Guideline

Ministry of Health, NSW
73 Miller Street North Sydney NSW 2060
Locked Mail Bag 961 North Sydney NSW 2059
Telephone (02) 9391 9000 Fax (02) 9391 9101
http://www.health.nsw.gov.au/policies/

Neonatal - Jaundice Identification and Management in Neonates ≥ 32 Weeks Gestation

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Summary This Guideline provides a framework for early identification of neonates ≥ 32 weeks gestation at risk of jaundice and provides guidance for appropriate care and management across the state. The Guideline assists clinicians to differentiate between pathological neonatal jaundice and those neonates with benign physiological jaundice and the appropriate treatment.

Author Branch Health and Social Policy

Branch contact Health and Social Policy Branch 02 94617174

Applies to Local Health Districts, Board Governed Statutory Health Corporations, Specialty Network Governed Statutory Health Corporations, Affiliated Health Organisations, Community Health Centres, NSW Ambulance Service, Public Health Units, Public Hospitals, NSW Health Pathology

Audience Staff of Maternity, Paediatric, Neonatal, Emergency, Biomedical, Pathology, Community Health, GPs

Distributed to Public Health System, Divisions of General Practice, Government Medical Officers, NSW Ambulance Service, Ministry of Health, Private Hospitals and Day Procedure Centres, Tertiary Education Institutes

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NSW GOVERNMENT Health

GUIDELINE SUMMARY

NEONATAL - JAUNDICE IDENTIFICATION AND MANAGEMENT IN NEONATES ≥ 32 WEEKS GESTATION

PURPOSE

This Guideline provides a framework for the early identification and management of jaundice in neonates ≥ 32 weeks gestation. Approximately 60% of neonates born at term and 85% of preterm neonates will develop jaundice. Many of these neonates will develop 'physiological jaundice', which is usually benign. However, when unconjugated serum bilirubin levels are too high, bilirubin can cross the blood brain barrier. Bilirubin is neurotoxic, particularly to the auditory nerve and basal ganglia, which can result in brain injury and lifelong disability. It is important therefore, to identify those neonates at risk of acute bilirubin encephalopathy and kernicterus.

KEY PRINCIPLES

This Guideline applies to all NSW Public Health Organisations providing care for neonates ≥ 32 weeks gestation which should include:

- The identification at birth of neonates with risk factors for neonatal jaundice
- Regular visual assessment from birth of all neonates
- Management of neonatal jaundice identified in the first 24 hours of age
- Management of neonatal jaundice identified ≥ 24 hours of age
- Follow-up care for neonates discharged at less than 3 days of age with risk factors for jaundice or jaundice at discharge
- Assessment and escalation of care for neonates with prolonged jaundice > 14 days of age in a term neonate, and beyond 21 days in a preterm neonate.

USE OF THE GUIDELINE

The Chief Executives of all NSW Local Health Districts are responsible for the implementation of this guideline within their services / facilities to ensure:

- Local processes and operating procedures are developed in line with this document to manage neonates ≥ 32 weeks gestation to ensure:
  - Prompt appropriate identification, management and escalation of neonatal jaundice
  - Equipment is used, maintained and its effectiveness is monitored
  - Discharge is planned and follow up processes are in place
  - Assessment and appropriate escalation of care for neonatal jaundice > 14 days of age in a term neonate and beyond 21 days in a preterm neonate.
- The Directors of Clinical Governance inform relevant staff in maternity, neonatal services and biomedical departments of this new Guideline

- Morbidity and mortality associated with neonatal jaundice is monitored and reviewed.

REVISION HISTORY

Version	Approved by	Amendment notes
November 2016 (GL2016_027)	Deputy Secretary, Strategy and Resources	New policy

ATTACHMENTS

1. Neonatal - Jaundice Identification and Management in Neonates ≥ 32 weeks Gestation: Guideline.

Neonatal - Jaundice Identification and Management in Neonates ≥ 32 Weeks Gestation

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1. BACKGROUND

Approximately 60% of neonates born at term and 85% of preterm neonates will develop jaundice[1,2]. Many of these neonates will develop 'physiological jaundice', which presents on day 3, peaks between 5 to 7 days of age and resolves by 14 days of age[2]. Physiological jaundice is usually benign. However, when unconjugated serum bilirubin (SBR) level is too high, bilirubin can cross the blood brain barrier. Bilirubin is neurotoxic, particularly to the auditory nerve and basal ganglia, which can result in brain injury and lifelong disability. It is important therefore, to identify those neonates at risk of acute bilirubin encephalopathy and kernicterus[1,2,3].

The clinical challenge is to differentiate the minority of neonates ≥ 32 weeks with pathological neonatal jaundice from the majority with benign physiological jaundice.

1.1 Scope

This document provides guidance to all clinicians responsible for the care of neonates who are born at ≥ 32 weeks gestation. This Guideline does not apply to neonates born at < 32 weeks who require neonatal specialist care.

1.2 Key definitions

1.2.1 Terminology

Should - indicates a recommended action that should be followed unless there are sound documented reasons for taking a different course of action.

Neonate - any baby from time of birth up to and including 28 days of age.

Preterm - a baby born before 37^{+0} weeks gestation.

Late preterm - a baby born between 34^{+0} and 36^{+6} weeks gestation.

Well neonate - a neonate, whose assessments are within normal range on the standard neonatal observation chart (SNOC).

Local paediatric-specific Clinical Emergency Response System (**CERS**) - a local **paediatric-specific** CERS protocol should be in place to define the process to escalate and access a senior medical officer or specialist paediatrician who has the care of the neonate incorporated in their scope of practice, and if required, specialty paediatric / neonatal expertise as per *PD2013_049_Recognition and management of patients who are clinically deteriorating.*

Urgent medical review - a bedside review by the most senior medical officer or specialist paediatrician responsible, as per local paediatric-specific CERS. Initial consultation may be by telephone to enable treatment to commence, however, a physical examination should occur as soon as possible.

Medical review - a bedside review should occur within six hours by the most senior medical officer responsible. Initial consultation may be by telephone to enable treatment to commence, however, a physical examination should occur within this time frame.

1.2.2 Jaundice

Jaundice - a yellowish staining of the skin and sclera.

Physiological jaundice - a common condition caused by the breakdown of fetal red blood cells combined with an immature liver that cannot effectively metabolise bilirubin and prepare it for excretion. Usually presents on day 3, peaks between days 5 to 7 and has resolved by 14 days of age[2].

Pathological jaundice - when non-physiological causes result in jaundice of the neonate, most commonly due to blood group incompatibility (ABO or rhesus blood group incompatibility). Other causes include sepsis, bruising, metabolic disorders or obstruction[2]. High conjugated fraction (> 20 micromol per litre (micromol/L) or > 20% of total SBR) is always pathological and should be investigated urgently.

Prolonged jaundice - jaundice persisting beyond 14 days of age in a term neonate and 21 days in a preterm neonate. It is more common in breast fed neonates[2].

Hyperbilirubinaemia - SBR measurement above that which requires treatment[2] to prevent encephalopathy and kernicterus.

Severe hyperbilirubinaemia - SBR measurement above exchange transfusion threshold line.

1.2.3 Bilirubin

Bilirubin - yellow pigment created in the body during the normal breakdown of red blood cells which leads to the production of unconjugated bilirubin[2].

Unconjugated bilirubin - the lipid-soluble form of bilirubin that binds to albumin and metabolised in the liver to form conjugated bilirubin[2]. Unconjugated bilirubin can cross the blood brain barrier in neonates and is potentially toxic to neural tissue. The measurement at which unconjugated bilirubin becomes toxic varies between neonates but certain risk factors increase the risk of acute bilirubin encephalopathy[2].

Conjugated bilirubin - unconjugated bilirubin is taken up by the liver cells and conjugated to form water-soluble bilirubin diglucuronide. This then passes through the gut and is excreted in the stools. Bilirubin can be reabsorbed from the stools remaining in the gut[2]. High conjugated fraction (> 20 micromol/L or > 20% of total SBR) is always pathological and should be investigated urgently.

Serum Bilirubin (SBR) - the measurement of the total conjugated and unconjugated bilirubin in the blood.

1.2.4 Bilirubin encephalopathy and kernicterus

Bilirubin encephalopathy - short or long term neurologic dysfunction caused by toxic unconjugated bilirubin crossing the blood-brain barrier. Signs and symptoms include: lethargy; hypotonia; poor suck; irritability; apnoea; abnormal posture (opisthotonos - rigid with back arched and retrocollis - head tilted backwards); high pitched cry; seizures and coma.

Kernicterus - the yellow staining caused by bilirubin deposited in the globus pallidus of the deep grey matter of the brain. It is a rare condition[2].

1.2.5 Phototherapy

Phototherapy - light energy used to convert bilirubin in the skin to a water soluble isomer that is excreted.

Fibre optic phototherapy - comprises a light generator, a fibre optic cable carrying light to a flexible light pad or blanket placed under or around the neonate.

Light emitting diode (LED) phototherapy - emits high intensity light in a narrow wavelength spectrum and produces minimal heat[4].

BiliBed - fluorescent tube, single light source positioned below the neonate in the cot while the neonate is wrapped in a therapy suit that exposes the back of the neonate to the light source (not recommended by the manufacturers for use in humidicribs).

Conventional phototherapy - a single fluorescent blue light unit positioned above the neonate[2].

Single light phototherapy (15 µW/nm/cm² to 30 µW/nm/cm^2) - one unit of phototherapy light; either fluorescent, LED or fibre optic phototherapy.

Multiple light phototherapy (> 30 µW/nm/cm^2) - more than one light source used simultaneously.

2. IDENTIFICATION, MEASUREMENT AND INVESTIGATION OF NEONATAL JAUNDICE

2.1 Identification and assessment

2.1.1 Universal surveillance and timing of visual assessments

Universal surveillance and timing of visual assessments (see Flowchart 1), is the responsibility of all clinical staff and includes:

- Identification at birth of neonates with risk factors for neonatal jaundice (see Table 1) who require planned, increased visual assessment, at least 3 times per day (recommended) for the first 24 to 48 hours. Visual assessment includes assessment of blanched skin (useful in all skin tones)[2] sclera and gums
- Regular visual assessment from birth of all neonates for jaundice at least daily as part of the newborn wellbeing assessment to identify neonates who become jaundiced
- Neonates who are jaundiced should be monitored for adequacy of oral intake. Providing lactation advice and support of breast feeding mothers is an important risk reduction strategy for hyperbilirubinaemia
- Neonates who are jaundiced ≤ 24 hours of age should have bilirubin measurement and urgent medical review in line with *PD2013_049_Recognition and management of patients who are clinically deteriorating* and the SNOC. Concerns should escalated as per local CERS
- Neonates identified as jaundiced ≥ 24 hours of age should have a medical review (see section 2.2 Measurement) and an SBR if their transcutaneous bilirubinometer (TcB) reading is ≥ 250 micromol/L or if staff or parents are concerned
- As neonatal jaundice usually peaks between 5 and 7 days of age, it is advised that all neonates are assessed regularly during this period. For those neonates discharged less than 3 days of age, guidance for timing of follow-up of neonates, with or without risk factors, is provided in Table 11 (see section 5.1 Timing of follow-up)
- Neonates with prolonged jaundice > 14 days of age require urgent medical review and bilirubin measurement
- All jaundiced neonates should be monitored for the presence of signs suggestive of early bilirubin encephalopathy.

2.1.2 Risk factors and causes of neonatal jaundice

Table 1: Risk Factors and Causes of Neonatal Jaundice	
Jaundice < 24 hours of age - *Suspect haemolysis until proven otherwise*	
Jaundice due to haemolysis	Immune - e.g. ABO blood group incompatibility, Rhesus disease, Kell, Duffy, anti-E (see section 3.4) Non-immune - e.g. Glucose-6-phosphate dehydrogenase deficiency (G6PD)
Individual neonatal risk factors	• Prematurity • Asphyxia • Apgar < 7 at 5 minutes, acidosis pH < 7 or base excess ≤ 12 mEq/L • Low serum albumin < 30g/L • Sepsis or congenital infections • Maternal diabetes • Cephalohaematoma / bruising • History of sibling who was jaundiced as a neonate • G6PD risk - family history or with exposure to trigger (see below)
Jaundice in the first 7 days of age – *Investigate high SBR and possible underlying causes*	
Typical neonatal jaundice	• Physiological jaundice • Neonates with delayed (versus early) cord clamping, may have a higher haematocrit and therefore an increased incidence of jaundice requiring phototherapy[5]
Breast feeding jaundice	• Early breast feeding jaundice. Develops within 2 to 4 days of birth and is thought to relate to infrequent breast feeding with a limited fluid intake • Possible increased reabsorption of bilirubin from the bowel
Breakdown of extravasated blood	• Significant bruising • Cephalohaematoma • Intracranial haemorrhage
Increased enterohepatic circulation	• Delayed passage of stool or gut obstruction
Red cell membrane defects	• Spherocytosis • Elliptocytosis
Prolonged jaundice after 2 weeks of age - *should be investigated measuring total and conjugated SBR.*	
Unconjugated hyperbilirubinaemia	• Breast milk jaundice (rare - can last up to 12 weeks) • Sepsis • Hypothyroidism (thyroid agenesis/dysplasia or hypopituitarism) • G6PD • Rarely, inborn deficiency of UDP-glucuronyltransferase enzyme in Crigler-Najjar Syndrome and related disorders
Conjugated hyperbilirubinaemia	• Idiopathic neonatal hepatitis • Infections (Hepatitis B, sepsis, non-bacterial congenital infection) • Congenital biliary tract obstruction (biliary atresia, choledochal cyst, bile duct stenosis) • Metabolic disorders (galactosaemia, hereditary fructose intolerance, Alpha-1 antitrypsin deficiency, tyrosinemia, glycogen storage disease type IV, hypothyroidism)
Onset at any time	
Secondary to sepsis	• Can occur following onset of sepsis (both early and late onset) • May have both raised unconjugated and conjugated bilirubin components of SBR
Glucose-6-phosphate dehydrogenase deficiency (G6PD)	• Can occur any time following exposure to a trigger such as naphthalene (moth balls), fava beans, sepsis and hypothermia.

2.2 Measurement

2.2.1 Non-invasive transcutaneous bilirubinometer (TcB) measurement

The main goal of TcB measurement is to identify more accurately those jaundiced neonates who need an SBR[6,7] and to reduce the number of invasive tests required. In the first instance a TcB measurement should be used if possible for the well neonate who is jaundiced at:

- ≥ 35^{+0} weeks gestation at birth and
- ≥ 24 hours of age.

2.2.2 Serum bilirubin measurement

SBR measurement remains the 'gold standard' for jaundice treatment decisions[8].

An SBR should be measured if:

- A TcB is not available[2]
- The TcB measurement is ≥ 250 micromol/L, or the result is on, or within 20 micromol/L of the phototherapy threshold line for gestation at birth (see section 2.2.3 Plotting bilirubin measurement and assessment for treatment)
- The neonate is:
  - Unwell
  - < 35 weeks gestation at birth
  - < 24 hours of age (see section 2.3 Investigation)
  - Undergoing phototherapy or has undergone phototherapy (there is insufficient evidence to recommend the use of TcB after phototherapy)[9].

It is essential to follow up bilirubin results in a timely way or ensure clinical handover of requirement to follow up.

Both venous and capillary total SBR results should be considered equivalent measures[1,2]. The total SBR should be used to determine appropriate treatment[1,2] rather than the unconjugated fraction of bilirubin.

If the SBR is < 50 micromol/L below the phototherapy treatment threshold line repeat the SBR within 12 to 24 hours.

2.2.3 Plotting bilirubin measurement and assessment for treatment

Accurate data entry of the TcB or total SBR measurement, plotted on **the appropriate** Neonatal Jaundice Treatment Threshold Graph for gestational age at birth[10] (see attachments 1-7) is essential to:

- Monitor the progression of neonatal jaundice
- Identify hyperbilirubinaemia and support decision to treat
- Monitor the effect of treatment and inform clinical decision making.

The appropriate jaundice treatment threshold graph for gestational age at birth should not be changed for the corrected gestation.

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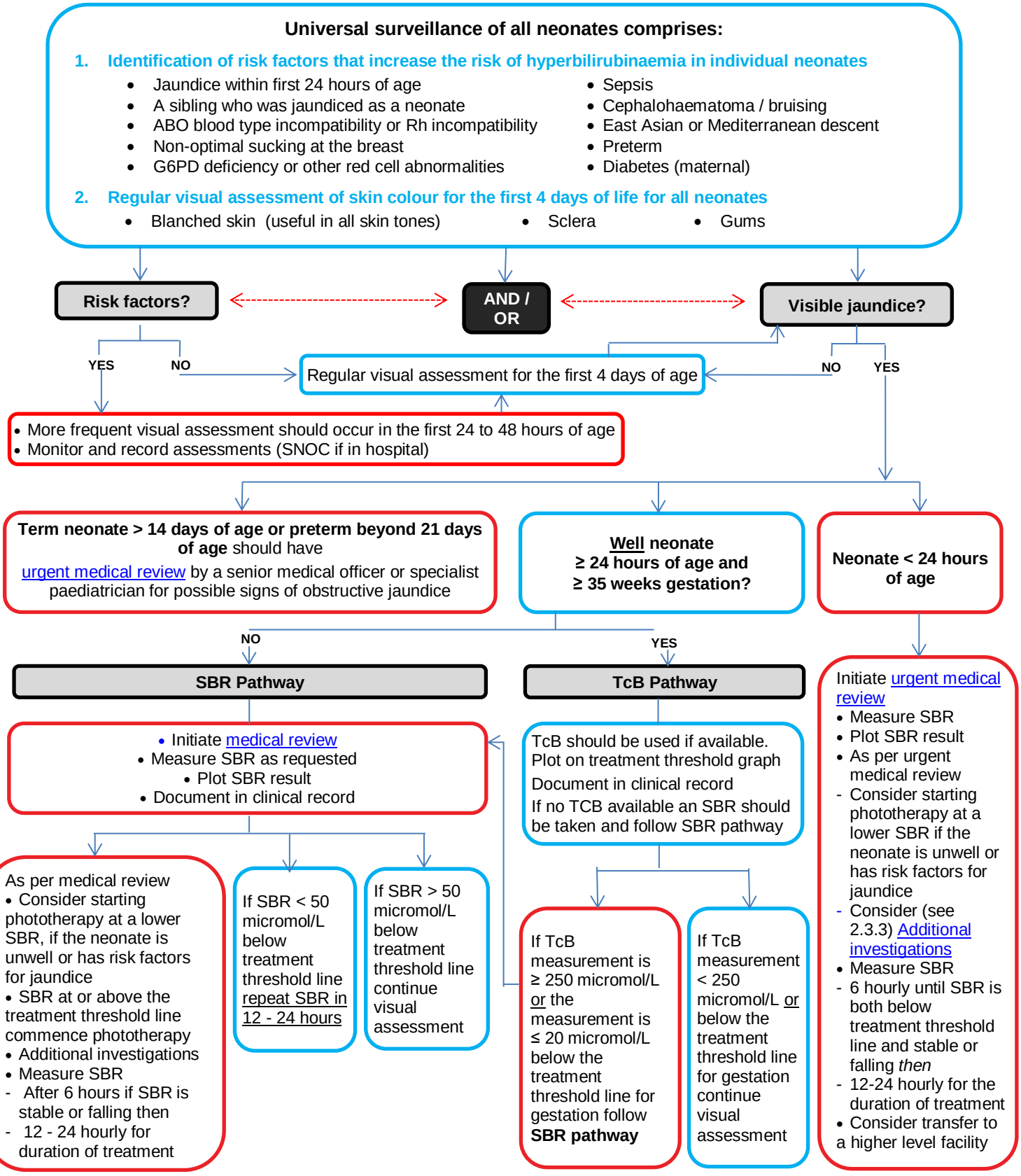
Flowchart 1: Identification and Investigation of Neonatal Jaundice



A neonate who has severe hyperbilirubinaemia or whose SBR is rapidly rising (> 8.5 micromol/L/hour) or who has any signs and symptoms of bilirubin encephalopathy is considered a medical emergency and should have an urgent medical review as per local paediatric-specific CERS.

2.3 Investigation

2.3.1 Urgent investigation of the neonate with visible jaundice < 24 hours of age

Table 2 outlines steps to identify and investigate the neonate with visible jaundice < 24 hours of age (see also Flowchart 1: Identification and Investigation of Neonatal Jaundice).

Table 2: Urgent Investigation of the Neonate with Visible Jaundice < 24 Hours of Age

Step	Action
1	Initiate urgent medical review by the most senior medical officer or specialist paediatrician responsible as per local CERS protocol. The initial consultation may be by telephone to order investigations and enable treatment to commence, however, a medical review at the bedside should occur as soon as possible
2	Measure and plot the SBR as per section 2.2 Measurement [2] and Flowchart 1: Identification and Investigation of Neonatal Jaundice
3	Measure and record any Additional Investigations recommended in section 2.3.3
4	Commence phototherapy
5	Measure the SBR at least every 6 hours until the SBR is both[2] • Below the treatment threshold and • Stable and / or falling
6	Measure and record SBR every 12 - 24 hours for the duration of phototherapy
Consider starting phototherapy at a lower SBR, if the neonate is < 24 hours of age, has risk factors of neonatal jaundice or is unwell	

2.3.2 Investigation of a neonate with visible jaundice ≥ 24 hours of age

Table 3 outlines the steps to identify and investigate the neonate with visible jaundice ≥ 24 hours of age (see also Flowchart 1 Identification and Investigation of Neonatal Jaundice).

Table 3: Investigation of a Neonate with Visible Jaundice ≥ 24 Hours of Age

Step	Action		
1	Where possible and if appropriate, the non-invasive TcB measurement should be used to determine if an SBR is required. If a TcB is not available an SBR should be taken[2]		
2	Measure and plot the neonatal bilirubin measurement as per section 2.2 Measurement[2] and Flowchart 1: Identification and Investigation of Neonatal Jaundice		
	If total SBR is at or above phototherapy treatment threshold	**If total SBR is rapidly rising**	**If total SBR is at or above exchange transfusion threshold**
3	Initiate a medical review	Initiate urgent medical review as per local CERS protocol	
	NOTE: Initial consultation may be by telephone to enable phototherapy treatment to commence, however, a bedside medical review should occur within 6 hours	**NOTE:** Initial consultation may be by telephone to enable phototherapy treatment to commence, however, a bedside medical review should occur as soon as possible	
4	Commence phototherapy and arrange Additional Investigations as recommended in section 2.3.3		
5	Measure the SBR at 6 hours to ensure the SBR is stable or falling		
6	When SBR is stable or falling, measure and record SBR every 12 - 24 hours for the duration of phototherapy		

2.3.3 Additional investigations to be considered in particular clinical situations

Table 4 outlines additional investigations to be considered in particular clinical situations

Table 4 Additional Investigations	
Clinical Feature	**Investigation**
Neonate of Rhesus negative mother	Blood group Direct Antiglobulin Test (DAT) An immediate SBR is required if the DAT is positive and the SBR is unknown
Neonate with jaundice within the first 24 hours of age **OR** Neonate with a rapidly rising total SBR (> 8.5 micromol/L/hour) **OR** Neonate with a total SBR above the phototherapy threshold	Full blood count (FBC) and film with reticulocyte count Blood group DAT Septic screen including blood and urine culture and sensitivity if sepsis suspected A G6PD screen if • There is a family history • This is a male neonate from a high risk ethnic origin/geographic area; African, Asian, Mediterranean and Middle Eastern[2] descent
The maternal blood group should be known and considered with the above investigations	
Neonate with a total SBR approaching exchange transfusion thresholds	• Serum albumin level • Liver function tests • Conjugated bilirubin
NOTE: Any neonate with a conjugated bilirubin > 20 micromol/L or > 20% of the total SBR[1], should have a medical review by the most senior medical officer or specialist paediatrician[11] (same day) and not discharged from hospital unless the cause is identified and treatment commenced.	

3. MANAGEMENT AND TREATMENT OF NEONATAL JAUNDICE

The decision to treat jaundice is based on:

- The bilirubin measurement plotted on the appropriate graph for gestational age and the proximity to:
  - The phototherapy treatment threshold line or
  - The exchange transfusion treatment threshold line
- The age at recognition of jaundice
- The clinical condition of the of the neonate
- Identified risk factors for jaundice.

Consideration should be given to starting phototherapy at a lower SBR if the neonate is < 24 hours of age, has risk factors for neonatal jaundice or is unwell

Treatment options will vary according to the services available at each facility. Treatment should encompass general management by a clinician skilled in neonatal care to assess the neonate, monitor the effectiveness of phototherapy (see Section 3.1.3) and treat any underlying illnesses that may be causing jaundice e.g. sepsis. If appropriate treatment is not available locally, transfer may be required.

Consultation, escalation and / or transfer to a higher level facility may be required. In these circumstances clinicians should:

- Follow local escalation processes in the first instance. This may involve contacting a specialist paediatrician and / or neonatologist in the Maternity and Neonatal Tiered Network with an appropriate service capability level
- Contact a neonatologist urgently either directly or via NETS (1300 36 2500) if the jaundice treatment required is an exchange transfusion.

Fully breast fed neonates with physiological jaundice can develop hyperbilirubinaemia associated with poor oral intake and/or dehydration[1]. By day 3 of life, 5-10% of fully breast fed neonates will lose 10% or more of their birth weight[1]. Ensuring adequate oral intake and appropriate lactation advice and support is therefore essential. It is preferable that expressed breast milk is given if additional feeds are required.

In some cases enteral or intravenous rehydration may be required for neonates under phototherapy with weight loss > 10% of birth weight and dehydration - see *GL2015_008 Standards for Paediatric Intravenous Fluids*

Sunlight is not a treatment option for jaundice.

3.1 Phototherapy

Phototherapy is the first line of treatment for neonatal jaundice and effectively reduces the SBR in most neonates. Clinical response to phototherapy depends on:

- The cause and severity of the hyperbilirubinaemia[12]
- The balance between the neonate's rate of bilirubin production, enterohepatic circulation, bilirubin elimination and degree of tissue bilirubin deposition
- The rate of the photochemical reactions of bilirubin
- The skin surface area exposed to phototherapy
- Phototherapy device efficacy[13,14] which can be influenced by multiple factors see Appendix B: Maximising Phototherapy Efficacy.

Each facility should have written information and established processes, in line with manufacturer's recommendations (see Section 3.1.3 Effectiveness of phototherapy and Appendix B: Maximising Phototherapy Efficacy) to guide:

- Clinical staff to set up, use and maximise the effectiveness of phototherapy
- Biomedical departments to measure light intensity and maintain the effectiveness of phototherapy equipment.

NOTE: At the time of this guideline publication there was no available high-quality evidence to support or refute the use of home phototherapy for uncomplicated physiological neonatal jaundice[13,15].

3.1.1 Contraindications to phototherapy

Contraindications for phototherapy include:

- Neonates with congenital porphyria
- Family history of porphyria
- Concurrent treatment with photosensitising drugs[12,13].

3.1.2 Potential adverse effects of phototherapy

Concerns regarding possible long term effects on the reproductive system from continuous phototherapy have been raised but have not been substantiated in animal studies[13]. Prolonged phototherapy is associated with increased[13]:

- Oxidative stress
- Lipid peroxidation
- Riboflavin deficiency
- Retinal damage (if eye protection recommendations are not followed)
- Eye trauma from eye protecting covers.

Recent clinical reports of other adverse outcomes have yet to be validated but potentially include skin changes[2]. Neonates who are not within phototherapy range should therefore not be treated.

3.1.3 Effectiveness of phototherapy (See Appendix B: Maximising Phototherapy Efficacy)

A review of the literature found that when used and maintained according to the manufacturer's instructions and when the light intensity is adequate:

- All modes of phototherapy are safe and effective as first-line medical treatment of hyperbilirubinaemia in preterm neonates[2]
- Conventional modes of phototherapy have been recommended for term neonates[2] however,
- Emerging evidence supports the use of LED phototherapy for term and near term neonates[16]
- The effect of fibre optic devices may be limited by the size of the device and the surface area of skin exposed[2].

It is essential to monitor the effectiveness of phototherapy (see section 2.2 Measurement) as some neonates, despite treatment, may require further medical intervention[2].

3.1.4 When to use single light phototherapy

Table 5 outlines appropriate clinical circumstances to use single light phototherapy.

Table 5: When to use Single Light Phototherapy (15µW/nm/cm² to 30µW/nm/cm²)

Use a single phototherapy light when

- The total SBR is at or above the phototherapy threshold as plotted on the appropriate Jaundice Treatment Threshold Graph for gestational age (See Attachment 1-7)
- The SBR is not rising rapidly
- The SBR is more than 50 micromol/L below the exchange transfusion threshold

Within 6 hours of commencing phototherapy the SBR should have decreased by 34 micromol/L in both the term and preterm neonate[13]

3.1.5 Clinical care of the neonate under single light phototherapy

Table 6 outlines clinical care considerations for neonates undergoing single light phototherapy.

Table 6 Clinical Care of the Neonate Under Single Light Phototherapy

Step	Action
Parent involvement	Parents are given clear information and are included in treatment and care planning decisions as well as care giving[2,17]
Location	Postnatal ward, special care nursery/non tertiary facility or Neonatal Intensive Care Unit (NICU)
Assessments	• Document input / output - loose stools are common (dark urine and or light stools may indicate obstructive causes of jaundice) • Bare weigh as necessary • Daily assessment of neonatal wellbeing should include assessment of skin integrity • Observe and record assessments 3-6 hourly on the SNOC and in clinical record
Monitoring	Use a cardio respiratory monitor or continuous oximetry when the neonate • Is cared for in a humidicrib • Is cared for in a position other than supine • Is receiving blue light phototherapy Record appropriately
Temperature	• Hourly for the first 3 to 4 hours and monitor and record on the SNOC • Then measure 3 - 6 hourly • Provide care in an environment that will maximise thermal stability and minimise energy expenditure taking into consideration the light source in use (e.g. LED phototherapy lights produce minimal heat). Consider using a humidicrib[2].
SBR measurement	• Repeat SBR 6 hours after commencement of phototherapy (the total SBR should be decreased by 34 micromol/L in this time period for both term and preterm neonates[13]) • Subsequent SBRs in line with neonatal age at recognition of jaundice see Table 2: Urgent investigation of the neonate with visible jaundice < 24 hours of age or Table 3: Investigation of the neonate with visible jaundice > 24 hours of age • If SBR is rapidly rising (> 8.5 mmol/L per hour) or continuing to rise under single light phototherapy consider changing to multiple light sources and earlier repeat of SBR • Repeat SBR 24 hours after phototherapy ceases
Feeding and hydration	• Demand breast feeding (maximum of 4 hour between feeds) • If formula feeding, recommend 3 - 4 hourly feeding • Phototherapy may be interrupted for feeding
Positioning	• Place the neonate in a supine position unless other clinical conditions prevent this[16]
Skin care	• Lotions or lubricants should not be used
Eye Care	• Eye protective mask/patches are mandatory for conventional light therapy (check placement) • If the neonate's eyes will not be directly exposed to BiliBed or fibre optic treatment lights eye protection is not required • Remove eye masks at feeds and check for eye discharge and conjunctivitis.
Surface area exposed	• Position phototherapy device according to manufacturer's instructions • Remove clothing but leave the nappy on for most single light and BiliBed phototherapy • Some fibre optic devices may be positioned next to the neonates skin under the singlet
Do **NOT** use a BiliBed in an humidicrib (see manufacturer's recommendations) Do **NOT** turn the humidicrib off during phototherapy (see manufacturer's recommendations) Plastic heat shields are no longer recommended for use	

3.1.6 Multiple light phototherapy

Evidence shows that multiple light phototherapy is more effective than conventional or single light phototherapy[2], and that it may reduce the need for exchange transfusion and possibly reduce the severity of bilirubin neurotoxicity[13]. This approach consists of delivering high levels of irradiance to the maximum skin surface (see Appendix B Maximising Phototherapy efficacy). The surface area exposed can be increased by using additional light banks and by combining devices such as a conventional phototherapy light bank plus fibre optic pads or a light emitting diode (LED) devices[13].

There is no evidence regarding the efficacy of intermittent phototherapy when multiple light phototherapy is required. Treatment should therefore not be interrupted for oral feeds[2] see Table 8 Clinical care of neonate under multiple light phototherapy.

Table 7 outlines the clinical circumstances in which to use multiple light phototherapy

Table 7: When to use Multiple Light Phototherapy (> 30µW/nm/cm²)

Initiate multiple light phototherapy to treat all neonates if any of the following applies

- The SBR is rising rapidly (> 8.5 micromol/L per hour)
- The SBR is < 50 micromol/L below the exchange transfusion treatment threshold line
- The SBR fails to respond to single light phototherapy (that is, the SBR is static, continues to rise, within 6 hours of starting single light phototherapy)
- A rapid reduction in SBR is required

Multiple light phototherapy will usually cause a high SBR to fall when due to physiological jaundice. If the SBR falls during multiple light phototherapy to 50 micromol/L below the threshold for which exchange transfusion is indicated, a step down to single light phototherapy should be considered.

3.1.7 Clinical care of the neonate under multiple light phototherapy

Table 8 details the clinical care for neonates undergoing multiple light phototherapy

Table 8: Clinical Care of Neonate when Undergoing Multiple Light Phototherapy Treatment

Step	Action
Parent involvement	As for parents of neonates under single light phototherapy
Location	Special care nursery / non tertiary facility or NICU
Assessments	As for neonates under single light phototherapy • Assess for the presence of signs suggestive of early bilirubin encephalopathy
Monitoring	As for neonates under single light phototherapy
Temperature	As for neonates under single light phototherapy
SBR measurement	• Repeat SBR 6 hours after commencement of phototherapy (the total SBR should be decreased by 34 micromol/L in this time period for both term and preterm neonates[13]) • Subsequent SBRs in line with neonatal age at recognition of jaundice see Table 2: Urgent investigation of the neonate with visible jaundice < 24 hours of age or Table 3: Investigation of the neonate with visible jaundice > 24 hours of age • If the SBR is rapidly rising (> 8.5mmol/L per hour) consider early repeat of SBR • Repeat SBR 24 hours after phototherapy ceases
Feeding and Hydration	• Phototherapy should not be interrupted for breast / bottle feeding • Consider administration of intravenous or enteral feeds • Expressed breast milk is the fluid of choice if additional fluids are required
Positioning	As for neonates under single light phototherapy If only one side of the neonate is exposed to phototherapy consider position change every 3-4 hours to maximise skin exposure
Skin care	• Lotions or lubricants should not be used

Eye care	As for single light phototherapy plus • Eye protective mask/patches are mandatory for multiple light phototherapy

Surface area exposed	Position phototherapy device according to manufacturer's instructions
	• Maximise skin surface area exposed to phototherapy (see Appendix B)
	  ◦ Remove head covers, clothes and nappy
	  ◦ Ensure phototherapy is not obstructed from reaching the neonate's skin, consider removal of tape, reposition chest leads.

Plastic heat shields are no longer recommended for use	

3.1.8 Ceasing phototherapy

The suggested total SBR measurement for ceasing phototherapy is ≥ 50 micromol/L below the phototherapy treatment line on the appropriate Jaundice Treatment Threshold Graph for gestational age at birth[1,2] (see Attachments 1-7).

A rebound in total SBR can occur after phototherapy is discontinued[2]. A clinically significant rebound is more likely in neonates who are < 37 weeks gestation, have known haemolytic disease or who have identified pathology. Check for rebound of hyperbilirubin by repeat SBR at 12 to 24 hours of age.

Neonates who do not have these risk factors do not need to delay discharge to assess for a rebound in total SBR. Instead consider follow-up SBR measurement within 12 to 24 hours after discharge (See Section 5: Discharge planning).

3.2 Adjunct therapy

The only adjunct therapy supported by evidence is the use of intravenous immunoglobulin in cases of Rhesus or ABO haemolytic disease [2,16].

Pharmacologic options should always be discussed with a neonatologist prior to treatment as per *PD2010_69_NSW Critical Care Tertiary Referral Networks (Perinatal)*.

3.2.1 Intravenous immunoglobulin (IVIG)

There is some evidence that intravenous immunoglobulin (IVIG) will reduce the need for exchange transfusions in neonates with immune haemolytic jaundice[18]. Consider using IVIG (500 mg/kg over 4 hours) as an adjunct to multiple light phototherapy in isoimmunised haemolytic disease when the SBR continues to rise by > 8.5 micromol/L per hour[2].

3.2.2 Other agents

The use of albumin is not currently recommended as an intervention for jaundice treatment. There is insufficient evidence to support its routine use as an adjunct therapy prior to exchange transfusion[16,19].

Agents such as metalloporphyrins, gammaglobulins, drugs (phenobarbitol, clofibrate, cholestyramine), agar, charcoal, suppositories, other rectal modes of treatment; and complementary or alternative medicines (e.g. Chinese herbal remedies such as Yin-chen) are not recommended for the treatment of neonatal hyperbilirubinaemia[2,16].

3.3 Exchange transfusion for severe hyperbilirubinaemia

A neonate who has severe hyperbilirubinaemia or whose SBR is rapidly rising or who has signs and symptoms of bilirubin encephalopathy is considered a medical emergency and should have an urgent medical review by the most senior medical officer or specialist paediatrician as per the local paediatric-specific CERS protocol.

3.3.1 When to undertake an exchange transfusion

Exchange transfusion may be appropriate in the following clinical circumstances and care should be escalated accordingly where:

- The total SBR is above the exchange transfusion threshold when plotted on the Jaundice Treatment Threshold Graph for gestational age see Attachments 1-7
- SBR is rising > 8.5 micromol/L per hour despite multiple light phototherapy in a neonate with known haemolysis OR
- There are signs of bilirubin encephalopathy (see section 1.2.4).

3.3.2 Where to undertake an exchange transfusion

Table 9 provides information in relation to the most appropriate place to undertake an exchange transfusion and lists important considerations.

Table 9: Where to Undertake an Exchange Transfusion

Exchange transfusions should be carried out at a level 5 or 6 NICU (see *GL2016_018 NSW Maternity and Neonatal Service Capability Framework.*

When anticipated, antenatal referral is recommended for care planning including the appropriate place of birth.

If the neonate presents at the Emergency Department or at lower level neonatal facility consult a neonatologist within the Tiered Maternity and Neonatal Network *PD2010_069 NSW Critical Care Tertiary Referral Networks (Perinatal)* regarding treatment.

Consider the need for urgent transfer to a level 5 or 6 NICU facility if the baby is systemically unwell and contact NETS (Newborn and Paediatric Emergency Transport Service) 1300 36 2500.

A systemically unwell neonate	The risks of exchange transfusion are much higher in a systemically unwell neonate Consider transfer to a NICU in this situation
Staff availability	A minimum of two staff members (nurse/midwife and doctor) are required to remain at the bedside for the duration of the exchange transfusion
Staff capacity	A clinician with the skills to perform an exchange transfusion should be available. This includes the capacity to insert an umbilical venous catheter (UVC). If the skills are not available locally, the regional paediatric- specialist may be able to attend
Availability of blood	As exchange transfusion is a medical emergency, low titre O negative blood is used but only in consultation with a neonatologist

3.3.3 Clinical care of the neonate undergoing exchange transfusion

Table 10 outlines clinical care required by the neonate undergoing exchange transfusion.

Table 10: Clinical Care of Neonate Undergoing Exchange Transfusion

NOTE: Multiple light phototherapy treatment (if not in progress) should be commenced immediately and continue throughout the exchange transfusion.

Clinical care	**Tertiary facility (NICU)** Complete all clinical care and assessments as per local guidelines **Non tertiary facility** Follow *Neonatal Exchange Transfusion in a Non-Tertiary Hospital - How to guide* available on the NSW Pregnancy and Newborn Services Network website www.psn.org.au for all recommended clinical care and assessments during exchange transfusion The insertion of a UVC remains a suitable option for up to 7-10 days post birth[20] If insertion of a UVC is not possible then a peripheral line will need to be inserted
Post exchange transfusion	• Maintain multiple light or high intensity phototherapy • Measure SBR within 2 hours of completion of the exchange transfusion • Continue under the care of a neonatal specialist. **Tertiary facility (NICU)** Complete all clinical care and assessments as per local guidelines post exchange transfusion. **Non tertiary facility** Follow *Neonatal Exchange Transfusion in a Non-Tertiary Hospital - How to guide* available at the NSW Pregnancy and newborn Services Network website www.psn.org.au for all recommended clinical care post exchange transfusion

3.4 Management of neonates with known in utero rhesus sensitisation

All neonates with known isoimmunisation prior to birth should be birthed at a tertiary facility with an NICU. Transfer if birth has occurred at a lower level facility.

The following investigations should be completed at birth on cord blood:

- Blood group
- FBC
- DAT
- SBR
- If affected, have blood ready for exchange transfusion.

3.4.1 Without in-utero transfusion

For neonates who have not received an in-utero transfusion the threshold for a rapidly rising total SBR remains > 8.5 micromol/L per hour.

If initial SBR result is ≥ 80 micromol/L commence single light phototherapy. Consider multiple light phototherapy, immunoglobulin and early exchange transfusion[1].

3.4.2 With in-utero transfusion

For neonates who have had an in-utero transfusion the criteria for an exchange transfusion should be decided on a case by case basis by a neonatologist experienced in the management of neonates with known Rhesus disease.

4. PROLONGED JAUNDICE

Jaundice persisting beyond the first 14 days of life in a term neonate or beyond 21 days of life in a preterm neonate should have an urgent medical review by the most senior medical or specialist paediatrician for signs of obstructive jaundice.

The initial investigations should include:

- Assess stool colour - look for acholic pale chalky stools
- Assess urine - look for dark urine that stains the nappy
- Complete the following tests:
  - Total bilirubin
    - Conjugated bilirubin
  - FBC to exclude a red cell structural problem (e.g. spherocytosis)
  - Blood group (if not already done)
  - Confirm maternal blood group
  - DAT (if not already done) and interpret the result of the DAT taking account of the strength of reaction, and whether or not the mother received prophylactic anti-D immunoglobulin during pregnancy
  - Urine culture
  - Thyroid function tests including TSH and Free T4.

Conjugated bilirubin < 20 micromol/L is usually benign breast milk jaundice, however specific investigations may be considered e.g. metabolic screen; G6PD screen

Conjugated bilirubin > 20 micromol/L or > 20% of the total SBR is always pathological and should be investigated for intra-hepatic and obstructive causes.

Delay in diagnosis of biliary atresia is an important prognostic factor. Early discussion with a gastroenterologist is essential. Where local services are not available, it is important to refer the neonate to a tertiary paediatric critical care centre able to investigate and in particular, to exclude biliary atresia.

See NSW Health Policy Directive *PD2010_69 NSW Critical Care Tertiary Referral Networks (Perinatal)* and *PD2010_030 Critical Care Tertiary Referral Networks (Paediatrics)*

5. DISCHARGE PLANNING

Hyperbilirubinaemia is a potentially preventable cause of 35% of early readmissions of neonates, with higher rates among late preterm neonates[21,22].

Individual evaluation of each mother-neonate dyad to determine the optimal time of discharge and the follow-up required is essential. LHDs are responsible for the development of local process for follow up assessment of the neonate including providing the location of that service and a process for escalation of concerns about the ongoing care of the neonate with jaundice. Midwives, early childhood nurses and general practitioners should be aware that jaundice in the term neonate peaks between 5 to 7 days of age and if discharged prior to this time may require further assessment after discharge.

A recent study in NSW found that birth at 37 and 38 weeks gestation with a length of stay (LOS) of 0 to 2 days increased the risk of readmission for treatment of hyperbilirubinaemia compared with birth at 39 weeks gestation and LOS of 3 to 4 days[22]. Significant factors related to neonatal readmission for hyperbilirubinaemia include neonates discharged 0 to 2 days of age, vaginal birth, being born to a mother from an Asian country, being born to a first-time mother, or breast feeding at discharge.

The risk of unrecognised severe hyperbilirubinaemia is also increased if:

- There are gaps in clinical handover between hospital and community-based clinicians
- It is unclear who is responsible for the neonate's healthcare in the first days after discharge
- Parents or caregivers do not know what to look for
- Parents or caregivers do not know when, or how, to access a health care professional for review of their neonate's progress after discharge[11,23].

It is therefore important that a comprehensive discharge plan is formulated with parents or caregivers of neonates at risk of hyperbilirubinaemia (in line with *PD2009_060 Clinical Handover – Standard Key Principles)*.

5.1 Timing of follow-up

Table 11 outlines the recommended maximum timing for post hospital discharge follow-up by clinicians of neonates with or without risk factors for hyperbilirubinaemia; who are jaundiced or who have received phototherapy, based on their age at discharge.

Table 11: Timing of Follow-up

Age in hours at discharge	Neonate with risk factors for jaundice or who are jaundiced at discharge or who have received phototherapy	Neonate with no risk factors
Before 24 hours of age	By 48 hours of age	By 72 hours of age
Between 24 and 48 hours of age	By 72 hours of age	By 96 hours of age
Between 49 and 72 hours of age	By 96 hours of age	By 120 hours of age

Adapted from American Academy of Pediatrics Subcommittee on Hyperbilirubinaemia[1]

5.2 Preparation for discharge and clinical handover

Table 12 outlines the preparation that maternity services should take prior to discharge of a neonate < 48 hours of age with risk factors for hyperbilirubinaemia (see Table 1), or who are jaundiced or who have required phototherapy treatment.

Table 12: Preparation for Discharge and Clinical Handover of Neonates < 48 Hours of Age With Risk Factors for Hyperbilirubinaemia or Who are Jaundice at Discharge or Who Have Received Phototherapy

Step	Action
1	If mother is Rh negative, review the neonate's results for • Blood group • DAT
2	A TcB as close to discharge as practical (**if the neonate has not been under phototherapy**[9]) An SBR should be completed[1] for neonates who have risk factors for hyperbilirubinaemia or have been under phototherapy
3	If the TcB measurement is • < 20 micromol/L below the treatment threshold line, measure bilirubin with an SBR If the SBR measurement is • < 50 micromol/L below phototherapy treatment threshold line consider delay of discharge and repeat the SBR in 12 to 24 hours or ensure the parents are aware of the need to repeat the SBR in line with local processes as outlined in point 4 below • > 50 micromol/L below the phototherapy threshold line at discharge then clinical follow-up is still necessary in line with Table 11. Such neonates may be discharged with planned clinical follow-up with consideration given for bilirubin measurement using either TcB or SBR as appropriate (see Section 2.2: Measurement)
4	Local processes should be in place for • Clinical follow-up at appropriate times in line with Table 11 • The measurement of bilirubin after discharge (see section 2.2 Measurement) • The location where follow-up is to occur e.g. in the home or in a community based setting • Clinicians to escalate concerns about the ongoing care of neonates with jaundice
5	Consider screening for G6PD deficiency pre-discharge if • There is a family history • This is a male neonate from a high risk ethnic origin/geographic area; African, Asian, Mediterranean, Middle Eastern[2] descent
6	Document all results in • The clinical record • The Personal Health Record (Blue Book) • The discharge summary
7	Provide parents or caregivers with • Personal Health Record (Blue Book) • Discharge summary • Copy of any letters of referral • Information sheet on jaundice in preferred language see Section 6 Information for parents and care givers • Details of any follow-up appointments

5.3 Preparation for discharge of neonates who are jaundiced or had phototherapy

All neonates who are jaundiced at discharge or who have received phototherapy should have a bilirubin measurement with either a TcB or an SBR prior to discharge as appropriate (see Section 2.2: Measurement).

This is particularly important to plan for discharge and clinical handover of neonates discharged < 48hours who have risk factors of hyperbilirubinaemia or who have received phototherapy as they require ongoing surveillance, planned and timely follow-up by a clinician[1] as outlined in Table 11 and Table 12.

5.4 Jaundice that develops after discharge from hospital

Neonates who develop jaundice after discharge from hospital should be referred for an urgent SBR by the clinician identifying the condition. If the result is above the phototherapy treatment threshold line on the Jaundice Treatment Threshold Graph for gestational age[1, 2] (see Attachments 1-7) the neonate requires urgent medical review, including investigation and readmission without delay.

Rapid readmission will follow local admission protocols developed in line with *PD2011_038 Children and infants - Recognition of a Sick Baby or Child in the Emergency Department* and *PD2009_055 Emergency Department - Direct Admission to Inpatient Wards.*

6. INFORMATION FOR PARENTS AND CAREGIVERS

6.1 Neonatal jaundice

Parents and caregivers play an important role in the detection of jaundice and the support of neonates who are jaundiced. Parents and caregivers should be involved in decisions regarding investigations, treatment and care[17] and should receive verbal and written information on jaundice irrespective of whether or not the neonate appears to be jaundiced. A fact sheet has been developed by the Sydney Children's Hospital Network and Kaleidoscope Fact Sheet: Jaundice in newborn babies May 2015 to inform parents and caregivers. This factsheet is available in the following languages:

- English
- Arabic
- Bengali
- Chinese Simplified
- Chinese Traditional
- Dari
- Dinka
- Farsi
- Hindi
- Japanese
- Khmer
- Korean
- Nepali
- Punjabi
- Somali
- Swahili
- Tamil
- Thai
- Turkish
- Urdu
- Vietnamese.

6.2 Glucose-6-phosphate dehydrogenase (G6PD) deficiency

On discharge, written information on G6PD deficiency should be given to all parents whose neonate has been diagnosed with this enzyme deficiency, or whose neonate may be at risk of G6PD if:

- There is family history
- This is a male neonate from a high risk ethnic origin/geographic area (African, Asian, Mediterranean and Middle Eastern)[2].

In Australia, approximately 5% of people from African, Asian, Mediterranean or Middle Eastern descent have G6PD deficiency. Affected neonates can develop massive haemolysis at virtually any time within hours of exposure to triggers such as:

- Clothes stored with moth balls containing naphthalene
- Fava beans - also called broad beans
- Sepsis
- Particular medication including some antibiotics.

Mothers who are breast feeding their neonate diagnosed with G6PD may need to avoid the substances and medications that can trigger haemolysis under the guidance of the medical officer caring for the neonate.

Exposure to these triggers most commonly occurs after discharge. A G6PD deficiency Fact Sheet in English is available from the Royal Children's Hospital Melbourne website. A multi-lingual NSW Health information sheet Naphthalene in Moth Balls and Toilet Deodorant Cakes is available from the NSW Multicultural Health Communication Service website.

Further advice on the health risks of naphthalene can be obtained 24 hours a day, 7 days a week Australia-wide from the NSW Poisons Information Centre on 13 11 26, or from local Public Health Units. Contact information for all NSW Public Health Units is available from NSW Health by telephone on 1300 066 055 or via the website and search facility at http://www.health.nsw.gov.au/Infectious/Pages/phus.aspx.

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8. APPENDIX A: ABBREVIATIONS

Appendix A: Abbreviations	
CERS	Clinical Emergency Response System
DAT	Direct antiglobulin test (also known as the Coombs test)
FBC	Full blood count
G6PD	Glucose-6-phosphate dehydrogenase
LHD	Local Health District
Micromol/L	Micromol per litre
NETS	Newborn and paediatric Emergency Transport Service (NETS NSW)
NICU	Neonatal Intensive Care Unit
PSN	Pregnancy and newborn Services Network
Rh	Rhesus antigen on red blood cells
SBR	Serum bilirubin
SCN	Special care nursery
SNOC	Standard neonatal observation chart
TcB	Transcutaneous bilirubin
UVC	Umbilical venous catheter
$\mu W.cm^{-2}nm^{-1}$	Light irradiance cm^2 - body surface area nm - light source

9. APPENDIX B: MAXIMISING PHOTOTHERAPY EFFICACY

Appendix B: Maximising Phototherapy Efficacy	
Phototherapy efficacy depends on three criteria • Effectiveness of the light source • Dose (light intensity or irradiance) of phototherapy administered • The skin surface area effectively illuminated by the phototherapy light	
Light source effectiveness	• Lights in the blue and blue-green spectrum on conventional devices have both been found to be effective[13,14]. Wavelengths in the blue-green spectrum (~460-490 nm) are effective with special blue being the most effective (~460 nm)[12] • Do not use white lights painted blue or covered with blue plastic sheaths[13] • Position the light as close to the neonate as manufacturer's instructions allow • Position the light rays perpendicular to the surface of the humidicrib to minimise reflectance and loss of efficacy[13] • Fibre optic phototherapy devices use a standard light source, usually a quartz halogen bulb. Filtered light passes through a fibre optic bundle into a pad of woven optic fibres that can be placed next to the neonate's skin[14]. The effect of fibre optic devices may be limited by the size of the device and the surface area of skin exposed[2] particularly when used for larger neonates
Dose of phototherapy administered	• Light intensity output (or irradiance) varies widely between devices and depends on factors such as the number and quality of bulbs, tubes or light sources[14] • Light intensity output is displayed on each device and is usually measured in microwatts per cm^2 of exposed skin ($\mu W/sq\ cm^2$), confirmed using the irradiance meter recommended by the device manufacturer, calibrated over the appropriate wavelength range[13] • Evidence suggests phototherapy increases effectiveness in a linear relationship from **20 to 55 $\mu W/cm^2/nm^{-1}$** and demonstrates a decrease in TcB after 24hrs of therapy. No evidence of saturation point was demonstrated [25] • Check phototherapy devices regularly as per local protocols in accordance with the manufacturer's instructions[13]. With use, the irradiance of all lamps decreases, so do not utilise beyond the manufacturer's useful-lifetime estimates[13] **NOTE: Heat generation from halogen or tungsten lights can cause a burn so manufacturer's instructions should always be followed for the minimum distance from the light to the neonate as this can vary from 25cm to 50cm[13]**
The skin surface area effectively exposed to phototherapy treatment	• Ensure the light is not obstructed by equipment or objects that decreases the exposed skin surface area, such as – Radiant warmers – Head covers – Large nappies – Large eye masks that cover large areas of the scalp – Tape – Electrode patches – Insulating plastic covers[13]

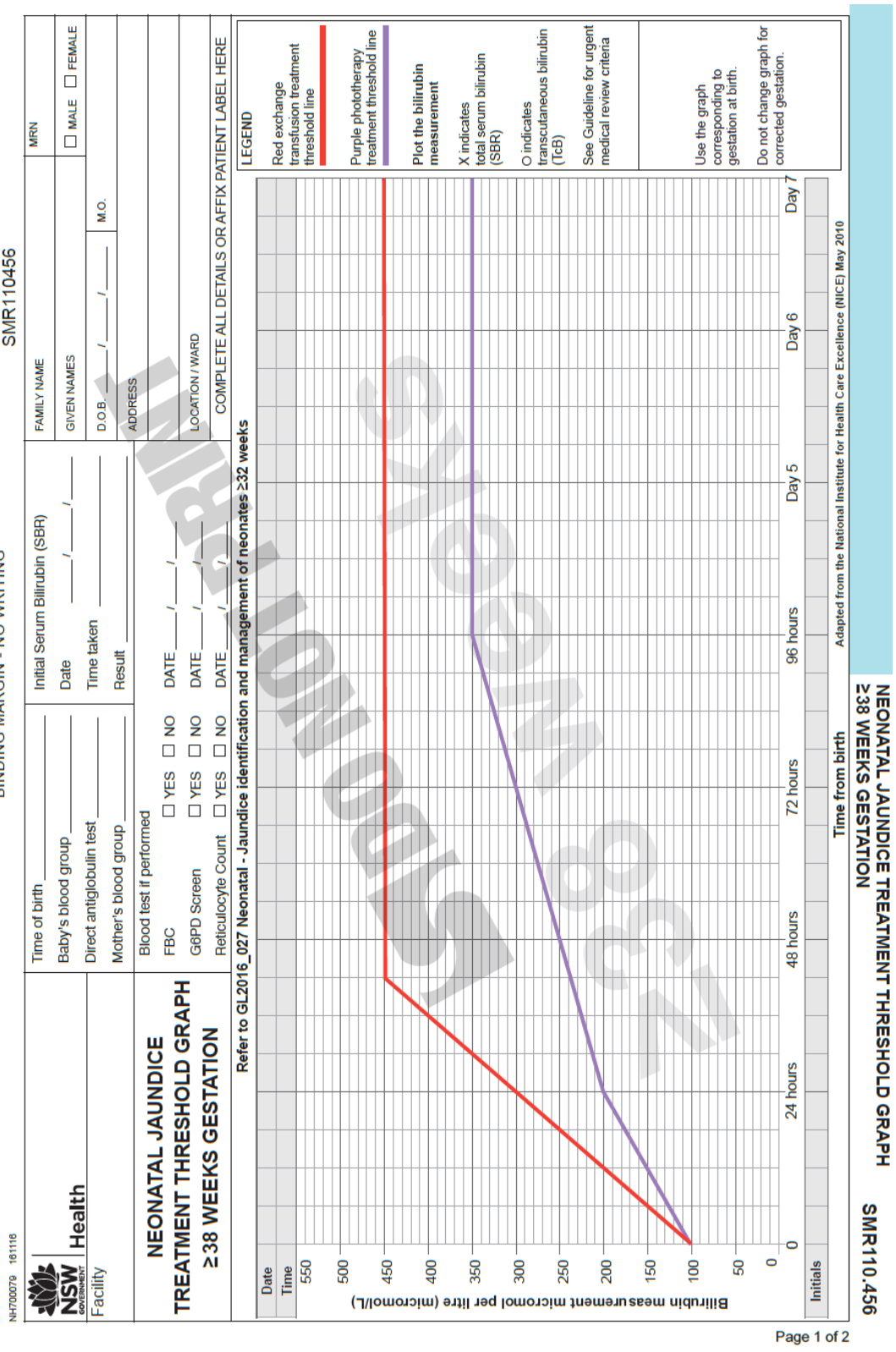
10. APPENDIX C: RELEVANT DOCUMENTS

Appendix D: Relevant Documents		
Type	**Publisher**	**Title**
Guideline	NSW Health	GL2016_018 Maternity and Neonatal Service Capability Framework
Policy Directive	NSW Health	PD2010_69 Critical Care Tertiary Referral Networks (Perinatal)
Policy Directive	NSW Health	PD2010_030 Critical Care Tertiary Referral Networks (Paediatrics)
Policy Directive	NSW Health	PD2011_015 Care Coordination: Planning from Admission to Transfer of Care in NSW Public Hospitals
Policy Directive	NSW Health	PD2009_060 Clinical Handover - Standard Key Principles
Policy Directive	NSW Health	PD2010_022 National Midwifery Guidelines for Consultation and Referral
Policy Directive	NSW Health	PD2011_038 Children and infants - Recognition of a Sick Baby or Child in the Emergency Department
Policy Directive	NSW Health	PD2009_055 Emergency Department - Direct Admission to Inpatient Wards
Policy Directive	NSW Health	PD2013_049_Recognition and Management of Patients Who are Clinically Deteriorating
Guideline	NSW Health	GL2008_015 Term Changeover - ensuring an effective handover of patient care
Resource	Pregnancy and newborn Services Network	Neonatal Exchange Transfusion in a Non-Tertiary Hospitals - How to guide
Resource	NSW Health	My Personal Health Record (Blue Book)
Resource	The Sydney Children's Hospitals Network and Kaleidoscope Hunter Children's Health Network.	Fact Sheet: Jaundice in newborn babies. Available in 20 languages
Resource	NSW Health	NSW Health: Naphthalene in moth balls and toilet deodorant cakes
Resource	Royal Children's Hospital Melbourne	G6PD Deficiency Fact Sheet 2011

11. ATTACHMENTS

NEONATAL JAUNDICE TREATMENT THRESHOLD GRAPHS

Attachment 1: Neonatal Jaundice treatment threshold graph 38 weeks gestation



NH700079 161116

NSW GOVERNMENT Health

Facility

NEONATAL JAUNDICE TREATMENT THRESHOLD GRAPH ≥38 WEEKS GESTATION

Use single light phototherapy if

- SBR is at or above the phototherapy treatment threshold line

Use multiple light phototherapy if

- SBR is rising rapidly (>8.5 micromol/L per hour)
- SBR is <50 micromol/L below the RED exchange transfusion line
- SBR fails to respond to single light phototherapy

If the SBR is rapidly rising or approaching the RED exchange transfusion treatment threshold line an urgent medical review should occur

FAMILY NAME	MRN
GIVEN NAMES	☐ MALE ☐ FEMALE
D.O.B. _____ / _____ / _____	M.O.
ADDRESS	
LOCATION / WARD	

COMPLETE ALL DETAILS OR AFFIX PATIENT LABEL HERE

Neonate with jaundice <24 hours of age or greater than 14 days of age should have urgent medical review and

- Measure the SBR and plot on the jaundice treatment threshold graph
- Urgent medical review will determine when to start phototherapy. Consider starting phototherapy at a lower SBR if the neonate has risk factors for neonatal jaundice (see *Table A*) or is unwell
- Measure the SBR every
  - 6 hours until the SBR is both below the phototherapy treatment threshold line and stable or falling, then
  - 12-24 hourly for the duration of treatment
- Consider
  - Additional investigations (see *Table B*)
  - Transfer to a higher level facility if appropriate

Neonate with jaundice ≥24 hours of age

- Do a transcutaneous bilirubin (TcB) if well and ≥35 weeks or
- Do an SBR if
  - Unwell or <35 weeks
  - The TcB is ≥250 micromol/L or
  - The TcB is <20 micromol/L below the treatment threshold line
- Medical review will determine when to start phototherapy. Consider starting phototherapy at a lower SBR if the neonate has risk factors for neonatal jaundice (see *Table A*) or is unwell
- If SBR <50 micromol/L below the phototherapy treatment threshold line repeat the SBR in 12-24 hours
- If SBR >50 micromol/L below the phototherapy treatment threshold line continue regular visual assessments
- If phototherapy is commenced measure SBR
  - After 6 hours to ensure SBR is stable or falling, then
  - Every 12-24 hours for the duration of treatment
- Consider
  - Additional investigations (see *Table B*)
  - Transfer to a higher level facility if appropriate

Table A Risk Factors and Causes of Neonatal Jaundice

Jaundice <24 hours of age - *Suspect haemolysis until proven otherwise*	
Jaundice due to haemolysis	Immune - e.g. ABO blood group incompatibility Rhesus disease, Kell, Duffy, anti-E Non-immune - e.g. G6PD
Individual neonatal risk factors	• Prematurity • Asphyxia • Apgar <7 at 5 minutes or acidosis pH <7 or base excess ≤12 mEq/L • Low serum albumin <30 grams per litre • Sepsis or congenital infections • Maternal diabetes • Cephalohaematoma / bruising • History of sibling who was jaundiced as a neonate • G6PD risk with family history or with exposure to trigger

Table B Additional Investigations

Clinical Feature	**Investigation**
Neonate of Rhesus negative mother	Blood Group Direct Antiglobulin Test (DAT) An immediate SBR is required if the DAT is positive and the SBR is unknown
Neonate with jaundice within the first 24 hours of age OR Neonate with a rapidly rising total SBR (>8.5 micromol/L per hour) OR Neonate with a total SBR above the phototherapy threshold	Full blood count (FBC) and film with reticulocyte Blood group DAT Septic screen including blood and urine culture & sensitivity if sepsis suspected A G6PD screen if • There is a family history • This is a male neonate with dark hair from a high risk ethnic origin/geographic area e.g. African, Asian Mediterranean and Middle Eastern descent
Identification of maternal blood group should also be considered with the above investigations	
Neonate with a total SBR approaching exchange transfusion thresholds	• Serum albumin level • Liver function tests • Conjugated bilirubin
A neonate of any gestation with a conjugated bilirubin >20 micromol/L or >20% of the total SBR, should have a medical review by the most senior medical officer (same day before discharge from hospital)	

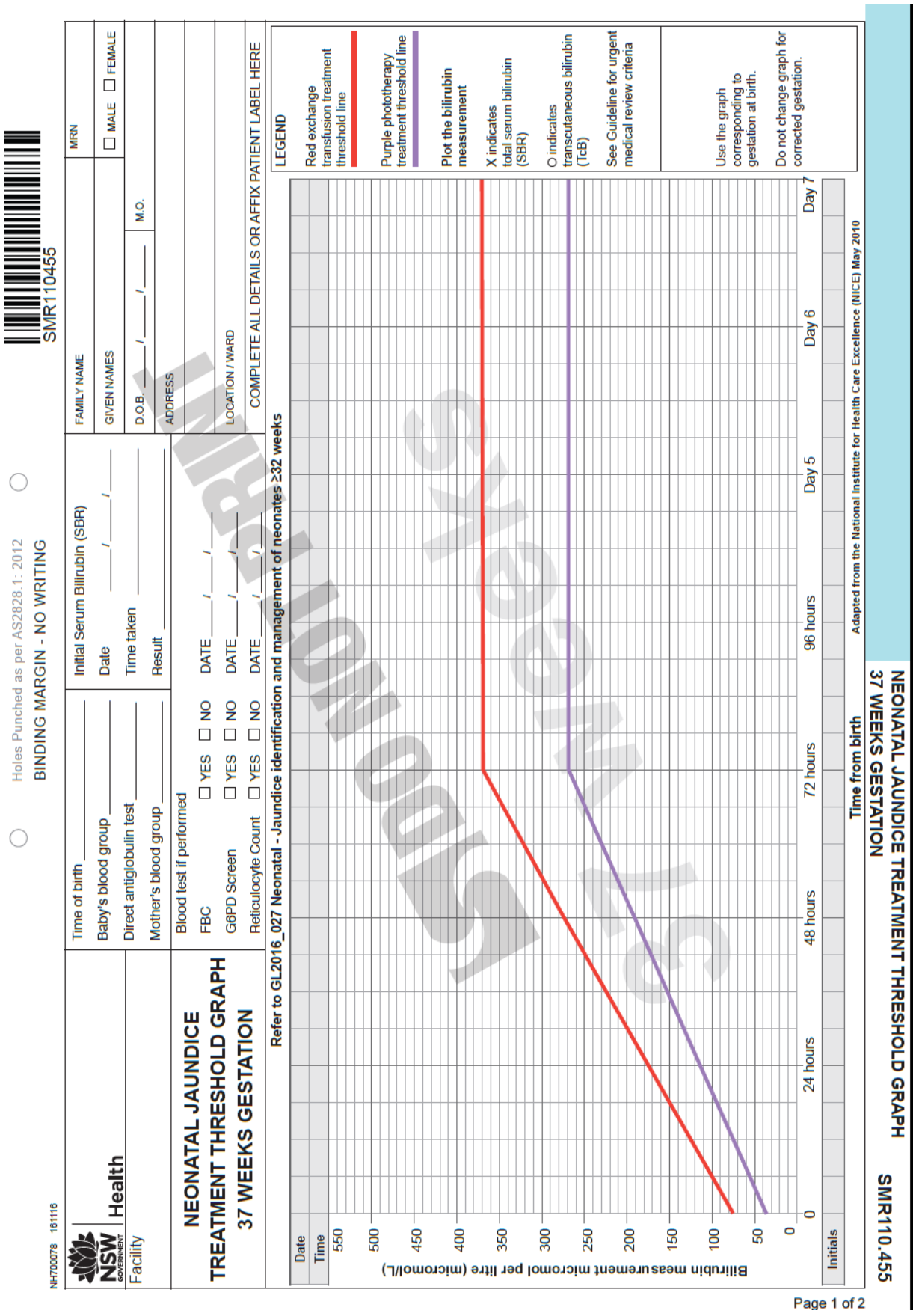
DO NOT PRINT

SMR110456

BINDING MARGIN - NO WRITING

Holes Punched as per AS2828.1: 2012

Attachment 2: Neonatal Jaundice treatment threshold graph 37 weeks gestation



NH700078 161116

NSW GOVERNMENT Health

Facility

NEONATAL JAUNDICE TREATMENT THRESHOLD GRAPH 37 WEEKS GESTATION

Use single light phototherapy if

- SBR is at or above the phototherapy treatment threshold line

Use multiple light phototherapy if

- SBR is rising rapidly (>8.5 micromol/L per hour)
- SBR is <50 micromol/L below the RED exchange transfusion line
- SBR fails to respond to single light phototherapy

If the SBR is rapidly rising or approaching the RED exchange transfusion treatment threshold line an urgent medical review should occur

FAMILY NAME	MRN
GIVEN NAMES	☐ MALE ☐ FEMALE
D.O.B. ____/____/____	M.O.
ADDRESS	
LOCATION / WARD	

COMPLETE ALL DETAILS OR AFFIX PATIENT LABEL HERE

DO NOT PRINT

Neonate with jaundice <24 hours of age or greater than 14 days of age should have urgent medical review and

- Measure the SBR and plot on the jaundice treatment threshold graph
- Urgent medical review will determine when to start phototherapy. Consider starting phototherapy at a lower SBR if the neonate has risk factors for neonatal jaundice (see *Table A*) or is unwell
- Measure the SBR every
  - 6 hours until the SBR is both below the phototherapy treatment threshold line and stable or falling, then
  - 12-24 hourly for the duration of treatment
- Consider
  - Additional investigations (see *Table B*)
  - Transfer to a higher level facility if appropriate

Neonate with jaundice ≥24 hours of age

- Do a transcutaneous bilirubin (TcB) if well and ≥35 weeks or
- Do an SBR if
  - Unwell or <35 weeks
  - The TcB is ≥250 micromol/L or
  - The TcB is <20 micromol/L below the treatment threshold line
- Medical review will determine when to start phototherapy. Consider starting phototherapy at a lower SBR if the neonate has risk factors for neonatal jaundice (see *Table A*) or is unwell
- If SBR <50 micromol/L below the phototherapy treatment threshold line repeat the SBR in 12-24 hours
- If SBR >50 micromol/L below the phototherapy treatment threshold line continue regular visual assessments
- If phototherapy is commenced measure SBR
  - After 6 hours to ensure SBR is stable or falling, then
  - Every 12-24 hours for the duration of treatment
- Consider
  - Additional investigations (see *Table B*)
  - Transfer to a higher level facility if appropriate

Table A Risk Factors and Causes of Neonatal Jaundice

Jaundice <24 hours of age - *Suspect haemolysis until proven otherwise*	
Jaundice due to haemolysis	Immune - e.g. ABO blood group incompatibility Rhesus disease, Kell, Duffy, anti-E Non-immune - e.g. G6PD
Individual neonatal risk factors	• Prematurity • Asphyxia • Apgar <7 at 5 minutes or acidosis pH <7 or base excess ≤12 mEq/L • Low serum albumin <30 grams per litre • Sepsis or congenital infections • Maternal diabetes • Cephalohaematoma / bruising • History of sibling who was jaundiced as a neonate • G6PD risk with family history or with exposure to trigger

Table B Additional Investigations

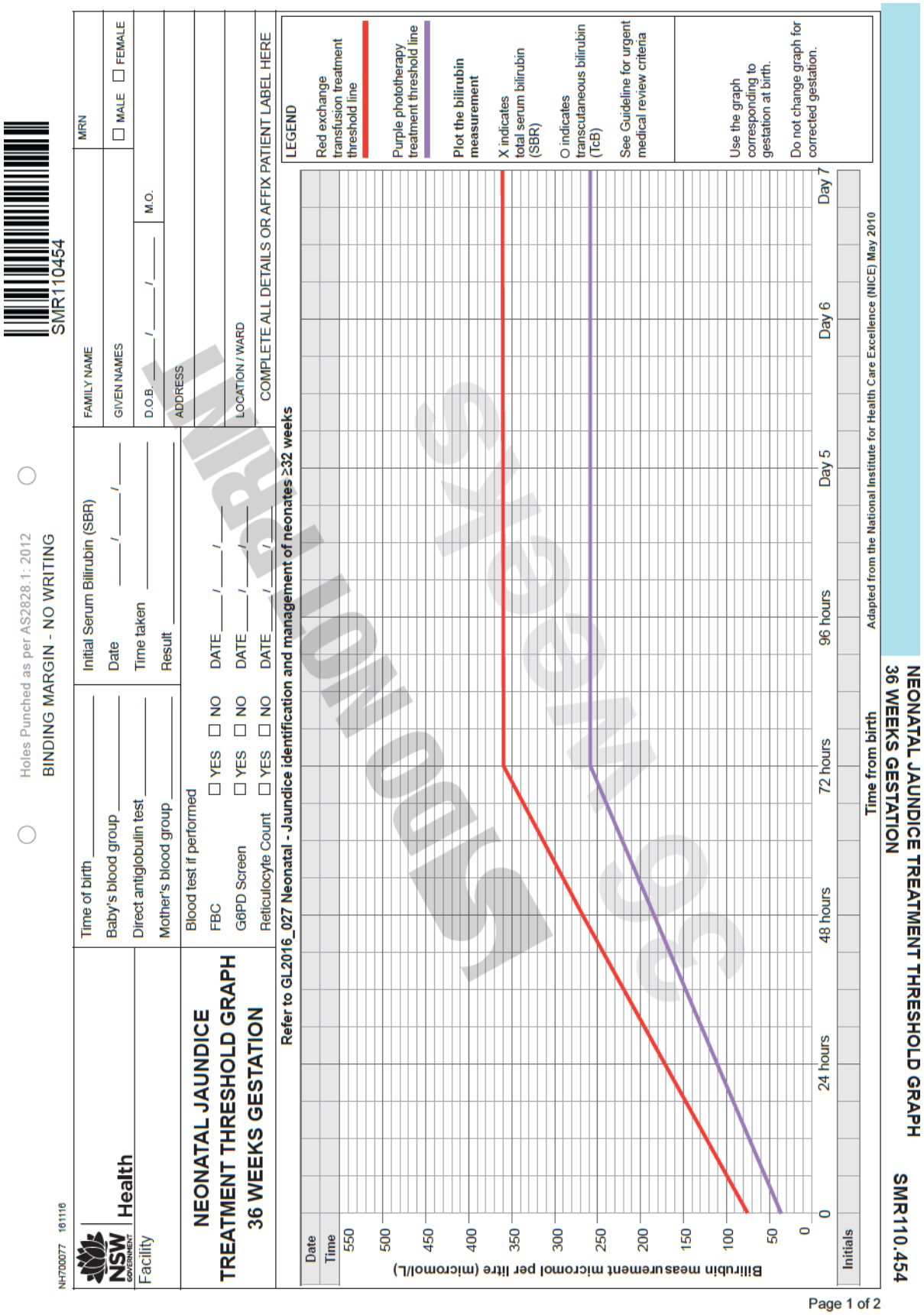
Clinical Feature	**Investigation**
Neonate of Rhesus negative mother	Blood Group Direct Antiglobulin Test (DAT) An immediate SBR is required if the DAT is positive and the SBR is unknown
Neonate with jaundice within the first 24 hours of age OR Neonate with a rapidly rising total SBR (>8.5 micromol/L per hour) OR Neonate with a total SBR above the phototherapy threshold	Full blood count (FBC) and film with reticulocyte Blood group DAT Septic screen including blood and urine culture & sensitivity if sepsis suspected A G6PD screen if • There is a family history • This is a male neonate with dark hair from a high risk ethnic origin/geographic area e.g. African, Asian Mediterranean and Middle Eastern descent
Identification of maternal blood group should also be considered with the above investigations	
Neonate with a total SBR approaching exchange transfusion thresholds	• Serum albumin level • Liver function tests • Conjugated bilirubin
A neonate of any gestation with a conjugated bilirubin >20 micromol/L or >20% of the total SBR, should have a medical review by the most senior medical officer (same day before discharge from hospital)	

SMR110455

BINDING MARGIN - NO WRITING

Holes Punched as per AS2828.1: 2012

Attachment 3: Neonatal Jaundice treatment threshold graph 36 weeks gestation



Uncontrolled when printed

NH700077 161116

NSW GOVERNMENT Health

Facility

NEONATAL JAUNDICE TREATMENT THRESHOLD GRAPH 36 WEEKS GESTATION

Use single light phototherapy if

- SBR is at or above the phototherapy treatment threshold line

Use multiple light phototherapy if

- SBR is rising rapidly (>8.5 micromol/L per hour)
- SBR is <50 micromol/L below the RED exchange transfusion line
- SBR fails to respond to single light phototherapy

If the SBR is rapidly rising or approaching the RED exchange transfusion treatment threshold line an urgent medical review should occur

FAMILY NAME	MRN
GIVEN NAMES	☐ MALE ☐ FEMALE
D.O.B. _____ / _____ / _____	M.O.
ADDRESS	
LOCATION / WARD	

COMPLETE ALL DETAILS OR AFFIX PATIENT LABEL HERE

Neonate with jaundice <24 hours of age or greater than 14 days of age should have urgent medical review and

- Measure the SBR and plot on the jaundice treatment threshold graph
- Urgent medical review will determine when to start phototherapy. Consider starting phototherapy at a lower SBR if the neonate has risk factors for neonatal jaundice (see ***Table A***) or is unwell
- Measure the SBR every
  - o 6 hours until the SBR is both below the phototherapy treatment threshold line and stable or falling, then
  - o 12-24 hourly for the duration of treatment
- Consider
  - o Additional investigations (see ***Table B***)
  - o Transfer to a higher level facility if appropriate

Neonate with jaundice ≥24 hours of age

- Do a transcutaneous bilirubin (TcB) if well and ≥35 weeks or
- Do an SBR if
  - o Unwell or <35 weeks
  - o The TcB is ≥250 micromol/L or
  - o The TcB is <20 micromol/L below the treatment threshold line
- Medical review will determine when to start phototherapy. Consider starting phototherapy at a lower SBR if the neonate has risk factors for neonatal jaundice (see ***Table A***) or is unwell
- If SBR <50 micromol/L below the phototherapy treatment threshold line repeat the SBR in 12-24 hours
- If SBR >50 micromol/L below the phototherapy treatment threshold line continue regular visual assessments
- If phototherapy is commenced measure SBR
  - o After 6 hours to ensure SBR is stable or falling, then
  - o Every 12-24 hours for the duration of treatment
- Consider
  - o Additional investigations (see ***Table B***)
  - o Transfer to a higher level facility if appropriate

Table A Risk Factors and Causes of Neonatal Jaundice

Jaundice <24 hours of age - *Suspect haemolysis until proven otherwise*	
Jaundice due to haemolysis	Immune - e.g. ABO blood group incompatibility Rhesus disease, Kell, Duffy, anti-E Non-immune - e.g. G6PD
Individual neonatal risk factors	• Prematurity • Asphyxia • Apgar <7 at 5 minutes or acidosis pH <7 or base excess ≤12 mEq/L • Low serum albumin <30 grams per litre • Sepsis or congenital infections • Maternal diabetes • Cephalohaematoma / bruising • History of sibling who was jaundiced as a neonate • G6PD risk with family history or with exposure to trigger

Table B Additional Investigations

Clinical Feature	**Investigation**
Neonate of Rhesus negative mother	Blood Group Direct Antiglobulin Test (DAT) An immediate SBR is required if the DAT is positive and the SBR is unknown
Neonate with jaundice within the first 24 hours of age OR Neonate with a rapidly rising total SBR (>8.5 micromol/L per hour) OR Neonate with a total SBR above the phototherapy threshold	Full blood count (FBC) and film with reticulocyte Blood group DAT Septic screen including blood and urine culture & sensitivity if sepsis suspected A G6PD screen if • There is a family history • This is a male neonate with dark hair from a high risk ethnic origin/geographic area e.g. African, Asian Mediterranean and Middle Eastern descent
Identification of maternal blood group should also be considered with the above investigations	
Neonate with a total SBR approaching exchange transfusion thresholds	• Serum albumin level • Liver function tests • Conjugated bilirubin

A neonate of any gestation with a conjugated bilirubin >20 micromol/L or >20% of the total SBR, should have a medical review by the most senior medical officer (same day before discharge from hospital)

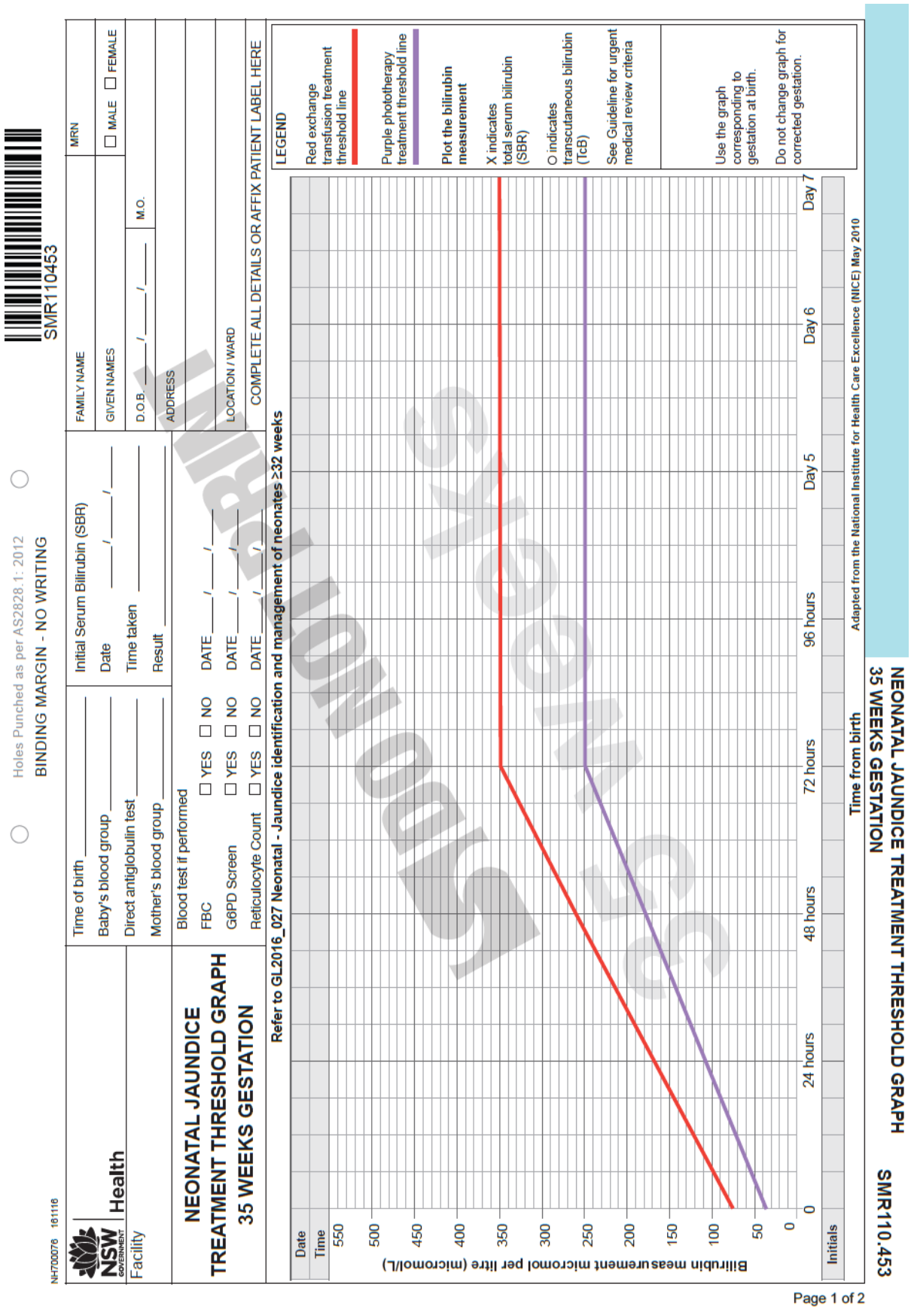
DO NOT PRINT

SMR110454

BINDING MARGIN - NO WRITING

Holes Punched as per AS2828.1: 2012

Attachment 4: Neonatal Jaundice treatment threshold graph 35 weeks gestation



NH700076 161116

NSW GOVERNMENT Health

Facility

NEONATAL JAUNDICE TREATMENT THRESHOLD GRAPH 35 WEEKS GESTATION

Use single light phototherapy if

- SBR is at or above the phototherapy treatment threshold line

Use multiple light phototherapy if

- SBR is rising rapidly (>8.5 micromol/L per hour)
- SBR is <50 micromol/L below the RED exchange transfusion line
- SBR fails to respond to single light phototherapy

If the SBR is rapidly rising or approaching the RED exchange transfusion treatment threshold line an urgent medical review should occur

FAMILY NAME	MRN
GIVEN NAMES	☐ MALE ☐ FEMALE
D.O.B. _____/_____/_____	M.O.
ADDRESS	
LOCATION / WARD	

COMPLETE ALL DETAILS OR AFFIX PATIENT LABEL HERE

Neonate with jaundice <24 hours of age or greater than 14 days of age should have urgent medical review and

- Measure the SBR and plot on the jaundice treatment threshold graph
- Urgent medical review will determine when to start phototherapy. Consider starting phototherapy at a lower SBR if the neonate has risk factors for neonatal jaundice (see ***Table A***) or is unwell
- Measure the SBR every
  - o 6 hours until the SBR is both below the phototherapy treatment threshold line and stable or falling, then
  - o 12-24 hourly for the duration of treatment
- Consider
  - o Additional investigations (see ***Table B***)
  - o Transfer to a higher level facility if appropriate

Neonate with jaundice ≥24 hours of age

- Do a transcutaneous bilirubin (TcB) if well and ≥35 weeks or
- Do an SBR if
  - o Unwell or <35 weeks
  - o The TcB is ≥250 micromol/L or
  - o The TcB is <20 micromol/L below the treatment threshold line
- Medical review will determine when to start phototherapy. Consider starting phototherapy at a lower SBR if the neonate has risk factors for neonatal jaundice (see ***Table A***) or is unwell
- If SBR <50 micromol/L below the phototherapy treatment threshold line repeat the SBR in 12-24 hours
- If SBR >50 micromol/L below the phototherapy treatment threshold line continue regular visual assessments
- If phototherapy is commenced measure SBR
  - o After 6 hours to ensure SBR is stable or falling, then
  - o Every 12-24 hours for the duration of treatment
- Consider
  - o Additional investigations (see ***Table B***)
  - o Transfer to a higher level facility if appropriate

Table A Risk Factors and Causes of Neonatal Jaundice

Jaundice <24 hours of age - *Suspect haemolysis until proven otherwise*	
Jaundice due to haemolysis	Immune - e.g. ABO blood group incompatibility Rhesus disease, Kell, Duffy, anti-E Non-immune - e.g. G6PD
Individual neonatal risk factors	• Prematurity • Asphyxia • Apgar <7 at 5 minutes or acidosis pH <7 or base excess ≤12 mEq/L • Low serum albumin <30 grams per litre • Sepsis or congenital infections • Maternal diabetes • Cephalohaematoma / bruising • History of sibling who was jaundiced as a neonate • G6PD risk with family history or with exposure to trigger

Table B Additional Investigations

Clinical Feature	**Investigation**
Neonate of Rhesus negative mother	Blood Group Direct Antiglobulin Test (DAT) An immediate SBR is required if the DAT is positive and the SBR is unknown
Neonate with jaundice within the first 24 hours of age OR Neonate with a rapidly rising total SBR (>8.5 micromol/L per hour) OR Neonate with a total SBR above the phototherapy threshold	Full blood count (FBC) and film with reticulocyte Blood group DAT Septic screen including blood and urine culture & sensitivity if sepsis suspected A G6PD screen if • There is a family history • This is a male neonate with dark hair from a high risk ethnic origin/geographic area e.g. African, Asian Mediterranean and Middle Eastern descent
Identification of maternal blood group should also be considered with the above investigations	
Neonate with a total SBR approaching exchange transfusion thresholds	• Serum albumin level • Liver function tests • Conjugated bilirubin
A neonate of any gestation with a conjugated bilirubin >20 micromol/L or >20% of the total SBR, should have a medical review by the most senior medical officer (same day before discharge from hospital)	

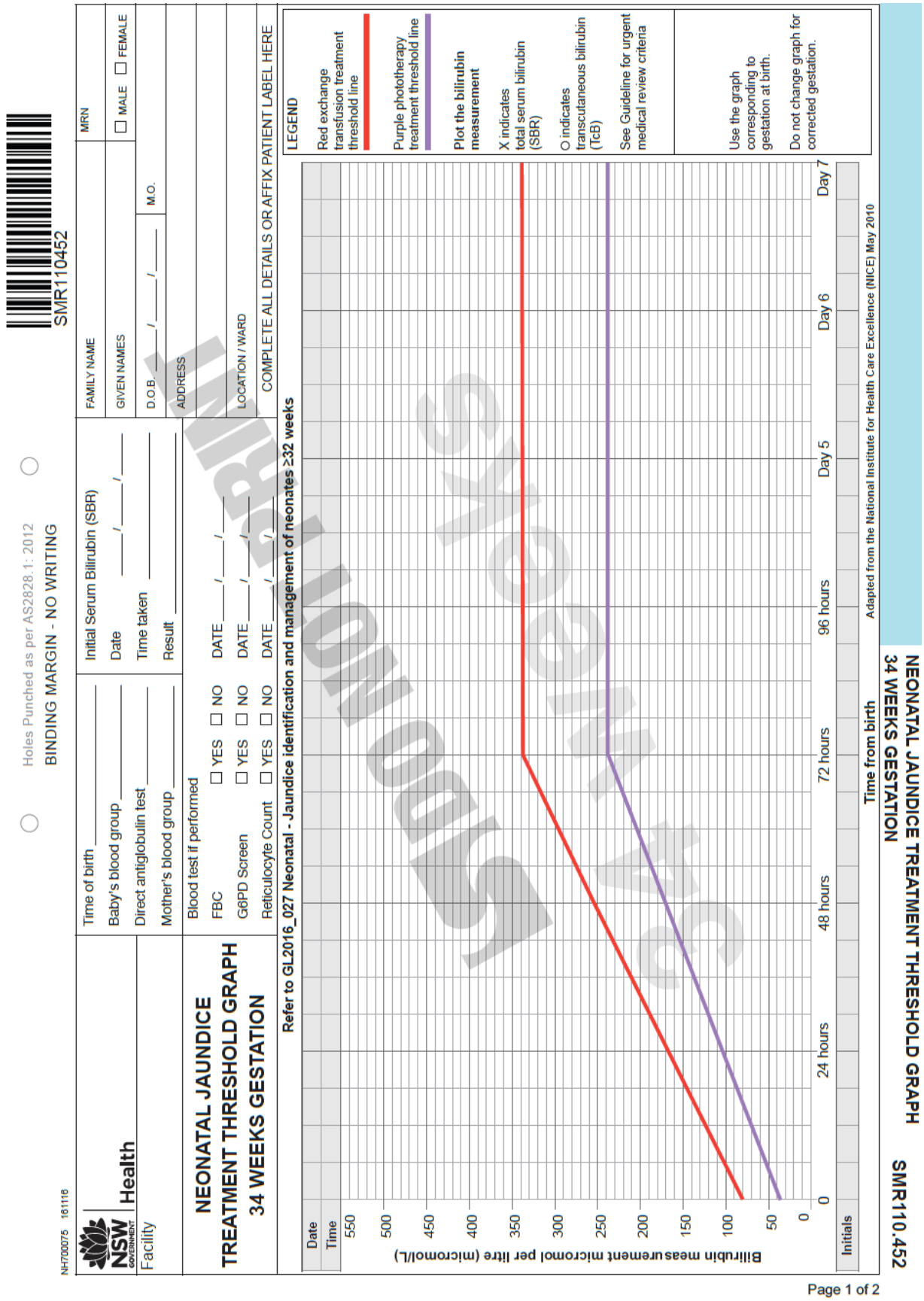
DO NOT PRINT

SMR110453

BINDING MARGIN - NO WRITING

Holes Punched as per AS2828.1: 2012

Attachment 5: Neonatal Jaundice treatment threshold graph 34 weeks gestation



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NH700075 161116

NSW GOVERNMENT Health

Facility

NEONATAL JAUNDICE TREATMENT THRESHOLD GRAPH 34 WEEKS GESTATION

Use single light phototherapy if

- SBR is at or above the phototherapy treatment threshold line

Use multiple light phototherapy if

- SBR is rising rapidly (>8.5 micromol/L per hour)
- SBR is <50 micromol/L below the RED exchange transfusion line
- SBR fails to respond to single light phototherapy

If the SBR is rapidly rising or approaching the RED exchange transfusion treatment threshold line an urgent medical review should occur

FAMILY NAME	MRN
GIVEN NAMES	☐ MALE ☐ FEMALE
D.O.B. _____ / _____ / _____	M.O.
ADDRESS	
LOCATION / WARD	

COMPLETE ALL DETAILS OR AFFIX PATIENT LABEL HERE

Neonate with jaundice <24 hours of age or greater than 14 days of age should have urgent medical review and

- Measure the SBR and plot on the jaundice treatment threshold graph
- Urgent medical review will determine when to start phototherapy. Consider starting phototherapy at a lower SBR if the neonate has risk factors for neonatal jaundice (see ***Table A***) or is unwell
- Measure the SBR every
  - 6 hours until the SBR is both below the phototherapy treatment threshold line and stable or falling, then
  - 12-24 hourly for the duration of treatment
- Consider
  - Additional investigations (see ***Table B***)
  - Transfer to a higher level facility if appropriate

Neonate with jaundice ≥24 hours of age

- Do a transcutaneous bilirubin (TcB) if well and ≥35 weeks or
- Do an SBR if
  - Unwell or <35 weeks
  - The TcB is ≥250 micromol/L or
  - The TcB is <20 micromol/L below the treatment threshold line
- Medical review will determine when to start phototherapy. Consider starting phototherapy at a lower SBR if the neonate has risk factors for neonatal jaundice (see ***Table A***) or is unwell
- If SBR <50 micromol/L below the phototherapy treatment threshold line repeat the SBR in 12-24 hours
- If SBR >50 micromol/L below the phototherapy treatment threshold line continue regular visual assessments
- If phototherapy is commenced measure SBR
  - After 6 hours to ensure SBR is stable or falling, then
  - Every 12-24 hours for the duration of treatment
- Consider
  - Additional investigations (see ***Table B***)
  - Transfer to a higher level facility if appropriate

Table A Risk Factors and Causes of Neonatal Jaundice

Jaundice <24 hours of age - *Suspect haemolysis until proven otherwise*

Jaundice due to haemolysis	Immune - e.g. ABO blood group incompatibility Rhesus disease, Kell, Duffy, anti-E Non-immune - e.g. G6PD
Individual neonatal risk factors	• Prematurity • Asphyxia • Apgar <7 at 5 minutes or acidosis pH <7 or base excess ≤12 mEq/L • Low serum albumin <30 grams per litre • Sepsis or congenital infections • Maternal diabetes • Cephalohaematoma / bruising • History of sibling who was jaundiced as a neonate • G6PD risk with family history or with exposure to trigger

Table B Additional Investigations

Clinical Feature	Investigation
Neonate of Rhesus negative mother	Blood Group Direct Antiglobulin Test (DAT) An immediate SBR is required if the DAT is positive and the SBR is unknown
Neonate with jaundice within the first 24 hours of age OR Neonate with a rapidly rising total SBR (>8.5 micromol/L per hour) OR Neonate with a total SBR above the phototherapy threshold	Full blood count (FBC) and film with reticulocyte Blood group DAT Septic screen including blood and urine culture & sensitivity if sepsis suspected A G6PD screen if • There is a family history • This is a male neonate with dark hair from a high risk ethnic origin/geographic area e.g. African, Asian Mediterranean and Middle Eastern descent
Identification of maternal blood group should also be considered with the above investigations	
Neonate with a total SBR approaching exchange transfusion thresholds	• Serum albumin level • Liver function tests • Conjugated bilirubin

A neonate of any gestation with a conjugated bilirubin >20 micromol/L or >20% of the total SBR, should have a medical review by the most senior medical officer (same day before discharge from hospital)

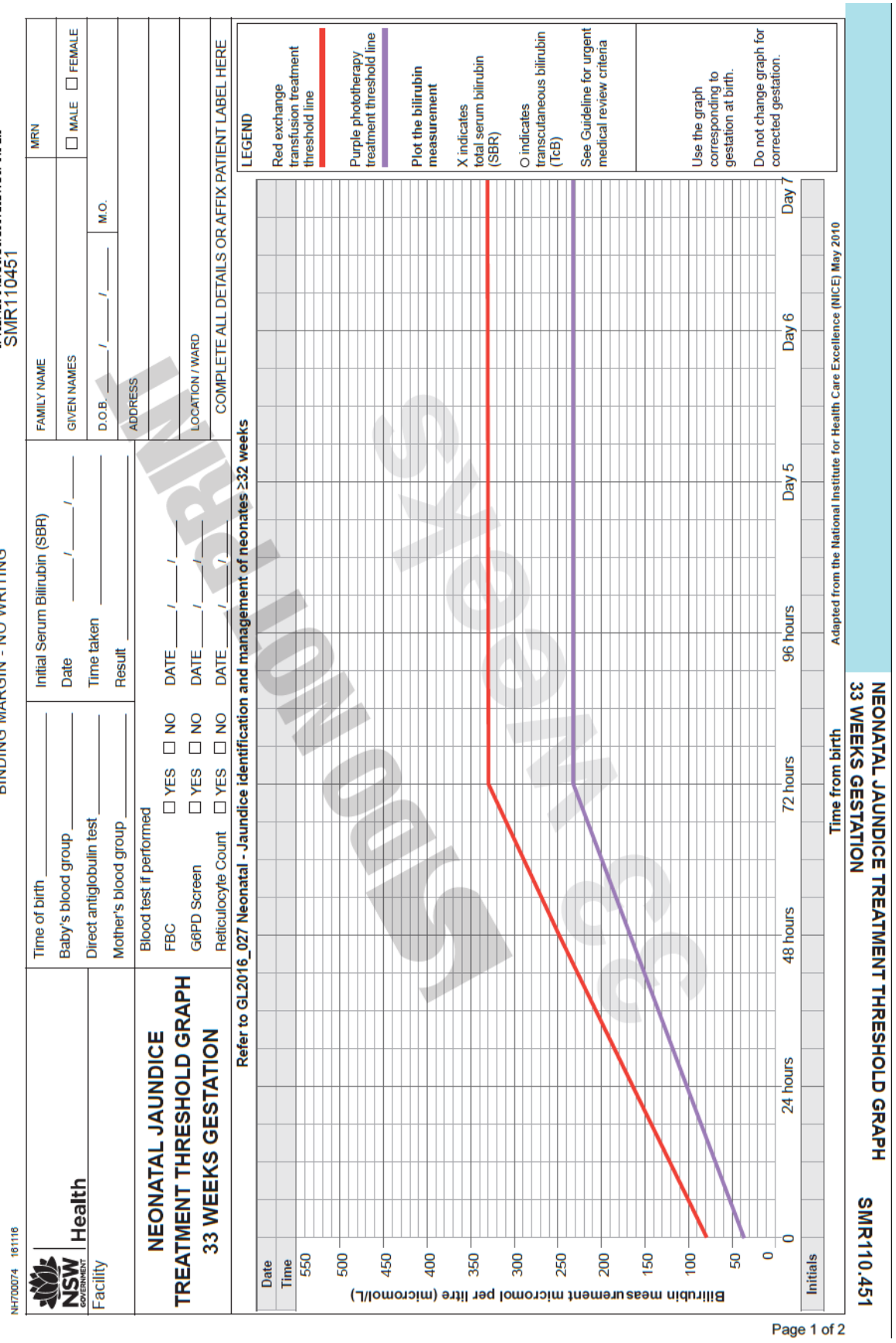
DO NOT PRINT

SMR110452

BINDING MARGIN - NO WRITING

Holes Punched as per AS2828.1: 2012

Attachment 6: Neonatal Jaundice treatment threshold graph 33 weeks gestation



Uncontrolled when printed

NH700074 161116

NSW GOVERNMENT Health

Facility

NEONATAL JAUNDICE TREATMENT THRESHOLD GRAPH 33 WEEKS GESTATION

Use single light phototherapy if
- SBR is at or above the phototherapy treatment threshold line

Use multiple light phototherapy if
- SBR is rising rapidly (>8.5 micromol/L per hour)
- SBR is <50 micromol/L below the RED exchange transfusion line
- SBR fails to respond to single light phototherapy

If the SBR is rapidly rising or approaching the RED exchange transfusion treatment threshold line an urgent medical review should occur

FAMILY NAME	MRN
GIVEN NAMES	☐ MALE ☐ FEMALE
D.O.B. ____/____/____	M.O.
ADDRESS	
LOCATION / WARD	

COMPLETE ALL DETAILS OR AFFIX PATIENT LABEL HERE

Neonate with jaundice <24 hours of age or greater than 14 days of age should have urgent medical review and
- Measure the SBR and plot on the jaundice treatment threshold graph
- Urgent medical review will determine when to start phototherapy. Consider starting phototherapy at a lower SBR if the neonate has risk factors for neonatal jaundice (see ***Table A***) or is unwell
- Measure the SBR every
  - 6 hours until the SBR is both below the phototherapy treatment threshold line and stable or falling, then
  - 12-24 hourly for the duration of treatment
- Consider
  - Additional investigations (see ***Table B***)
  - Transfer to a higher level facility if appropriate

Neonate with jaundice ≥24 hours of age
- Do a transcutaneous bilirubin (TcB) if well and ≥35 weeks or
- Do an SBR if
  - Unwell or <35 weeks
  - The TcB is ≥250 micromol/L or
  - The TcB is <20 micromol/L below the treatment threshold line
- Medical review will determine when to start phototherapy. Consider starting phototherapy at a lower SBR if the neonate has risk factors for neonatal jaundice (see ***Table A***) or is unwell
- If SBR <50 micromol/L below the phototherapy treatment threshold line repeat the SBR in 12-24 hours
- If SBR >50 micromol/L below the phototherapy treatment threshold line continue regular visual assessments
- If phototherapy is commenced measure SBR
  - After 6 hours to ensure SBR is stable or falling, then
  - Every 12-24 hours for the duration of treatment
- Consider
  - Additional investigations (see ***Table B***)
  - Transfer to a higher level facility if appropriate

Table A Risk Factors and Causes of Neonatal Jaundice

Jaundice <24 hours of age - *Suspect haemolysis until proven otherwise*

Jaundice due to haemolysis	Immune - e.g. ABO blood group incompatibility Rhesus disease, Kell, Duffy, anti-E Non-immune - e.g. G6PD
Individual neonatal risk factors	• Prematurity • Asphyxia • Apgar <7 at 5 minutes or acidosis pH <7 or base excess ≤12 mEq/L • Low serum albumin <30 grams per litre • Sepsis or congenital infections • Maternal diabetes • Cephalohaematoma / bruising • History of sibling who was jaundiced as a neonate • G6PD risk with family history or with exposure to trigger

Table B Additional Investigations

Clinical Feature	Investigation
Neonate of Rhesus negative mother	Blood Group Direct Antiglobulin Test (DAT) An immediate SBR is required if the DAT is positive and the SBR is unknown
Neonate with jaundice within the first 24 hours of age OR Neonate with a rapidly rising total SBR (>8.5 micromol/L per hour) OR Neonate with a total SBR above the phototherapy threshold	Full blood count (FBC) and film with reticulocyte Blood group DAT Septic screen including blood and urine culture & sensitivity if sepsis suspected A G6PD screen if • There is a family history • This is a male neonate with dark hair from a high risk ethnic origin/geographic area e.g. African, Asian Mediterranean and Middle Eastern descent
Identification of maternal blood group should also be considered with the above investigations	
Neonate with a total SBR approaching exchange transfusion thresholds	• Serum albumin level • Liver function tests • Conjugated bilirubin
A neonate of any gestation with a conjugated bilirubin >20 micromol/L or >20% of the total SBR, should have a medical review by the most senior medical officer (same day before discharge from hospital)	

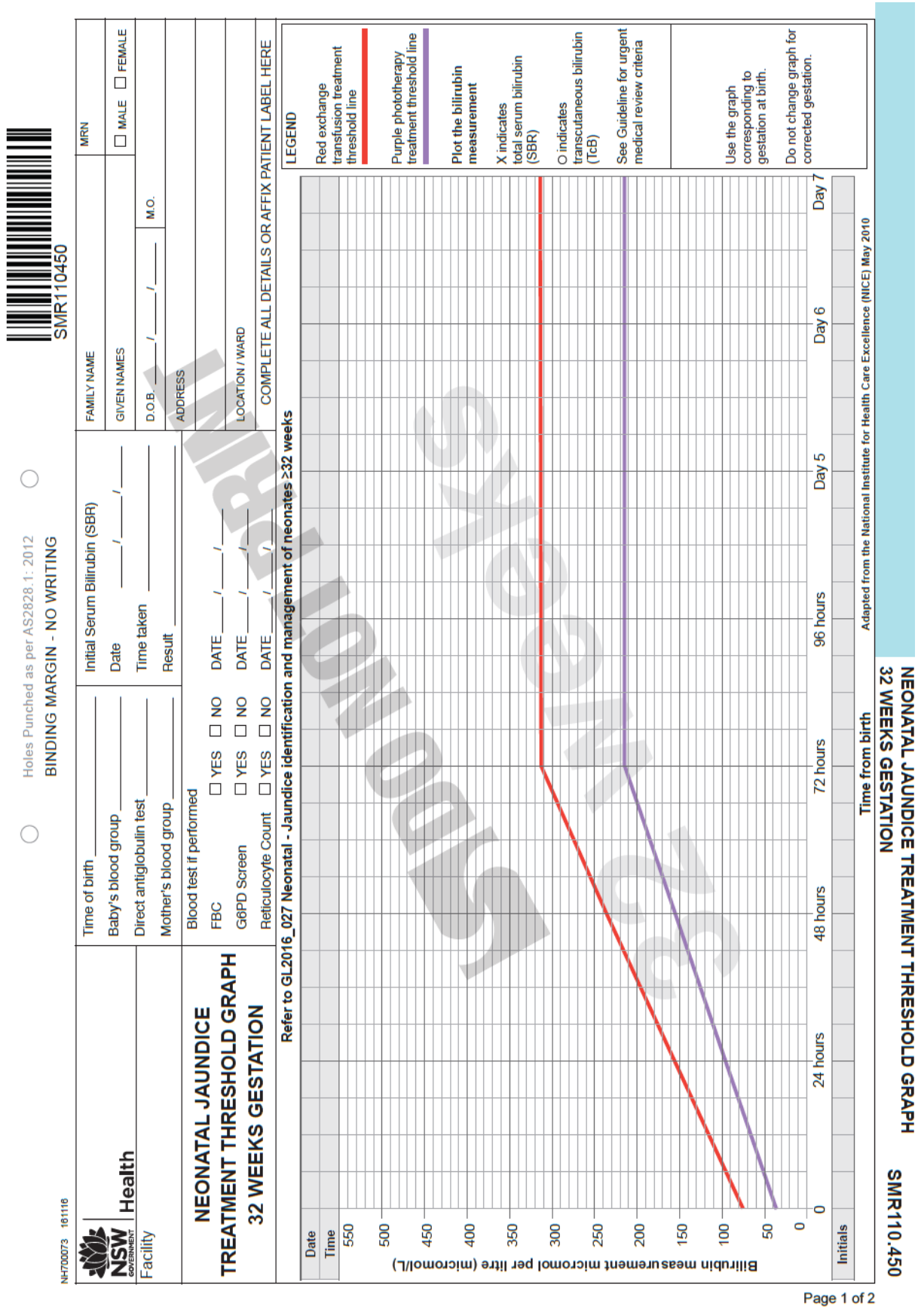
DO NOT PRINT

SMR110451

BINDING MARGIN - NO WRITING

Holes Punched as per AS2828.1: 2012

Attachment 7: Neonatal Jaundice treatment threshold graph 32 weeks gestation



NH700073 161116

NSW GOVERNMENT Health

Facility

NEONATAL JAUNDICE TREATMENT THRESHOLD GRAPH 32 WEEKS GESTATION

Use single light phototherapy if

- SBR is at or above the phototherapy treatment threshold line

Use multiple light phototherapy if

- SBR is rising rapidly (>8.5 micromol/L per hour)
- SBR is <50 micromol/L below the RED exchange transfusion line
- SBR fails to respond to single light phototherapy

If the SBR is rapidly rising or approaching the RED exchange transfusion treatment threshold line an urgent medical review should occur

FAMILY NAME	MRN
GIVEN NAMES	☐ MALE ☐ FEMALE
D.O.B. _____/_____/_____	M.O.
ADDRESS	
LOCATION / WARD	

COMPLETE ALL DETAILS OR AFFIX PATIENT LABEL HERE

Neonate with jaundice <24 hours of age or greater than 14 days of age should have urgent medical review and

- Measure the SBR and plot on the jaundice treatment threshold graph
- Urgent medical review will determine when to start phototherapy. Consider starting phototherapy at a lower SBR if the neonate has risk factors for neonatal jaundice (see *Table A*) or is unwell
- Measure the SBR every
  - 6 hours until the SBR is both below the phototherapy treatment threshold line and stable or falling, then
  - 12-24 hourly for the duration of treatment
- Consider
  - Additional investigations (see *Table B*)
  - Transfer to a higher level facility if appropriate

Neonate with jaundice ≥24 hours of age

- Do a transcutaneous bilirubin (TcB) if well and ≥35 weeks or
- Do an SBR if
  - Unwell or <35 weeks
  - The TcB is ≥250 micromol/L or
  - The TcB is <20 micromol/L below the treatment threshold line
- Medical review will determine when to start phototherapy. Consider starting phototherapy at a lower SBR if the neonate has risk factors for neonatal jaundice (see *Table A*) or is unwell
- If SBR <50 micromol/L below the phototherapy treatment threshold line repeat the SBR in 12-24 hours
- If SBR >50 micromol/L below the phototherapy treatment threshold line continue regular visual assessments
- If phototherapy is commenced measure SBR
  - After 6 hours to ensure SBR is stable or falling, then
  - Every 12-24 hours for the duration of treatment
- Consider
  - Additional investigations (see *Table B*)
  - Transfer to a higher level facility if appropriate

Table A Risk Factors and Causes of Neonatal Jaundice

Jaundice <24 hours of age - *Suspect haemolysis until proven otherwise*

Jaundice due to haemolysis	Immune - e.g. ABO blood group incompatibility Rhesus disease, Kell, Duffy, anti-E Non-immune - e.g. G6PD
Individual neonatal risk factors	• Prematurity • Asphyxia • Apgar <7 at 5 minutes or acidosis pH <7 or base excess ≤12 mEq/L • Low serum albumin <30 grams per litre • Sepsis or congenital infections • Maternal diabetes • Cephalohaematoma / bruising • History of sibling who was jaundiced as a neonate • G6PD risk with family history or with exposure to trigger

Table B Additional Investigations

Clinical Feature	Investigation
Neonate of Rhesus negative mother	Blood Group Direct Antiglobulin Test (DAT) An immediate SBR is required if the DAT is positive and the SBR is unknown
Neonate with jaundice within the first 24 hours of age OR Neonate with a rapidly rising total SBR (>8.5 micromol/L per hour) OR Neonate with a total SBR above the phototherapy threshold	Full blood count (FBC) and film with reticulocyte Blood group DAT Septic screen including blood and urine culture & sensitivity if sepsis suspected A G6PD screen if • There is a family history • This is a male neonate with dark hair from a high risk ethnic origin/geographic area e.g. African, Asian Mediterranean and Middle Eastern descent
Identification of maternal blood group should also be considered with the above investigations	
Neonate with a total SBR approaching exchange transfusion thresholds	• Serum albumin level • Liver function tests • Conjugated bilirubin

A neonate of any gestation with a conjugated bilirubin >20 micromol/L or >20% of the total SBR, should have a medical review by the most senior medical officer (same day before discharge from hospital)

DO NOT PRINT

SMR10450

BINDING MARGIN - NO WRITING

Holes Punched as per AS2828.1: 2012