

South Australian Perinatal Practice Guideline

Neonatal Jaundice

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Note:

This guideline provides advice of a general nature. This statewide guideline has been prepared to promote and facilitate standardisation and consistency of practice, using a multidisciplinary approach. The guideline is based on a review of published evidence and expert opinion.

Information in this statewide guideline is current at the time of publication.

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Health practitioners in the South Australian public health sector are expected to review specific details of each patient and professionally assess the applicability of the relevant guideline to that clinical situation.

If for good clinical reasons, a decision is made to depart from the guideline, the responsible clinician must document in the patient's medical record, the decision made, by whom, and detailed reasons for the departure from the guideline.

This statewide guideline does not address all the elements of clinical practice and assumes that the individual clinicians are responsible for discussing 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,
- Advising consumers of their choice and ensuring informed consent is obtained,
- Providing care within scope of practice, meeting all legislative requirements and maintaining standards of professional conduct, and
- Documenting all care in accordance with mandatory and local requirements

Note: The words woman/women/mother/she/her have been used throughout this guideline as most pregnant and birthing people identify with their birth sex. However, for the purpose of this guideline, these terms include people who do not identify as women or mothers, including those with a non-binary identity. All clinicians should ask the pregnant person what their preferred term is and ensure this is communicated to the healthcare team.

Explanation of the aboriginal artwork:

The Aboriginal artwork used symbolises the connection to country and the circle shape shows the strong relationships amongst families and the Aboriginal culture. The horse shoe shape design shown in front of the generic statement symbolises a woman and those enclosing a smaller horse shoe shape depicts a pregnant woman. The smaller horse shoe shape in this instance represents the unborn child. The artwork shown before the specific statements within the document symbolises a footprint and demonstrates the need to move forward together in unison.



Australian Aboriginal Culture is the oldest living culture in the world yet Aboriginal people continue to experience the poorest health outcomes when compared to non-Aboriginal Australians. In South Australia, Aboriginal women are 2-5 times more likely to die in childbirth and their babies are 2-3 times more likely to be of low birth weight. The accumulative effects of stress, low socio economic status, exposure to violence, historical trauma, culturally unsafe and discriminatory health services and health systems are all major contributors to the disparities in Aboriginal maternal and birthing outcomes. Despite these unacceptable statistics, the birth of an Aboriginal baby is a celebration of life and an important cultural event bringing family together in celebration, obligation and responsibility. The diversity between Aboriginal cultures, language and practices differ greatly and so it is imperative that perinatal services prepare to respectfully manage Aboriginal protocol and provide a culturally positive health care experience for Aboriginal people to ensure the best maternal, neonatal and child health outcomes.

Purpose and Scope of Perinatal Practice Guideline (PPG)

The aim of this guideline is to provide practical guidance for the management of jaundiced babies by midwives, general practitioners, paediatric residents and paediatricians working in country and metropolitan hospitals and for community midwives and child health nurses. Charts that may be used stand-alone for management of lower and higher risk babies are included.



Neonatal Jaundice

Flowchart 1 - Risk Assessment of Jaundiced in Babies $\geq 35^{+0}$ Weeks Gestation

USE THIS TOOL TO DECIDE WHICH JAUNDICE CHART TO SELECT.

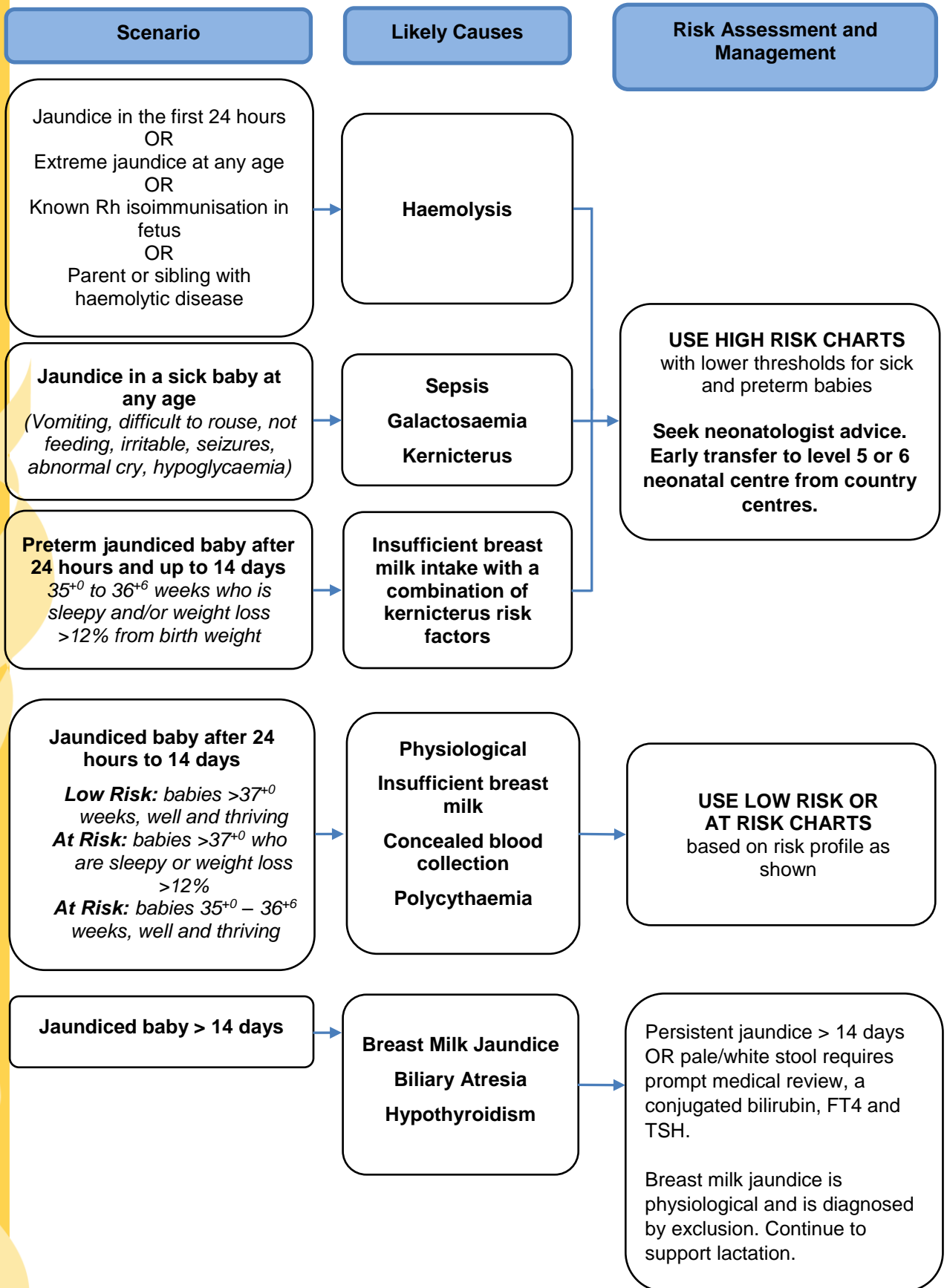


Table of Contents

Purpose and Scope of Perinatal Practice Guideline (PPG)	1
Flowchart 1 - Risk Assessment of Jaundiced in Babies $\geq 35^{+0}$ Weeks Gestation.....	2
Summary of Practice Recommendations.....	4
Abbreviations.....	4
Definitions.....	4
Neonatal Jaundice - Management of Low-Risk Babies in the Community, Postnatal Ward and Level 3 or 4 Neonatal Services	5
Neonatal Jaundice – Management of at-Risk Babies in the Community, Postnatal Ward and Level 3 or 4 Neonatal Services	6
Neonatal Jaundice – Management of High-Risk Babies Requiring Level 5 or 6 Neonatal Services	7
Neonatal Jaundice – Management of High-Risk Babies Requiring Level 5 or 6 Neonatal Services	8
Neonatal Jaundice - Management of Preterm Babies $< 35^{+0}$ Weeks.....	9
Introduction.....	11
The Importance of Community Management of Jaundice	11
Appropriate Clinical Settings for Management of Jaundice	11
Risk Assessment	11
Monitoring Jaundice.....	12
Clinical Assessment.....	12
Transcutaneous Bilirubin Measurement	12
Hour Specific Bilirubin Charts	13
Phototherapy	13
Treatment Guidelines	13
Effectiveness of Phototherapy	14
Nursing Care.....	14
Re-testing Bilirubin after Stopping Phototherapy	14
Home Phototherapy.....	15
Exchange Transfusion.....	15
Intravenous Immunoglobulin.....	15
Prolonged Jaundice	15
Standard Investigations for Prolonged Jaundice Are:	15
Follow-Up of Jaundiced Babies	16
References	17
Acknowledgements.....	18
Write Group Lead	18
Write Group Members	18
SAPPG Management Group Members.....	18
Document Ownership & History.....	19



Summary of Practice Recommendations

Assess all newborn babies for risk of developing either jaundice or kernicterus both at birth and before hospital discharge.

Measure a plasma bilirubin (BR) in all babies with any visible jaundice in the first 24 hours even if only on the face or above the nipple line.

Consider a plasma BR or transcutaneous bilirubin level (TcB) in dark skinned babies if any jaundice visible or at the time of the newborn screening test.

If haemolysis is suspected, plasma BR levels continue to rise despite phototherapy, or if a baby presents with a plasma BR above exchange threshold, maximise phototherapy (both overhead lights and fibre optic blanket), seek advice, and refer to a Level 5 or 6 Neonatal Service.

Country practitioners need to consider time delays in obtaining plasma BR results in rural centres when managing jaundiced babies.

Abbreviations

AABR	Automated auditory brainstem response
AAP	American Academy of Pediatrics
ABO	ABO blood group system
BR	Bilirubin
BW	Birth weight
CBE/P	Complete blood examination/picture
cm	Centimetre
DAT	Direct antiglobulin test
e.g.	For example
g/kg	Gram/s per kilogram
g/L	Grams per litre
Hb	Haemoglobin
i.e.	That is
IVIG	Intravenous immunoglobulin
nm	Nanometre
Rh	Rhesus
SA	South Australia
TcB	Transcutaneous bilirubin
T₄	Thyroxine
µmol / L	Micromole/s per litre
µmol/L/hr	Micromole/s per litre per hour
µW/cm²/nm	Microwatt/s per centimetre squared per nanometre
wks	Weeks
/ kg / d	Per kilogram per day
%	Percent
>	Greater than
<	Less than
+	Plus

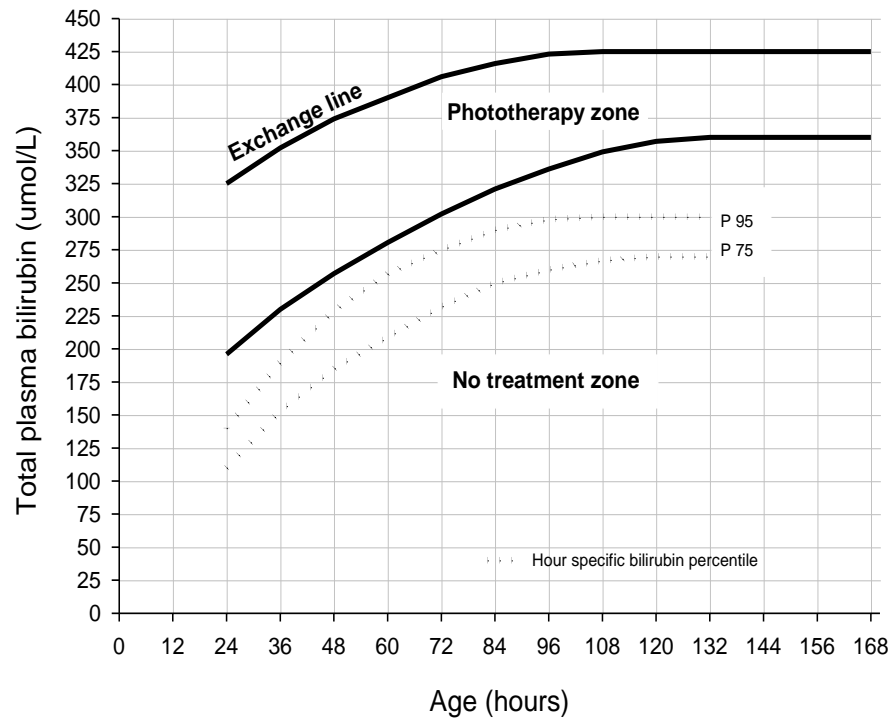
Definitions

Jaundice	Jaundice is the clinical appearance of yellow skin in babies due to hyperbilirubinaemia
Sepsis	Strong clinical suspicion of systemic bacterial or viral infection based on clinical condition, haematology and CRP, with or without positive culture or PCR from a normally sterile site. Note: treatment of an asymptomatic baby with intravenous antibiotics is not a risk factor for bilirubin encephalopathy.
Kernicterus	Bilirubin induced encephalopathy characterised by lethargy, poor feeding, high-pitched cry, irritability, seizures, back arching, apnoea, sun-setting eyes.



Neonatal Jaundice - Management of Low-Risk Babies in the Community, Postnatal Ward and Level 3 or 4 Neonatal Services

≥ 37⁺⁰ Weeks Gestation, No Set-Up for Haemolysis, Feeding Well, Acceptable Weight Loss < 12% BW



Use this chart to plot serial plasma BRs

ROUTINE TESTS FOR ALL BABIES UNDER PHOTOTHERAPY			
Check maternal blood group & antibody screen in pregnancy		Baby's blood group	
CBP, Red cell morphology on blood film & reticulocyte count		Direct antiglobulin test (DAT)	

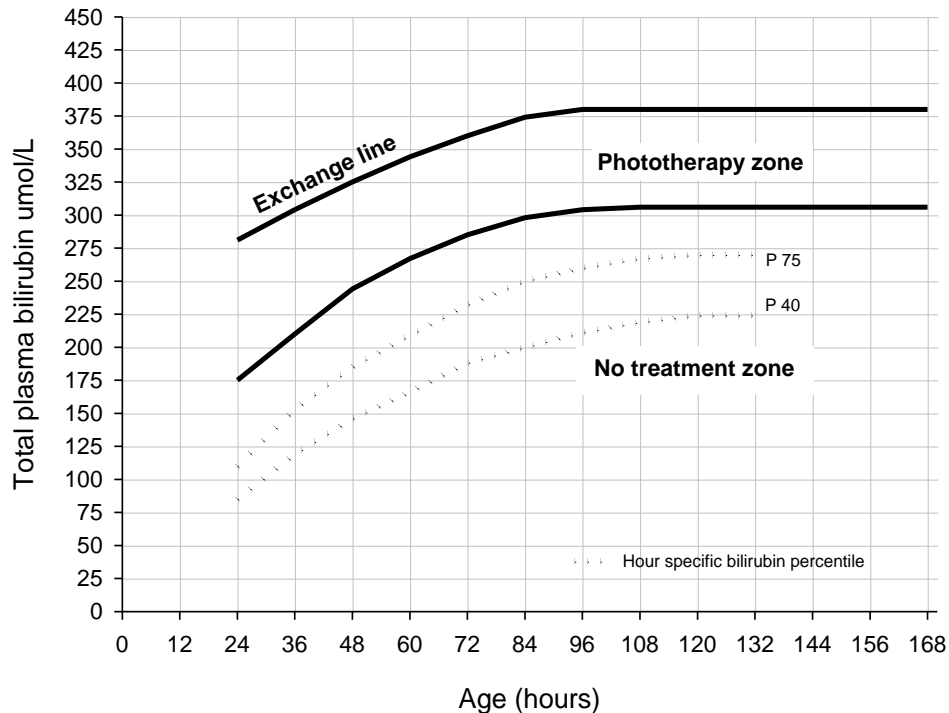
- **Ensure lactation support for all breastfeeding mothers.** Early discharge and community follow-up are appropriate.
- **Measure a plasma BR in all babies with any visible jaundice in the first 24 hours even if only on the face or above the nipple line**
- **Consider a plasma BR or transcutaneous bilirubin level (TcB) in dark skinned babies if any jaundice visible or at the time of the newborn screening test**
- Where jaundice is above the nipple line at discharge in pale skinned babies more than 24 hours of age, monitor clinically in the community every 2-3 days until visibly improved
- Where jaundice is below the nipple line either at discharge or on review in the community, measure a plasma BR or a transcutaneous bilirubin level (TcB). Refer to chart for management
- If plasma BR or TcB is below P75, assess clinically every 2-3 days. Consider another plasma BR or TcB only if the jaundice is visibly worse.
- Measure a plasma BR if the TcB is above the P75 line
- If plasma BR is between P75 and P95 repeat a blood every 2 days
- If plasma BR is above P95 and below phototherapy line repeat a blood level daily. Continue to monitor blood levels until bilirubin has peaked or phototherapy zone is reached
- Where phototherapy is required, routinely perform a blood group and DAT, full blood count, film and reticulocyte count. Use either overhead lights and/or a fibre optic blanket
- Repeat plasma BR levels daily in the Phototherapy Zone
- Increased fluids not generally required with phototherapy unless there is a clinical concern regarding hydration, or if slow weight gain suggests inadequate milk intake
- Cease phototherapy when plasma BR is at least 50µmol/L below treatment threshold. Then repeat a TcB or plasma BR every 1-2 days until peaked.
- **If plasma BR levels continue to rise despite phototherapy, or if a baby presents with a plasma BR above exchange threshold, maximise phototherapy (both overhead lights and fibre optic blanket), seek advice, and refer to a Level 6 Neonatal Service**
- **Seek paediatrician advice and prompt review if the baby has not regained birth weight**



Neonatal Jaundice – Management of at-Risk Babies in the Community, Postnatal Ward and Level 3 or 4 Neonatal Services

35⁺⁰ - 36⁺⁶ Weeks Gestation, No Set-Up for Haemolysis, Feeding Well, Acceptable Weight Loss < 12% BW

≥ 37⁺⁰ Weeks Gestation, No Set-Up for Haemolysis, Poor Feeding, Sleepiness, Weight Loss > 12% BW



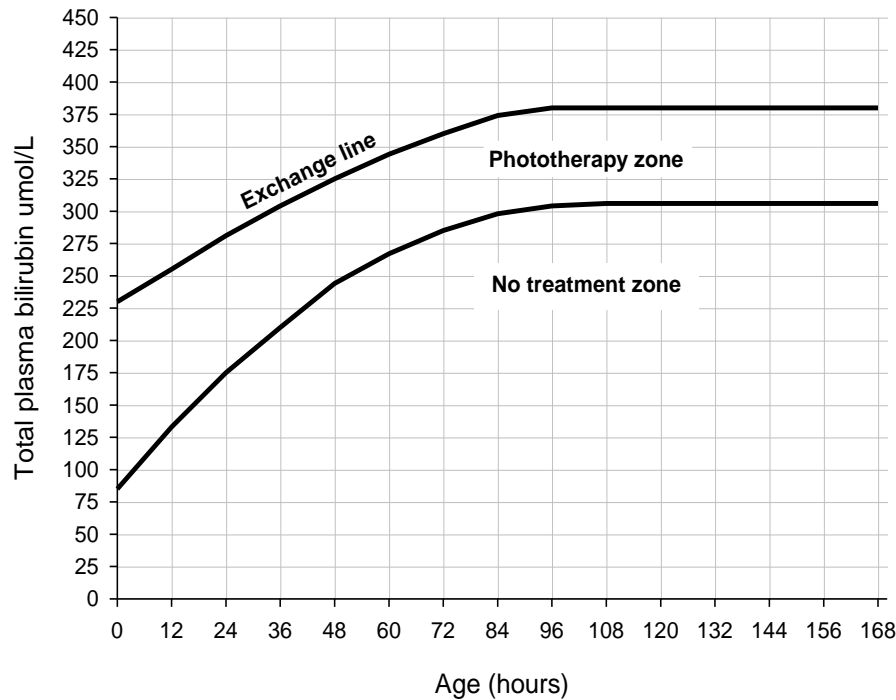
Use this chart to plot serial plasma BRs

ROUTINE TESTS FOR ALL BABIES UNDER PHOTOTHERAPY			
Check maternal blood group & antibody screen in pregnancy		Baby's blood group	
CBP, Red cell morphology on blood film & reticulocyte count		Direct antiglobulin test (DAT)	

- **Ensure lactation support for all breastfeeding mothers.** Early discharge (<48 hours) is not recommended.
- **Babies who are sleepy, feeding poorly or who have lost > 10 % of birth weight require medical or neonatal nurse practitioner review.**
- **Measure a plasma BR in all babies with any visible jaundice in the first 24 hours even if only on the face or above the nipple line**
- **Consider a plasma BR or transcutaneous bilirubin level (TcB) in dark skinned babies if any jaundice visible or at the time of the newborn screening test**
- Measure a plasma BR or TcB if jaundice is below the nipple line
- If TcB below P75, repeat TcB daily until level has peaked or exceeds P75. Measure a plasma BR if TcB is above P75.
- If plasma BR is above P75 and below phototherapy line repeat blood level daily
- If plasma BR is between P40 and P75 repeat level every 2 days
- If plasma BR is below P40 follow clinically and repeat only if visibly more jaundiced
- Continue repeat levels until bilirubin has peaked or phototherapy line reached.
- Where phototherapy is required, routinely perform a blood group and DAT, full blood count, film and reticulocyte count. Use either overhead lights and/or a fibre optic blanket
- Repeat plasma BR level daily in the Phototherapy Zone. A level 12 hours after commencing phototherapy is reasonable at clinician discretion.
- Increased fluids not required for phototherapy, but increased milk intake is required if weight loss >10% or slow weight gain.
- Cease phototherapy when plasma BR is at least 50µmol/L below treatment threshold. Then repeat a TcB or plasma BR every 1-2 days until peaked.
- **If plasma BR levels continue to rise despite phototherapy, or if a baby presents with a plasma BR above exchange threshold, maximise phototherapy (both overhead lights and fibre optic blanket), seek advice, and refer to a Level 6 Neonatal Service**

Neonatal Jaundice – Management of High-Risk Babies Requiring Level 5 or 6 Neonatal Services

≥ 37⁺⁰ Weeks with Confirmed OR Likely Haemolysis



Use this chart to plot serial plasma BRs

- **Seek neonatologist advice. Early transfer to a level 6 service from country centres.**
- Commence phototherapy as soon as possible. Maximise skin area exposed to phototherapy (above and below baby) and the time under phototherapy
- Do blood group and DAT, CBP and film, reticulocyte count
- Consider preparation for exchange transfusion (do Group and Save, notify Blood Transfusion Service, establish appropriate vascular access, administration of albumin).
- Measure serial plasma BR 4-12 hourly depending on severity to assess the rate of rise of bilirubin
- Follow-up bilirubin measurement within 24 hours of ceasing phototherapy is recommended²².
- Ensure adequate milk intake where baby is stable. Consider gavage feeding to ensure fluid intake and maximise time under phototherapy. Support lactation where appropriate by expressing and storing milk.
- Investigate and treat systemic illness
- Consider the need to cease feeding and give IV fluids or antibiotics in a sick baby

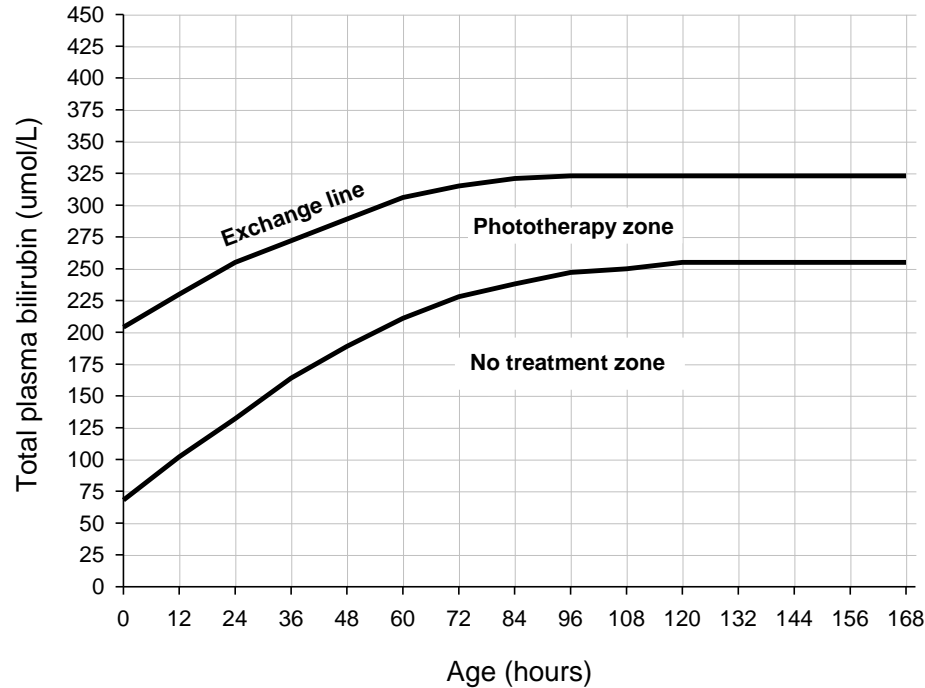
CHECK LIST FOR ALL BABIES WITH CONFIRMED OR LIKELY HAEMOLYSIS			
Discuss with neonatologist		Cord blood or baby's blood group	
Check maternal blood group & antibody screen in pregnancy		Direct antiglobulin test (DAT)	
CBP, red cell morphology & reticulocyte count		Antibody elution if cord blood sample available	
G6PD screen		Group and save	
Notify blood bank that exchange transfusion may be required		Fresh, irradiated, CMV negative blood available	
Reconstituted red cells prepared if exchange transfusion likely		Neonatal Screening Test prior to exchange if less than 36 hours old and repeat 48 hours post transfusion	



Neonatal Jaundice – Management of High-Risk Babies Requiring Level 5 or 6 Neonatal Services

> 35⁺⁰ - 36⁺⁶ Weeks Gestation with Any of Confirmed OR Likely Haemolysis, Poor Feeding, Weight Loss >12% BW

≥ 35⁺⁰ Weeks and Clearly Unwell with Any of: Fever, Irritable, Abnormal Cry, Seizures, Difficult to Rouse, Not Feeding, Vomiting, Hypoglycaemia, Hypoxic-Ischaemic Encephalopathy



Use this chart to plot serial plasma BRs

- Seek neonatologist advice. Early transfer to a level 6 service.
- Commence phototherapy as soon as possible. Maximise skin area exposed to phototherapy (above and below baby) and the time under phototherapy
- Do blood group and DAT, CBP and film, reticulocyte count
- Consider preparation for exchange transfusion (do Group and Save, notify Blood Transfusion Service, establish appropriate vascular access, administration of albumin).
- Measure serial plasma BR 4-12 hourly depending on severity to assess the rate of rise of bilirubin
- Is this sepsis? Is this galactosaemia? Consider IV fluids and antibiotics. Check newborn screening test.
- Is this kernicterus? Immediate exchange transfusion required.
- Ensure adequate milk intake where baby is stable. Consider gavage feeding to ensure fluid intake and maximise time under phototherapy. Support lactation where appropriate by expressing and storing milk.

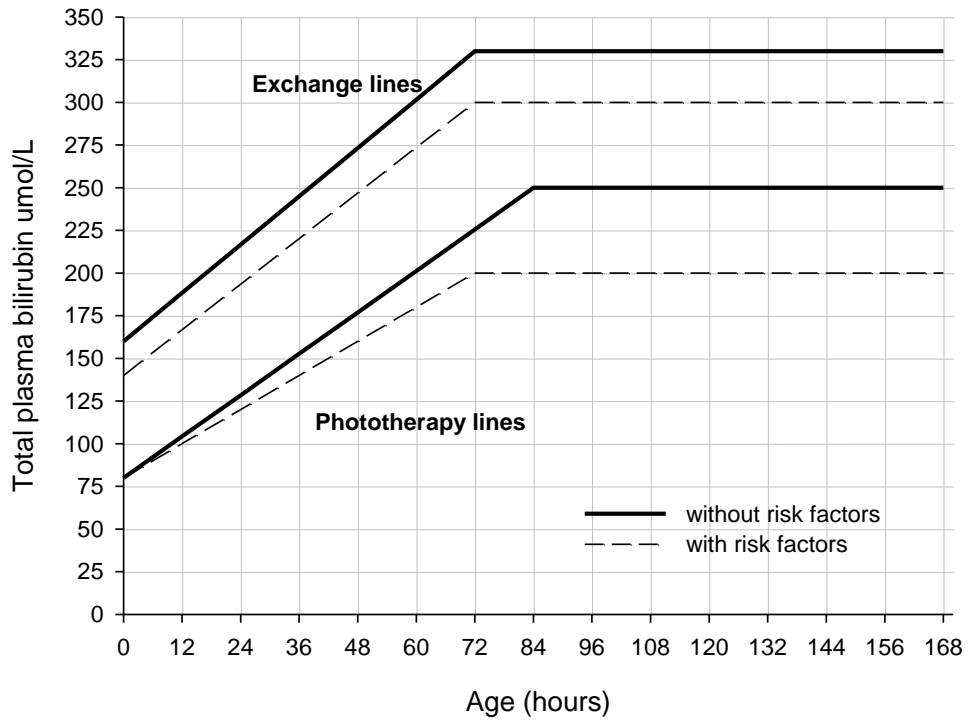
CHECK LIST FOR ALL BABIES WITH CONFIRMED OR LIKELY HAEMOLYSIS			
Discuss with neonatologist		Cord blood or baby's blood group	
Check maternal blood group & antibody screen in pregnancy		Direct antiglobulin test (DAT)	
CBP, red cell morphology & reticulocyte count		Antibody elution if cord blood sample available	
G6PD screen		Group and save	
Notify blood bank that exchange transfusion may be required		Fresh, irradiated, CMV negative blood available	
Reconstituted red cells prepared if exchange transfusion likely		Neonatal Screening Test prior to exchange if less than 36 hours old and repeat 48 hours post transfusion	



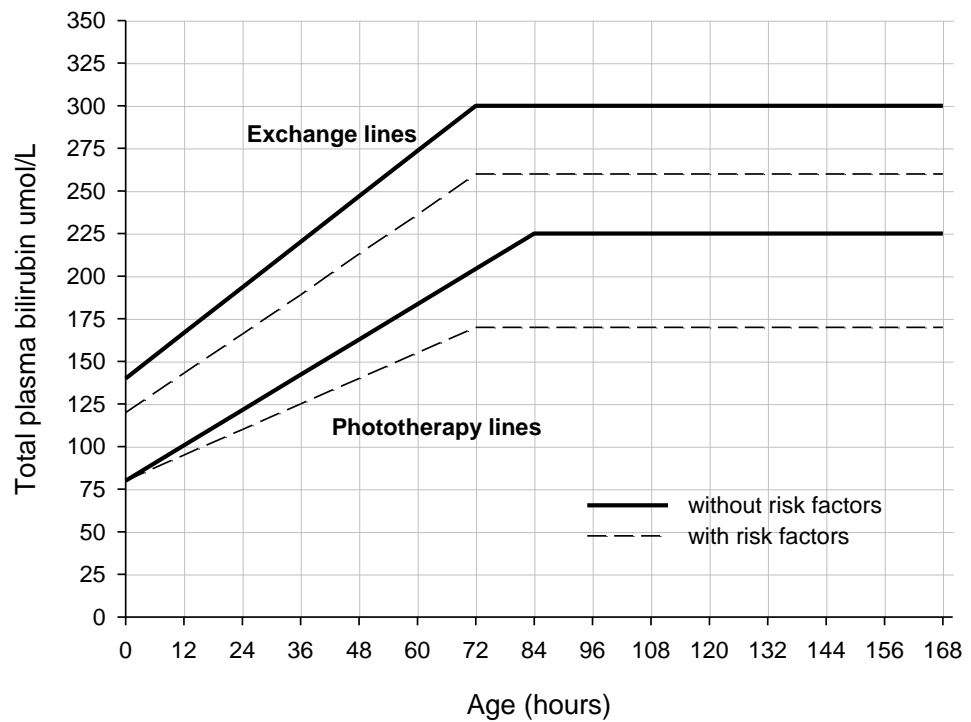
Neonatal Jaundice

Neonatal Jaundice - Management of Preterm Babies < 35⁰ Weeks

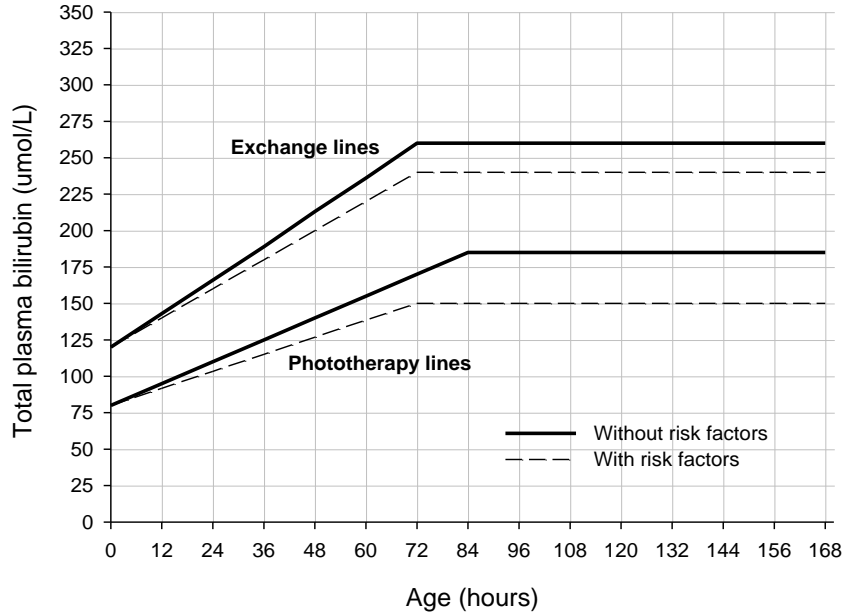
34⁰ – 34⁶ Weeks Gestation



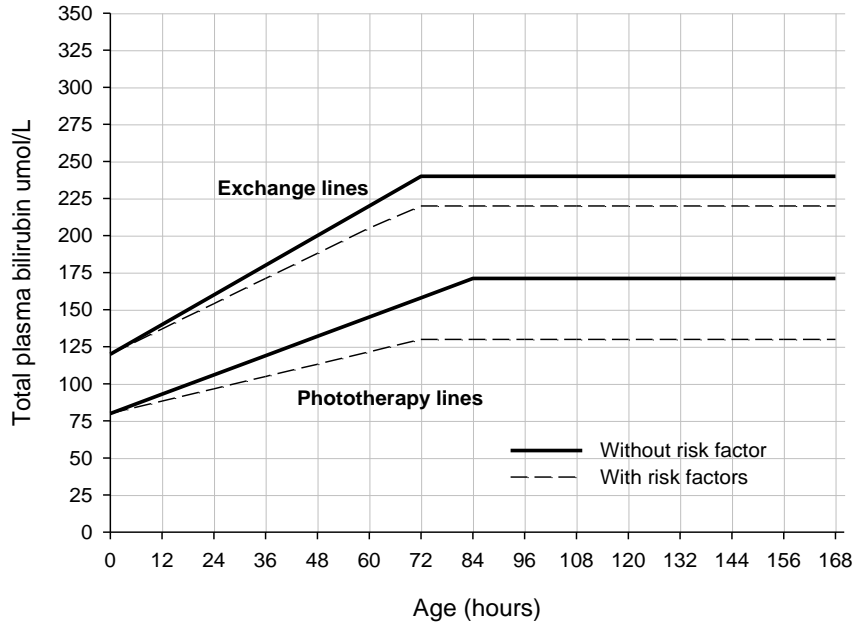
32⁰ – 33⁶ Weeks Gestation



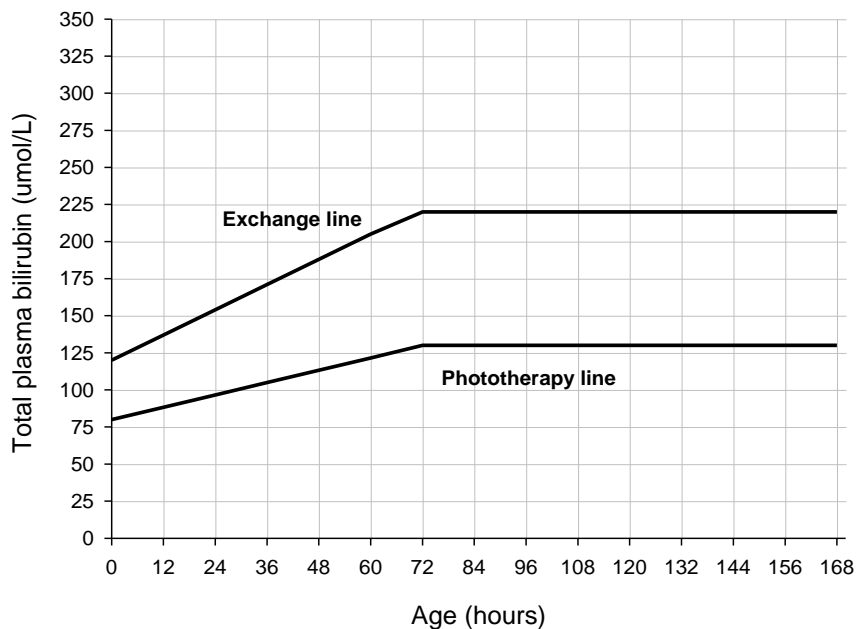
30⁺⁰ – 31⁺⁶ Weeks Gestation



28⁺⁰ – 29⁺⁶ Weeks Gestation



22⁺⁰ – 27⁺⁶ Weeks Gestation



Introduction

While jaundice is very common in new-born babies and generally harmless, extreme hyperbilirubinaemia can be damaging to the brain resulting in sequelae of cerebral palsy and sensorineural hearing loss. This syndrome has been termed kernicterus due to the pathological finding of yellow staining of the brain. Kernicterus is completely preventable by early detection of jaundice and treatment with phototherapy.

In South Australia, most babies are discharged from hospital within 1-3 days and for this reason the detection and management of neonatal jaundice is largely community based. This state protocol details the pathway for detection, monitoring and treatment of neonatal jaundice.

The Importance of Community Management of Jaundice

With current standards of perinatal care, the great majority of babies who develop clinically significant jaundice will do so after discharge from hospital.

Health services that provide a birthing service (Level 3 - 6 Perinatal Services) must have well-coordinated maternity outreach systems for mothers and babies that enable regular clinical assessment of jaundice in the community, the provision of lactation support for breast feeding mothers, and the recognition of babies who are unwell.

Prematurity, weight loss due to inadequate breast milk intake, and lack of recognition of jaundice leading to delays in presentation and treatment are common factors described in cases of kernicterus.^{1,2,3}

Appropriate Clinical Settings for Management of Jaundice

Management of jaundiced babies in the community, or in a Level 3 or 4 neonatal service is appropriate for well babies > 35⁺⁰ weeks – i.e., feeding well, no set-up for or confirmed haemolysis, and acceptable weight loss < 12 % of birth weight.

Management of jaundiced babies > 35⁺⁰ weeks with sleepy behaviour, poor feeding, weight loss > 12% of birth weight may be appropriate in a Level 3 or 4 neonatal service in consultation with a paediatrician.

Management should be in a Level 5 or 6 neonatal service where a jaundiced baby has confirmed or likely haemolysis or is clearly unwell. In a rural or remote setting early transfer to a tertiary centre is advised.

Management of babies <35 weeks gestation with jaundice should be in a clinical service appropriate to the degree of prematurity.

Risk Assessment

It is important to assess all newborn babies for risk of developing either jaundice or kernicterus both at birth and before hospital discharge. 'Risk' refers to the likelihood of developing jaundice in treatment ranges based on the American Academy of Paediatrics Clinical Practice Guideline treatment levels, or risk of bilirubin encephalopathy.⁴ Refer to the [Risk Assessment Flowchart](#).

The following clinical factors constitute a high-risk scenario:

1. Confirmed or likely haemolysis
 - > In utero haemolysis confirmed or presumed on the basis of fetal anaemia in the context of a positive maternal antibody screen
 - > Jaundice in the first 24 hours
 - > A baby presenting with a blood bilirubin level above exchange level
 - > After birth, a rate of rise of total bilirubin >5µmol/L/hour without phototherapy, or a continued rise despite effective phototherapy
 - > Previous child with antibody mediated haemolytic disease of the newborn (including ABO mediated haemolysis)

Neonatal Jaundice

- > Family history of G6PD deficiency, inherited red cell membrane or metabolic defects (e.g. hereditary spherocytosis, pyruvate kinase deficiency) causing neonatal jaundice
 - > A positive maternal blood group antibody screen and a positive cord blood direct antiglobulin test (DAT or Coombs' test) due to anti-D (not derived from maternal passive immunisation), anti-c, anti-Kell. Note: A positive DAT due to other Rhesus antibodies, anti-A or B, and minor blood group antibodies are less likely to cause haemolysis. In particular, a positive DAT due to anti A or anti B results in haemolysis in a minority of cases and other indicators (rate of rise, spherocytosis, reticulocytosis, raised LDH) are required to confirm haemolysis with ABO incompatibility.
2. Unwell baby with sepsis, seizures, apnoea, unusual hypoglycaemia
 3. Late preterm baby who is sleepy and/or has lost >12% of birth weight

The following clinical factors identify increased risk:

- Term gestation baby with weight loss > 12 % birth weight or poor feeding
- Gestation 35⁺⁰ – 37⁺⁰ weeks

Monitoring Jaundice

All babies should be assessed clinically for jaundice at least daily while in hospital either by blanching the skin with a fingertip in bright natural or white fluorescent light, or by using a transcutaneous point-of-care light reflectance meter (TcB). The exceptions are those babies who are having close monitoring of blood (plasma or serum) total bilirubin levels.

Clinical screening and transcutaneous bilirubin measurement both have limited accuracy. Laboratory chemical methods for measuring plasma or serum total bilirubin are the gold standard.

Clinical or transcutaneous bilirubin estimation is suitable for lower risk babies.

Transcutaneous bilirubin measurement is unsuitable for babies receiving phototherapy.

Higher risk babies require blood bilirubin measurements. Visual assessment of progression of jaundice is not reliable. The frequency of measurement depends on the clinical scenario and advice is given in the accompanying charts.

Blood samples collected for bilirubin analysis by midwives and child health nurses in the community should be protected from light by putting them in a brown paper bag. Carrying blood samples in a foam esky in the car is recommended to avoid excessive heat. Analysis should be undertaken as soon as is practical.

Parents **should not** be advised to place babies by a window or in direct sun due to risk of sunburn and overheating.

Clinical Assessment

A finding of jaundice extending below the nipple line will detect with high sensitivity total plasma bilirubin levels above the 75th centile for hour-specific bilirubin levels at between 48-72 hours of age (97 % sensitivity for levels > 205 µmol/L with low specificity).⁵

Jaundice visible below the nipple line should be checked - either with a transcutaneous point-of-care light reflectance meter or by a blood (plasma or serum) total bilirubin.

Clinical assessment has limited utility in dark skinned babies, and any degree of detectable jaundice in these babies should be checked with either a transcutaneous or a blood level, and management guided by hour-specific percentiles.⁶

Transcutaneous Bilirubin Measurement

Transcutaneous bilirubin measurement (TcB) using a point-of-care light reflectance device is useful for screening jaundiced babies and reducing the number of blood tests required.⁶ multi-wavelength spectral analysis is generally unaffected by gestation, postnatal age or skin pigmentation.⁷ While skin pigmentation may influence readings with different devices, TcB remains a valid tool in dark skinned babies.⁸

Neonatal Jaundice

Transcutaneous bilirubin measurements tend to underestimate plasma or serum total bilirubin levels particularly at higher blood levels.⁹ It is reasonable practice to measure a blood bilirubin level if a transcutaneous level is \geq 75th centile. A transcutaneous level $<$ 75th centile can be managed with continued clinical review and either a repeat transcutaneous measurement or a blood level if the baby becomes visibly more jaundiced or if the baby develops poor feeding, excessive weight loss or becomes unwell.

Hour Specific Bilirubin Charts

In healthy term and late preterm babies where haemolysis is unlikely, transcutaneous or blood levels are interpreted in the context of percentile charts for hour-specific bilirubin.^{6,7}

Hour-specific bilirubin percentiles are helpful in predicting jaundice that may require phototherapy, in reducing numbers of repeat blood tests and for guiding the frequency of community outreach assessments.⁶

Studies that have validated hour specific bilirubin levels are limited to well babies without haemolysis and their use is therefore restricted to these groups.

For well babies $> 38^{+0}$ weeks gestation, a plasma total bilirubin below the 75th percentile line has a very low probability of rising to the AAP phototherapy threshold.⁶ Similarly, for the well late preterm baby $35^{+0} - 37^{+6}$ weeks gestation a plasma bilirubin level below the 40th centile has a very low probability of reaching treatment levels. Bilirubin levels above the 75th centile have risks of exceeding 340 $\mu\text{mol/L}$ of up to 40 % and 20 % respectively for well babies $35^{+0} - 37^{+6}$ and $> 38^{+0}$ weeks.¹⁰ In the current protocol, these published data have been assumed to approximate the risks of reaching treatment levels for our modified definitions of Low Risk ($\geq 37^{+0}$ weeks) and At Risk ($35^{+0} - 36^{+6}$ weeks).

Phototherapy

Treatment Guidelines

Phototherapy and exchange transfusion decision lines in this guideline are derived from the American Academy of Paediatrics (AAP) Clinical Practice Guideline 2004 for babies of $> 35^{+0}$ weeks gestation.⁴ The AAP charts have been re-drawn to incorporate phototherapy and exchange lines on single charts, and to incorporate hour-specific bilirubin percentiles to assist postnatal ward clinical staff, community midwives and child health nurses when monitoring lower risk babies in the community.⁶ One difference to the AAP guideline is the lowering of the threshold for Low Risk to 37 weeks gestation, which has been made to reduce hospital admission for phototherapy, and which is based on the absence of clear evidence that 37 weeks gestation of itself increases the risk of kernicterus above that of 38 weeks gestation. This is consistent with a Swedish national guideline.¹¹ Similarly, the use of 12% weight loss rather to 10% weight loss has been introduced as a marker of increased risk as there is limited evidence that 10% weight loss of itself increases the risk of kernicterus.

There are no published guidelines comparable to the above AAP Clinical Practice Guideline that relate to preterm infants $< 35^{+0}$ weeks gestation. In preterm babies, bilirubin neurotoxicity is unpredictable at lower bilirubin levels and individual risk is modified by co-morbidities.¹² Conservative intervention levels for phototherapy and exchange transfusion have effectively eliminated kernicterus in preterm infants. While aggressive phototherapy in preterm infants $< 1000\text{g}$ has been found to reduce neurodevelopmental impairment when compared to conservative phototherapy, this was at the risk of higher mortality.¹³ The preterm charts used in this guideline are based largely on the exchange and phototherapy intervention lines of Horn et al in the consensus guidelines for South African hospitals, adapting the higher thresholds for phototherapy published by Morris et al in babies < 30 weeks gestation.^{13,14} These graphs are broadly consistent with NICE guidelines for phototherapy, but in addition consider the importance of risk factors in decision making.

When selecting a chart, use the chart that corresponds to the birth gestation over the first 7 days of postnatal life even if the baby crosses to a higher gestation category.



Effectiveness of Phototherapy

Phototherapy is most effective at high spectral irradiance (at least $30\mu\text{W}/\text{cm}^2/\text{nm}$) in the blue wavelength band (430-490nm) continuously applied to as much body surface area as possible.^{4,14,15}

Only phototherapy units that are stated by the manufacturer to deliver a minimum peak irradiance of $30\mu\text{W}/\text{cm}^2/\text{nm}$ at normal operating distance are suitable for the treatment of jaundice.

Blue LED light sources are more reliable at delivering 430-490nm light at high intensity than fluorescent or halogen light sources.⁴ LED phototherapy pads produce high irradiance blue light levels close to the skin and allow swaddling and close contact between babies and mothers without interrupting phototherapy.^{4,15} LED phototherapy pads are effective at reducing bilirubin levels in jaundiced babies if applied correctly.¹⁷

Maximised phototherapy consists of both continuous overhead and fibre optic blanket phototherapy. Note: when the output of a single overhead bank is $30\mu\text{W}/\text{cm}^2/\text{nm}$, increasing irradiance to the same area of skin with a second bank will have some additional effect in reducing bilirubin, as no apparent plateau in rate of bilirubin decline was documented up to $50\mu\text{W}/\text{cm}^2/\text{nm}$.^{16,18} However, additional overhead lights will be most effective if the surface area exposed is increased.

Nursing Care

Overhead phototherapy should be administered to babies nursed undressed in a nappy with the nappy undone, in either an incubator or bassinet depending on environmental temperature.

Good quality overhead phototherapy units shouldn't need to come closer than 30 cm to the baby to deliver irradiance at close to saturation levels ($> 30\mu\text{W}/\text{cm}^2/\text{nm}$). Bringing lights closer to the baby can result in overheating, especially with halogen globes.

Fibre optic blankets are applied directly against the skin, with care taken to maximise contact between the skin and the blanket's effective surface area.

Pulse oximetry is advisable when babies are under overhead blue lights, as cyanosis is not easily detected.

Nasogastric feeding is desirable to facilitate continuous phototherapy and ensure adequate milk intake. Babies who require maximised phototherapy and who are breast fed may need nasogastric feeding to avoid breaks in phototherapy. Women should be supported with expression of breast milk and maintenance of supply.

Phototherapy increases insensible water loss in babies of all gestations and postnatal ages. However, supplemental enteral fluids (milk or clear fluids) are not routinely required for the treatment of jaundice in term and late preterm babies.⁴ Increased fluids may be required for preterm babies but this needs individual assessment taking renal function and cardio-respiratory function into account.

Breast fed babies who are jaundiced and have excessive weight loss or poor weight gain should receive supplemental expressed breast milk or formula if parents are agreeable, in preference to intravenous fluid.⁴

All babies requiring phototherapy should have a blood group, DAT and blood film, and reticulocyte count performed to exclude haemolysis.

Re-testing Bilirubin after Stopping Phototherapy

When phototherapy is used for infants with haemolytic diseases, or is initiated early and discontinued before the infant is 3 to 4 days old, a follow-up bilirubin measurement within 24 hours of ceasing phototherapy is recommended²². Discharge from the hospital need not be delayed to observe the infant for rebound jaundice.

Discharge plans for babies with haemolytic disease of the newborn managed with intensive phototherapy, should be discussed with a senior clinician prior to discharge, and must include rechecking bilirubin levels and follow up of results. Some of these babies might need to remain in hospital to check for early rebound.



Home Phototherapy

For Low-Risk babies, home phototherapy can be administered safely when this is incorporated into a midwifery home support service.¹⁹ Clear protocols and procedures should be developed by LHNs undertaking home phototherapy, that include criteria for patient selection, consideration of the home environment, parental education, and appropriate support services.

Exchange Transfusion

Indications for exchange transfusion for jaundice are:

1. Rising total bilirubin despite intensive phototherapy and the exchange line is approached
2. Anaemia with a haemoglobin < 100 g / L, cardiac failure or hydrops
3. Suspected kernicterus (exchange required even if bilirubin is below the exchange line)

Exchange transfusion requires management in a Level 6 service because of risks and monitoring requirements. Neonatologist consultation and planned birth in a Level 6 service are necessary where a haemolytic process is suspected in utero. If a baby is born outside of a level 6 service and has proven or likely haemolysis after birth (rise in bilirubin > 5 µmol/L/hr without phototherapy, a continued rise despite effective phototherapy, presentation with a bilirubin above exchange levels) early transfer to a Level 6 service is strongly advised.

Intravenous Immunoglobulin

Antibody mediated haemolysis is not an indication for IVIG.^{20,21}

Intravenous albumin can be administered where hypoalbuminaemia has been documented or the need for an exchange transfusion is anticipated.

Prolonged Jaundice

Jaundice that persists beyond 2 weeks in babies > 35⁺⁰ weeks gestation or 3 weeks in babies <35⁺⁰ weeks gestation is termed 'prolonged' and requires investigation.

When babies are discharged from community follow-up parents are to be advised that any visible jaundice after the age of 2 weeks requires medical review.

Acholic stools require prompt paediatric medical review.

Standard Investigations for Prolonged Jaundice Are:

1. Review the result of the Newborn Screening Test.
2. Total and conjugated bilirubin
3. Free T4, TSH
4. A urine culture may be indicated where there is faltering growth, but is not a routine test in prolonged jaundice

Abnormal test results require specialist paediatric management – seek advice

Where the above tests are normal in a healthy breast fed baby the parents can be counselled that their child has breast milk jaundice which is a natural condition that will resolve over the next 2-3 months.

Note: it is not necessary to trial infant formula to make this diagnosis - this practice may adversely affect breastfeeding.



Follow-Up of Jaundiced Babies

Current SA newborn hearing screening guidelines are to perform an automated auditory brainstem response test in every baby in South Australia as close to discharge and as close to term as possible. Babies that are readmitted post discharge with a bilirubin $> 350 \mu\text{mol/L}$ are re-screened if they have passed previously. Babies with hyperbilirubinaemia requiring exchange transfusion require audiological assessment at 12 months of age.

Babies with confirmed immune haemolysis require close follow-up over the following 4-6 weeks to watch for the development of late anaemia. Anaemia is more likely with rhesus isoimmunisation, where a weekly CBE and reticulocyte count is advised.

Give folic acid supplementation where continued haemolysis is suspected.

Unusual haemolysis may require further evaluation for membrane or red cell metabolic defects. Haematologist advice is recommended.

All babies with symptoms of encephalopathy or who have been unwell require a structured long-term follow-up coordinated by a paediatrician.



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