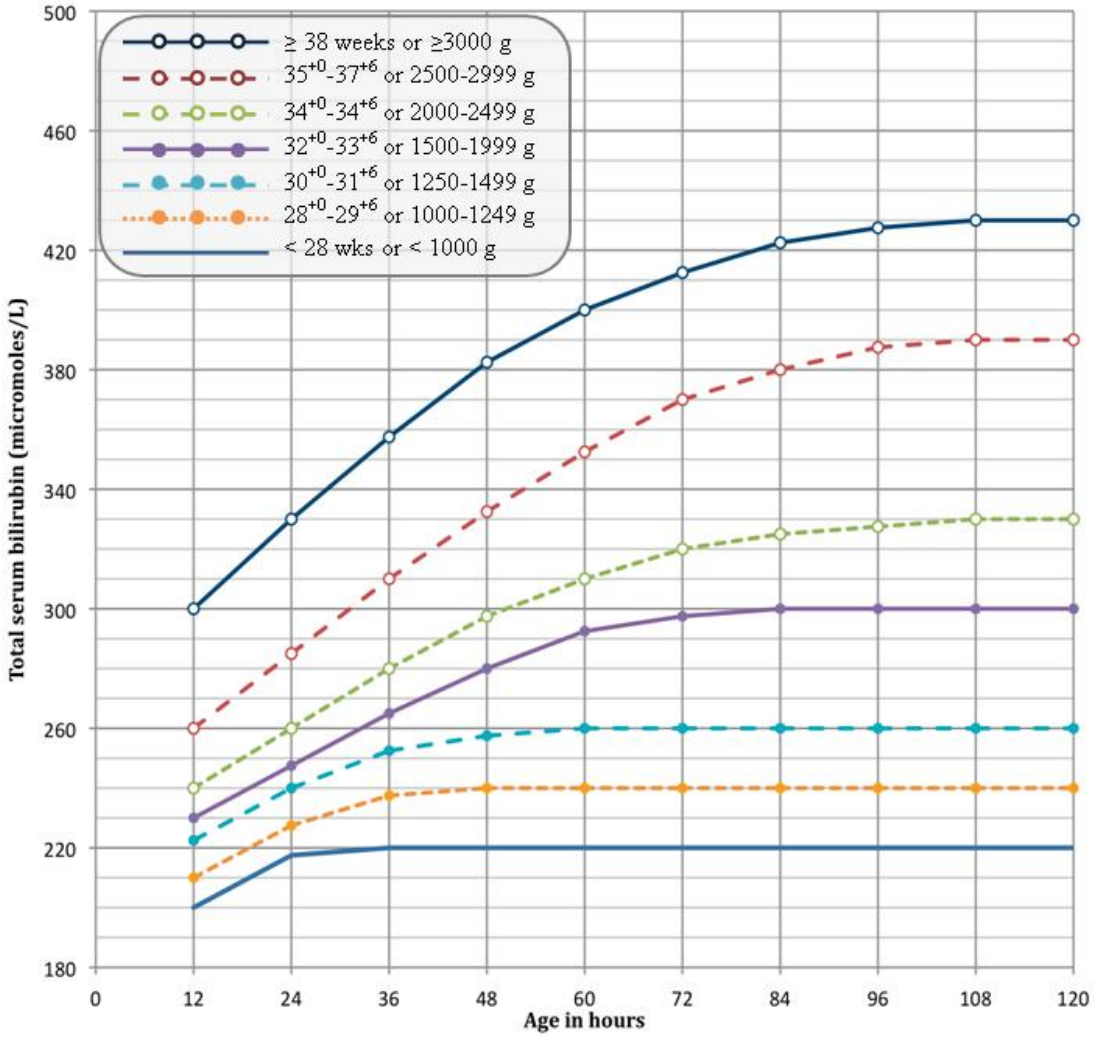
Start intensive phototherapy when the total serum bilirubin level is greater than or equal to (≥) the line according to gestation or weight.

Appendix B: Exchange transfusion guidelines for all gestational ages

If the gestational age is accurate, use the gestational age (weeks) rather than the body weight.

In the presence of risk factors (sepsis, haemolysis, acidosis or asphyxia) use one line lower (the gestation below) until less than (<) 1000 g.

- Babies who present with a total serum bilirubin level above threshold should have an exchange transfusion done if the total serum bilirubin level is not expected to be below the threshold after 6 hours of intensive phototherapy
- Immediate exchange is recommended if there are signs of bilirubin encephalopathy and usually also if the total serum bilirubin level is greater than 85 micromoles/L above the threshold at presentation
- Exchange if total serum bilirubin level continues to rise faster than 17 micromoles/L per hour despite intensive phototherapy



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Appendix C: Acknowledgements

The Maternity and Neonatal Clinical Guidelines Program gratefully acknowledge the contribution of Queensland clinicians and other stakeholders who participated throughout the guideline development process particularly:

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