Women and Babies: Neonatal Jaundice

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Changes in Current Version:
- Transcutaneous bilirubinometers can be used routinely in babies born after 31 completed weeks
- Transcutaneous bilirubin should be measured on the
Compliance with this Guideline is recommended

Sternum not on the forehead.

- Any baby with a transcutaneous bilirubin measurement within 50µmol/L below the appropriate phototherapy line should have a serum bilirubin measured.
- Babies on the postnatal ward with risk factors for jaundice should have routine transcutaneous bilirubin measured at 12, 24 and 48 hrs. (see routine surveillance flow diagram)
- The phototherapy threshold lines have changed for early postnatal serum bilirubin in preterm babies. (see phototherapy chart)
- Pre-discharge jaundice risk assessment should include a routine transcutaneous bilirubin measurement in any baby who has not had any serum bilirubin monitoring. (See pre-discharge risk assessment flow chart)

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RPA Women and Babies: Neonatal Jaundice

1. Introduction
This document provides guidance on the identification and management of jaundice in the newborn. Jaundice is caused by increased levels of bilirubin in the newborn's blood. It is important to detect or prevent very high levels of bilirubin, which can be harmful to the baby if not treated.

2. The Aims / Expected Outcome of this Policy/Procedure/Guideline
- Recognition of pathological neonatal jaundice
- Appropriate management of neonatal jaundice
- Pre-discharge risk assessment for neonatal jaundice

3. Risk Statement
SLHD Enterprise Risk Management System (ERMS) Risk # 106 Recognising and Responding to Clinical Deterioration in Acute Health Care
- Risk of brain injury and disability if pathological jaundice is not recognised and/or appropriately managed.

4. Scope
- Nurses, midwives, and student midwives working in Newborn Care or Women and Babies Wards
- Neonatal medical officers.

5. Resources
- None

6. Implementation
- Distribution and notification of this Guideline via usual means (email, relevant management and ward meetings).
- Education and training programs for nurses, midwives, medical officers and neonatal nurse practitioners

7. Key Performance Indicators and Service Measures
- Incidents of severe neonatal jaundice

8. Guideline
Background
Approximately 60% of term babies and 85% of preterm babies will develop clinically apparent jaundice.\(^1,2\) Most of these babies have so-called ‘physiological jaundice’, which typically becomes clinically apparent on day 3, peaks on day 5 to 7 and resolves by day 14. The clinical challenge is identifying the minority with pathological neonatal jaundice from the large majority with benign physiological jaundice.
Physiological jaundice is usually benign, however if unconjugated serum bilirubin levels get too high, bilirubin can cross the blood brain barrier where it is neurotoxic, particularly to the auditory nerve and basal ganglia. Brain injury and disability can result. Because of this, it is important to identify those babies at risk of the rare complication of acute bilirubin encephalopathy and kernicterus.1,2

The clinical challenge is identifying the minority with pathological neonatal jaundice from the large majority with benign physiological jaundice. There are important cues that jaundice may be pathological.

8.1 Incidence and risk factors

It is clinically useful to classify jaundice according to the age of the baby when he/she becomes visibly jaundiced. There are three clinical age based time frames:

1. Early (first 48 hours) - uncommon and pathological due to haemolysis until proven otherwise.
   - Haemolytic jaundice (Rhesus, ABO, others). Early clinically apparent jaundice should be assumed to be haemolysis until proven otherwise.

2. Intermediate (days 3-10) - common and usually benign.
   - Physiological Jaundice which may be exacerbated by/associated with:
     - Prematurity including late preterm 35-37 weeks
     - Bruising
     - Cephalohaematoma
     - Polycythaemia
     - Delayed passage of meconium
     - Breast feeding
     - Dehydration
     - Asian ethnicity, especially Chinese
     - Infant of diabetic mother, especially if macrosomic.
   - Haemolytic jaundice including G6PD deficiency - especially after discharge home

3. Late (days 14+) – pathological if conjugated bilirubin is raised.
   - Breast milk jaundice - common and always unconjugated
   - Sepsis
   - Hypothyroidism
   - Inherited deficiencies of glucuronyl transferase enzymes - very rare
   - Conjugated jaundice - uncommon – needs investigation.

8.2 Consequences

Unconjugated bilirubin is neurotoxic if it gets to levels that exceed the albumin binding capacity within the blood. This neurotoxicity can have acute effects, often called kernicterus or bilirubin encephalopathy. This clinical syndrome includes hypertonia progressing to opisthotonos, seizures, and may lead to death. The areas of the brain that are most vulnerable to bilirubin are the auditory nerve and the basal ganglia which lead to the late sequelae of kernicterus, sensorineural hearing impairment and cerebral palsy, often with ataxia and chorioathetosis.
The neurotoxicity is also dependent on the competence of the blood brain barrier which is mainly influenced by prematurity. So the risk of kernicterus is inversely related to gestational age but is also influenced by factors which can displace bilirubin from albumin including acidosis, drugs that also bind to albumin and hypoalbuminaemia.

Thus the risk of jaundice varies with gestational age but will also vary between individual babies of the same gestation. This risk cannot be accurately quantified in an individual baby. The exchange transfusion thresholds in the chart below represent the ‘best guess’ as to the level above which there is a significant risk of kernicterus. The phototherapy thresholds, in the chart below, are set at levels below which we think there is a risk of kernicterus to allow a therapeutic safety margin.

In a recent Australian surveillance study, the estimated incidence of hyperbilirubinaemia with a TSB≥450µmol/L was 9.4/100,000 live births. The commonest causes were haemolytic with ABO incompatibility, G6PD deficiency and rhesus isoimmunisation.

8.3 Clinical evaluation

Surveillance for neonatal jaundice involves the use of regular visual assessment of skin colour and transcutaneous bilirubin measurement (TcB) to identify babies who need total serum bilirubin measurement (TSB). TSB can then be used to determine need for treatment. There are some groups of babies who are at particularly high risk for neonatal jaundice; these babies need particularly close surveillance.

8.3.1 Visual Assessment of Severity of Jaundice

Visual assessment remains the mainstay of jaundice surveillance in the newborn. All babies should have ongoing assessments in the first 4 days of life, specifically those at risk of developing hyperbilirubinaemia during the neonatal period. Assessments should be at least 12 hourly in the first 48 hours of life, more frequently if there is very high risk.1,2

Always assess jaundice in good light by blanching the baby’s skin with a finger and observing the underlying skin colour.1,2 Two clinical features of increasing severity of neonatal jaundice dominate the visual assessment:

- The underlying skin colour changes from a lemon yellow to a deeper orange yellow.
- The jaundice also progresses caudally from the face with a progression to the trunk and extremities, following Kramer’s rule.4 If the feet or hands are visibly yellow, the TSB is likely to be above 250 micromol/L.

Kramer’s Rule4

Kramer drew attention to the observation that jaundice starts on the heads and face, and extends towards the feet as the level rises. This is useful in deciding whether or not a baby needs to have the TSB measured. Kramer divided the infant into 5 zones, the TSB range associated with progression to the zones is as follows:

<table>
<thead>
<tr>
<th>Zone</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSB (umol/L)</td>
<td>100</td>
<td>150</td>
<td>200</td>
<td>250</td>
<td>&gt;250</td>
</tr>
</tbody>
</table>
Limitations to visual assessment: There are limits to the accuracy of visual estimation of TSB levels, with or without the help of Kramer’s rule especially in darker skinned races,\textsuperscript{1,2,4} and, if there is any doubt clinically, TcB or TSB measurement should be performed. Visual and TcB assessment are also inaccurate on a baby once under phototherapy as this will tend to blanch the skin.\textsuperscript{5,6} A TSB level should always be used to assess response to phototherapy.

8.3.2 Transcutaneous bilirubin measurement (TcB)
Transcutaneous bilirubinometry provides an extra layer of non-invasive assessment of jaundice prior to taking blood for TSB levels.\textsuperscript{7,8} At RPAH, we use the Draeger JM-103 and JM-105 transcutaneous bilirubinometers. These has been validated against TSB measurement in term and in preterm babies down to 28 weeks, there are limitations to the accuracy.\textsuperscript{9} Because the consequences of inaccurate estimation of TSB are greater in the most immature babies, routine use of TcB at RPA will be in babies of 32 weeks or greater.

The main goal of TcB measurement is to select more accurately those babies who need further evaluation with a TSB. For this, there needs to be a high level of confidence the TSB would not be above phototherapy thresholds in an individual baby at the time of the measurement. The following general guidelines can be used:

- If a TcB level is less than 50 micromol/L under the threshold for phototherapy then a TSB level measurement is recommended.\textsuperscript{8}
- Because of differences in reliability of measurement between individual babies, trend of TcB measurements are more reliable than those made on a single value as the basis for clinical decision making.\textsuperscript{5,8}

Site of measurement: There is evidence that TCB measured on the sternum will be higher than that on the forehead, although both correlate well with TSB.\textsuperscript{11} The validation of the JM-103 in preterm and term babies was performed with a sternal measurement.\textsuperscript{8} The sternum should be routinely used for measurement of TcB \textbf{not} the forehead.

Other confounders to TcB accuracy:

- Ethnicity: TCB measurement seems to work well across different ethnicities though there is some evidence from studies in the USA that there is a wider scatter in babies of African descent.\textsuperscript{8}
- Phototherapy: The bleaching of the skin from phototherapy will compromise the accuracy of TcB measurement\textsuperscript{4,5} so TcB measurements should not be relied on during phototherapy and up to 24 hours afterwards should be interpreted with caution as a means of assessing rebound TSB after ceasing phototherapy.

When to measure transcutaneous bilirubin:

- Reactively, in any baby, where there is concern about the degree of jaundice on visual inspection.
- \textbf{Routinely in high risk babies, (See flow chart 1)} TcB should be measured at 12, 24 and 48 hours, in babies at high risk for developing jaundice. This includes:
  - Babies with known maternal rhesus or ABO antibodies.
  - Babies with severe birth related bruising or extra-cranial haemorrhage e.g cephalohaematomas or subgaleal haemorrhages.
  - Babies with previous siblings who had ABO incompatibility.
  - Babies with a family history of G6PD.
- Babies born before 37 weeks on the postnatal wards.

- **Pre-discharge** in all babies who have not had any TSB monitoring, see pre-discharge risk assessment below.

**IMPORTANT WARNING:** When the measured TcB is above 340 µmol/L in both the JM103 and the JM105, the display to warn you the reading is above the measureable scale is not intuitive. The JM103 displays “---” and the JM105 displays a blinking “0” (see diagram below)

**DO NOT INTEPRET THIS READING AS AN ERROR. ARRANGE FOR A TSB TO BE TAKEN URGENTLY.**

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8.3.3 Total Serum Bilirubin (TSB)

The TSB remains the ‘gold standard’ measurement for treatment decisions regarding jaundice. Venous and capillary TSB levels should be treated the same.\(^1\,^2\) The total serum bilirubin as opposed to the unconjugated fraction should be used for judging treatment thresholds in the phototherapy and exchange transfusion charts.\(^1\,^2\)

Initial TSB measurement should be requested based on clinical observation and the following factors:

- Any baby with clinically apparent jaundice before 24 hrs.
- In any baby, with a TcB measurement less than 50µmol/l under the phototherapy threshold, in other words, within 50µmol/l below the phototherapy line.
- Any baby, if there is clinical doubt about the degree of jaundice.
- Any unwell baby with jaundice.
- TcB not consistent with clinical picture.
- Blinking ‘0’ or blank reading (three lines) which can mean reading is above the recording range, see description above.
- 24 hours after ceasing phototherapy to check for a rebound in TSB level.

**Repeated TSB measurement:**

1. TSB should be repeated within 12 to 24 hours in any baby with a total serum bilirubin level less than 20 micromol/L above the phototherapy treatment threshold.

2. TSB should be checked 4-6 hours after commencing phototherapy in any babies where the TSB is more than 20 micromol/L above the phototherapy treatment line or in any baby with early onset jaundice starting phototherapy within the first 48 hrs.
9. Investigations

Investigation for a cause of neonatal jaundice should be considered in the following situations:

9.1 Early onset jaundice

- Babies of Rhesus negative mothers should routinely have cord blood sent for blood group and direct antibody (Coomb's) test (DAT).
- Babies of mothers with a positive antibody screen should routinely have cord blood sent for blood group, direct antibody (Coomb's) test (DAT), full blood count and TSB.
- Any neonate who is DAT positive should TcB measured at 12, 24 and 48 hours and a TSB measured if the TcB is above the gestation appropriate line on the transcutaneous bilirubin chart (see routine surveillance flow chart).
- Any neonate who is clinically jaundiced within the first 24 hours requires urgent investigation to exclude haemolysis due to Rhesus or ABO incompatibility, including TSB, FBC and film and mother and baby's blood group & DAT.

9.2 TSB above the phototherapy thresholds or rapidly rising TSB.

Any baby with a TSB above phototherapy threshold or other rapidly rising TSB should also be investigated. Also consider investigation in babies before 48 hours to facilitate discharge home or persistent jaundice below phototherapy thresholds. Investigations should include:

- Mother's and baby's blood group & DAT (if not already known) to assess for Rhesus or ABO incompatibility.
- Full blood count (FBC) and film with reticulocyte count to assess for markers of haemolysis.
- G6PD screen in babies with high risk family history or ethnic/geographic origin (Mediterranean, Middle Eastern, African, Asian).
- Consider a septic screen including blood and urine culture and sensitivity (C&S) if there is clinical concern about possible sepsis.

9.3 Jaundice approaching exchange transfusion levels

Additional investigations should include:

- Acid Base Balance
- Conjugated bilirubin
- Serum albumin level. Low albumin levels may be a risk factor for kernicterus

9.4 Prolonged jaundice.

Babies with prolonged jaundice (visible jaundice persisting for more than 2 weeks after birth in term babies and greater than 3 weeks in preterm babies) should be reviewed for history suggestive of obstructive jaundice e.g. acholic pale stools.

Figure 1: Acholic stools in a baby with biliary atresia
• In all babies with prolonged jaundice, blood should be taken for total and conjugated bilirubin level.
• Predominantly unconjugated prolonged jaundice (conjugated TSB less than 30 micromol/L) is usually benign breast milk jaundice but consider performing thyroid function tests to exclude thyroid agenesis/dysplasia or hypopituitarism, and a urine culture to exclude a UTI.
• Predominantly conjugated prolonged jaundice (conjugated TSB greater than 30 micromol/L): is always pathological and the baby should be investigated for intra-hepatic (e.g. hepatitis) and obstructive (e.g. biliary atresia) causes of prolonged jaundice. (see Conjugated Jaundice Guideline)

There should be no delay in investigation because age at diagnosis of biliary atresia is an important prognostic factor for successful surgical repair. Such babies should be referred to a tertiary Paediatric centre that has the facilities to investigate these babies and particularly to exclude biliary atresia.

10.  Treatment of Neonatal Jaundice

Treatment should include general management including rehydration in babies with excess weight loss (more than 10% of birth weight) and treatment of any underlying illnesses that may be causing jaundice (e.g. infection).

10.1 Phototherapy

Phototherapy is the first line treatment for neonatal jaundice and is effective in most babies in reducing TSB level. Phototherapy works by photo-isomerising bilirubin in the skin to a more water soluble form. Its efficacy depends on wavelength (visible blue spectrum light) and luminance of the light source and the skin surface area illuminated by the light 11 (See Phototherapy Guideline).

Phototherapy in preterm babies: Phototherapy thresholds are lower in preterm babies reflecting their increased vulnerability to the consequences of bilirubin, see graph below. There is some uncertainty as to how aggressively phototherapy should be used in very preterm babies. There is one large randomised clinical trial comparing aggressive vs conservative phototherapy in 1974 babies born at less than 1000g. 12 ‘Aggressive’ involved starting phototherapy at enrolment and using it to keep the TSB below 85µmol/l for the first seven days and below 120 µmol/L for the next 7 days. ‘Conservative’ involved using phototherapy to keep the TSB below 136 or 170 depending on the weight grouping. Aggressive phototherapy resulted in less neurodevelopmental impairment (26% vs 34%), mainly hearing loss and MDI but this was offset by a trend to increased mortality in babies less than 750g, 39% vs 34%, (relative risk, 1.13; 95% CI, 0.96 to 1.34). For the whole study cohort, there was no difference in the risk of death or neurodevelopmental impairment (relative risk 0.94, 95% CI 0.87–1.02).

These data suggest some need for caution in being too aggressive with phototherapy in the most immature babies while maintaining vigilance to ensure that TSB levels do not go too far above the thresholds in figure 2 below.
Figure 2: Phototherapy treatment thresholds

Plot TSB level according to postnatal age. If TSB is above the relevant line for gestation and risk factor criteria, then commence phototherapy

Disclaimer: Because high level evidence does not exist in this area, particularly for the lower gestations, these charts result from a consensus as to safe treatment thresholds.

Source: Term and near-term data adapted from reference 1.

Risk Factors: Babies with any of the risk factors described below should start phototherapy according to the line one below that indicated by their gestational age. These risk factors include haemolysis, G6PD deficiency, asphyxia, proven sepsis, any baby who is unwell: e.g. lethargy, temperature instability, respiratory distress, acidosis and albumin less than 30gram/L (if measured).
Intensive Phototherapy: In babies with severe (close to exchange levels) or rapidly rising TSB, the efficacy of phototherapy can be optimised by removing all clothes and nappy and having more than one light above the baby and having the baby lie on a fibre-optic or LED phototherapy mat. Intensive phototherapy should always be performed in the nursery.

Phototherapy on the Postnatal Ward: The phototherapy mat technology creates the opportunity to provide less intensive phototherapy on the postnatal ward and so allow mother and baby to stay together. Consider this option in babies in the physiological jaundice age range (day 3 to 7) close to (within 10µmol/l) the phototherapy threshold.

Stopping phototherapy: Consider ceasing phototherapy when the TSB level is more than 50 micromol/L below the phototherapy line. This will depend on the presence of risk factors, you should be much more cautious about ceasing phototherapy in a baby with known haemolysis.

Monitoring after phototherapy: A rebound in TSB levels can occur after phototherapy is discontinued. Babies born before 37 weeks gestation and those with known haemolysis disease are at increased risk of clinically significant rebound. Unless there is identified pathology, discharge need not be delayed to observe the baby for rebound, but follow up TSB level should be measured within 24 hours of ceasing phototherapy. (See Section 4 Discharge planning and transfer of care).

10.2 Exchange transfusion

For details of the procedure, see medical and nursing guidelines. The exchange transfusion thresholds are shown in Figure 2. The TSB level that confers likely high risk of kernicterus is that represented after 96 hrs on this chart. The lower thresholds prior to that time reflect the need to consider rate of TSB rise as well as absolute level. If serial TSB levels are rising towards the exchange thresholds despite intensive phototherapy, then it is preferable to initiate the exchange prior to the threshold being reached.

Exchange on absolute TSB level: Such severe jaundice is a medical emergency and preparation for exchange transfusion should commence as soon as possible with the baby placed under intensive phototherapy while blood is awaited and lines are inserted.

Exchange on rate of rise of TSB: It is preferable to anticipate the need for exchange transfusion prior to TSB reaching thresholds, particularly in a baby with known haemolysis. So, consider exchange transfusion where TSB levels are rising faster than 17 micromol/L per hour despite intensive phototherapy in a baby with known haemolysis.

Well babies without haemolysis: TSB will often fall quickly under intensive phototherapy. So in such babies consider a trial of rehydration (if dry) and intensive phototherapy (4-6 hours) prior to progressing to exchange transfusion. If doing a trial of phototherapy, blood for exchange transfusion should be ordered in case of need to progress to exchange transfusion e.g. the trial of phototherapy fails.

Babies with known haemolysis: Babies with known rhesus sensitisation are a special case (see below) and cord blood should be tested for group and DAT, full blood count and TSB. Cord haemoglobin less than 100 g/l and/or TSB above 120µmol/l should lead to consideration of early exchange transfusion.

Intravenous immunoglobulin should be considered in isoimmune haemolysis where there is a need to slow the rate of rise of bilirubin in babies who may need an exchange
transfusion, particularly if there is likely to be any delay in implementing the exchange. The dose required is 1.0 gram per kg given intravenously over 2 hours; this may be repeated 12 hours later if the TSB levels are still rising.\textsuperscript{15}

**Figure 2. Exchange transfusion thresholds**

Plot TSB level according to postnatal age, if above the relevant line for gestation and risk factor criteria, then discuss indication for exchange transfusion with senior consultant.

**Disclaimer:** Because high level evidence does not exist in this area, particularly for the lower gestations, these charts result from a consensus as to safe treatment thresholds.

![Graph showing exchange transfusion thresholds](image)

**Source:** Adapted from reference 1

**Risk Factors:** In babies with any of the risk factors below, exchange transfusion should be considered according to the line one below that indicated by their gestational age. These risk factors include: Haemolysis, G6PD deficiency, asphyxia, possible sepsis, any baby who is unwell: e.g. lethargy, temperature instability, respiratory distress, and acidosis.

Babies with rhesus iso-immunisation fall broadly into two categories:

1. **Severe fetal isoimmunisation that has required fetal blood transfusions**: This group of babies will be born with mainly donor rhesus negative red cells and so usually don’t develop severe early haemolysis and jaundice. Because they usually don’t need an exchange transfusion, they retain a full complement of maternal anti-D antibodies which will haemolyse new red cells as they’re produced and so they have more problems with late anaemia.

2. **Mild/moderate fetal isoimmunisation that has not required fetal blood transfusions or de novo isoimmunisation.** These babies will have their own rhesus positive red cells and so will develop haemolysis and they are at risk for jaundice.

Although the jaundice risk differs, the early management of rhesus iso-immunised babies is the same:

- At birth, cord blood should be taken for group, DAT, FBC and TSB.
- Babies should be admitted to the NICU and placed under intensive (triple light) phototherapy.
- If the cord haemoglobin is less than 100 g/L and/or the TSB above 120 µmol/L, this suggests a degree of haemolysis which makes it very likely that the baby will eventually need an exchange transfusion. Lines should be inserted and blood for an exchange should be ordered. Consideration should be given to performing an early exchange transfusion to pre-empt the rise in TSB.
- If an exchange transfusion is not performed. Intensive phototherapy should be continued and TSB should be monitored 4-6 hourly and the rate of rise of TSB plotted. If TSB is rising faster than 17µmol/l/hr despite phototherapy then an exchange transfusion should be considered.
- Intravenous Immunoglobulin (IVIG): There is some evidence that IVIG will reduce the need for exchange transfusions in babies with Rhesus haemolytic disease and other immune haemolytic jaundice. The evidence is limited by small numbers in the trials and the conclusion of the Cochrane review is cautious about recommending this treatment. A recent trial showed no benefit but, reflecting the changing landscape of Rh Disease, 66% of the babies enrolled had had in-utero transfusions where the chance of needing exchange will be lower.
- IVIG should be considered in iso-immune haemolysis where there is a need to slow the rate of rise of bilirubin in babies who may need an exchange transfusion, particularly if there is likely to be any delay in implementing the exchange. The dose required is 1.0 gram per kg given intravenously over 2 hours; this may be repeated 12 hours later if the TSB levels are still rising.

12. **Intravenous albumin**

The rationale for albumin supplementation is empirical; there is no high quality evidence to support its effectiveness. Consider administering 20% albumin (1 to 2g over 1 hour) as a rehydration fluid for babies with acute bilirubin encephalopathy or possibly even those approaching the level for exchange transfusion where there may be co-existent dehydration and particularly when the serum albumin level is less than 30 gram/L.
13. Breast Milk Jaundice

This occurs infrequently, peaks in the 2nd or 3rd week, and may persist at moderately high levels for 3-4 weeks before declining slowly. It is a diagnosis of exclusion. The main conditions to be excluded are hypothyroidism and (consider) hypopituitarism. In an otherwise well infant, breast milk jaundice is considered a benign condition. If feeding with breast milk is stopped, the serum bilirubin usually falls, however this would very rarely be indicated. The potential harms of stopping breast feeding would outweigh any risks of a mild or moderate hyperbilirubinaemia. The etiology is unknown, but there is some support for both a hormonal factor in the milk acting on the infant's hepatic metabolism, and an enzyme (lipase) facilitating intestinal absorption of bilirubin.

14. Discharge and transfer of care

Because professional surveillance cannot be as close at home as that provided in the postnatal ward, the post-discharge period, particularly early discharge before 72 hours, is a risk factor for the development of severe hyperbilirubinaemia.

The ability to predict risk of jaundice prior to discharge is therefore important. Routine early TSB and TcB predict the risk of subsequent jaundice above phototheraphy thresholds. Bhutani et al\textsuperscript{16} developed a risk based graph based on routine TSB to predict subsequent jaundice. In the study of Maisels et al,\textsuperscript{17} the three factors which were significantly predictive of subsequent jaundice requiring phototherapy were TcB percentile (>75\textsuperscript{th} centile), gestation (<38 weeks) and breast feeding.

14.1 Pre-discharge TcB screening. (See Flow Chart 2)

- All babies, unless they have had TSB monitoring for clinically apparent jaundice, should have a TcB measurement prior to discharge. This measurement should be plotted on the phototherapy chart.
- If the TcB is more than 50µmol/L below the gestation appropriate phototherapy line then the baby can go home with no further monitoring.
- If the TcB is less than 50µmol/L below the gestation appropriate phototherapy line then a TSB should be measured prior to discharge and further monitoring or intervention planned on the basis of that TSB measurement in consultation with the neonatal medical or NNPs or home visiting midwives, as appropriate.
  - If the TSB is above the gestation appropriate phototherapy line, the baby should be commenced on phototherapy.
  - If the TSB is less than 50µmol/L below the gestation appropriate phototherapy line then further monitoring will depend on the age of the baby at discharge. This should be discussed with the neonatal RMO/NNP covering the postnatal wards or the home visiting midwives, as appropriate.
  - If the TSB is more than 50µmol/L below the gestation appropriate phototherapy line then the baby can go home with no further monitoring.

14.2 Parent information

All parents should be provided with information about jaundice, including what to look for and who they should contact if there are concerns. This is included in the RPAH Postnatal Handbook. Further written parent information can be accessed at:
• The American Academy of Pediatric information sheet can be found at https://www.healthychildren.org/English/ages-stages/baby/pages/Jaundice.aspx in English, Spanish, Chinese and Italian.

• NSW Health multilingual Fact Sheet Jaundice in Newborn Babies for information in Arabic, Chinese Traditional, English, Indonesian, Khmer, Korean, Serbian, Tamil, Thai, Turkish and Vietnamese: http://www.mhcs.health.nsw.gov.au then click ‘multilingual resources’ and search under key word ‘Jaundice’.

• **Risks of naphthalene-based moth repellents:** All parents should be advised to thoroughly wash any baby clothes that have been stored with moth repellents containing naphthalene prior to use. See NSW Health multilingual factsheet No 8780 Health Risks from Exposure to Naphthalene in Moth Balls and Toilet Deodorant Cakes for information in many languages at http://www.mhcs.health.nsw.gov.au then click ‘multilingual resources’ and search under key word ‘Jaundice’.

**When to contact health care professionals**

Parents should be advised to contact a healthcare professional if:

- baby’s jaundice is worsening
- jaundice is persisting beyond 14 days
- their baby is passing pale stools

**14.3 Post Discharge Surveillance.**

Postnatal Home Visiting:
RPA has a team of domiciliary midwives whose role it is to visit and provide surveillance of early discharged mothers and babies up to 14 days postpartum. The midwives are equipped with transcutaneous bilirubinometers and can take capillary or venous blood for TSB if needed. Mobile phototherapy devices are available to treat babies at home in cases where the jaundice has already been investigated and the level is not too far above treatment thresholds.

If midwives are concerned about jaundice in any baby that they are reviewing, they should contact the Fellow or Neonatologist who is on-call for advice.

Jaundice Clinic:
There is a jaundice clinic each day at 10:00 hours in RPA Newborn Care. The purpose of this clinic is mainly to follow up babies from the postnatal ward whose pre-discharge assessment was that they should have a further TSB check following discharge. Details of how to book a patient into this clinic are in the RPA Newborn Care JMO Handbook.

Prolonged Jaundice:
Any term baby with clinically apparent jaundice beyond 2 weeks of age should be referred for investigation. The critical investigation to exclude pathology is a conjugated bilirubin level (should be less than 30 micromols/L).

Severe jaundice after discharge:
For babies who develop jaundice after discharge, any TSB above treatment thresholds should be admitted directly to the newborn nursery or to the maternity unit with the mother for immediate investigation and phototherapy. They should not be admitted through the hospital emergency department where unnecessary delays may occur. This is particularly true in babies with TSB above the recommended exchange thresholds (see Figure 2) or a TSB of 428 micromol/L or more. This is a medical emergency.
15: Key Points

<table>
<thead>
<tr>
<th>Key Point</th>
<th>Level of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phototherapy is a safe, effective method for lowering serum bilirubin, and reduces the need for exchange transfusion</td>
<td>★★★★ 8</td>
</tr>
<tr>
<td>The level for starting phototherapy is based on observational data only but is set at a level below which it is thought there is a risk of kernicterus to allow for a therapeutic safety margin.</td>
<td>★ ★</td>
</tr>
<tr>
<td>Aggressive phototherapy in very preterm babies is associated with lower morbidity but possibly higher mortality in babies &lt;750g.</td>
<td>★★★★ 12</td>
</tr>
<tr>
<td>Early TcB and TSB predict subsequent risk of jaundice requiring phototherapy and should be used in early discharge risk assessment.</td>
<td>★★★★ 16,17</td>
</tr>
</tbody>
</table>


18.1 **NSW Health Policies**

*Neonatal – Jaundice identification and management in neonates ≥ 32 weeks GL2016_027*

18.1 **National Standard**

Standard 1 Governance for Safety and Quality in Health Service Organisations

Standard 7 Blood and Blood Products

Standard 9 Recognising and Responding to Clinical Deterioration in Acute Health Care

Is the baby at high risk of jaundice?
- Baby of mothers with known antibodies
- DAT +ve baby
- Baby with severe bruising or cephalohaematomas or subgaleal haemorrhages.
- Baby with a previous sibling with ABO incompatibility.
- Baby with a family history of G6PD.
- Baby born before 37 weeks.

No

- Visual monitoring for jaundice.
- Transcutaneous Bilirubin (TcB) on sternum if concerned.
- Check Total Serum Bilirubin (TSB) if TcB within 50µmol/l of phototherapy line.
- Pre-discharge risk assessment

Yes

- Routine TcB measurement on the sternum at 12, 24 and 48 hours.
- Refer to the table below.
- Perform a TSB if TcB above the age specific limits.
- Pre-discharge risk assessment

### Postnatal-age specific TcB for routine high risk monitoring only.

<table>
<thead>
<tr>
<th>TcB Monitoring Age</th>
<th>38 weeks and above</th>
<th>35 to 37 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 hours</td>
<td>Do TSB if TcB</td>
<td>Do TSB if TcB</td>
</tr>
<tr>
<td></td>
<td>&gt;70 µmol/L</td>
<td>&gt;45 µmol/L</td>
</tr>
<tr>
<td>24 hours</td>
<td>Do TSB if TcB</td>
<td>Do TSB if TcB</td>
</tr>
<tr>
<td></td>
<td>&gt;115 µmol/L</td>
<td>&gt;90 µmol/L</td>
</tr>
<tr>
<td>48 hours</td>
<td>Do TSB if TcB</td>
<td>Do TSB if TcB</td>
</tr>
<tr>
<td></td>
<td>&gt;170 µmol/L</td>
<td>&gt;140 µmol/L</td>
</tr>
</tbody>
</table>

TcB = Transcutaneous Bilirubin
TSB = Total Serum Bilirubin
Flow Chart 2: Pre-Discharge Jaundice Risk Assessment

1. Has the baby had inpatient TSB monitoring?
   - Yes
     - Measure a TcB on the sternum and plot the result on the phototherapy chart.
     - Is the TcB less than 50µmol/l below the gestation appropriate phototherapy line.
   - No
     - Discharge with usual pre-discharge jaundice advice.
     - Check TSB and plot on phototherapy chart.

2. If the TSB above the gestation appropriate phototherapy line then start phototherapy in consultation with neonatal medical/NNP staff.

3. If the TSB below the gestation appropriate phototherapy line but within 50µmol/L of the phototherapy line then plan post discharge monitoring with either
   - Home midwifery (e.g. MDSP) or
   - The jaundice clinic in consultation with neonatal RMO/NNP.

Discharge plan on those TSBs and usual pre-discharge advice:
- How to recognise more severe jaundice.
- Where to get advice if jaundice more severe
- If jaundice persists >14days
- Moth repellent (Naphthalene) risks.