Neonatal Hyperbilirubinemia (Jaundice) and Management

Guideline Responsibilities and Authorisation

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Target Audience	NPs, CNSs, Registrars, SMOs and Nurses
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Guideline Review History

Version	Updated by	Date Updated	Summary of Changes
1	Luci Gravatt	June 2024	New Guideline Withdraw: Phototherapy – Nursing management in Newborn Intensive Care Unit (NICU) 4944

Neonatal Hyperbilirubinemia (Jaundice) and Management

Contents

1 Overview

1.1 Background

Jaundice is the yellow discolouration of the skin and sclera caused by the accumulation of bilirubin in the skin and mucous membranes. All newborns have increased bilirubin levels, with approximately 60% of term and 85% of preterm babies developing jaundice. Most cases of jaundice are benign, however if unconjugated bilirubin levels get too high, the protein-unbound portion can cross the blood brain barrier where it is neurotoxic. Acutely it can cause Acute Bilirubin Encephalopathy, and chronically it can lead to Kernicterus, where there is permanent damage to the brain – particularly the auditory nerve and basal ganglia.

1.2 Purpose

To outline the recognition, assessment and treatment of Neonatal hyperbilirubinemia (Jaundice).

1.3 Staff group

Health NZ Waikato staff working in NICU, postnatal ward and delivery suite.

1.4 Patient / client group

Babies and infants in NICU, postnatal ward and delivery suite.

1.5 Definitions and acronyms

ABO	Presence of antigens A and B with O being no antigens
BiliLux™	The BiliLux™ is a compact and lightweight unit with irradiance that can be dimmed in 5 steps to provide individualised therapy for the patient. It can be placed on the incubator hood or mounted with the spring arm to the incubator or radiant warmer.
Bilirubin	The orange-yellow pigment of bile, formed principally by the breakdown of haemoglobin in red blood cells at the end of their normal life-span. Neonate's bilirubin production rate is double that of adults and their clearance of bilirubin is reduced, hence the importance of monitoring levels and detecting jaundice in this early post-natal period.
Bilirubin encephalopathy	Acquired metabolic encephalopathy caused by unconjugated hyperbilirubinaemia
BiliSoft™	The BiliSoft™ 2.0 Phototherapy System is an LED fiber-optic pad that can be used with a radiant warmer, incubator, bassinet, or while in a caregiver's arms. Its increased surface area, high spectral irradiance, and long lasting blue narrow-band LED light are the features that are needed for intensive, efficacious phototherapy. It supports and promotes developmental care and enables infant-parent bonding.
CNS	Clinical Nurse Specialist

Conjugated 'direct' hyperbilirubinaemia	Increased levels of conjugated (water soluble) bilirubin. Levels greater than 25 micromol/L (or equal to, or greater than 10%) direct bilirubin of total bilirubin level may indicate the need for further investigations
Coombs test	Also known as a direct antiglobulin test. See Direct Antiglobulin Test (DAT).
Direct Antiglobulin Test (DAT)	An agglutination test that detects the presence of antibodies bound to red blood cells which can cause haemolysis.
G6PD	Glucose-6-phosphate dehydrogenase (G6PD) deficiency is an inherited condition characterised by reduced G6PD enzyme activity in red cells. This leads to increased susceptibility to oxidative haemolysis
GI obstruction	Gastro Intestinal obstruction
Haemolysis	Destruction of red blood cells in the blood stream
Hb	Haemoglobin
Hyperbilirubinaemia	Increased level of bilirubin in the blood
IVH	Intraventricular haemorrhage
Jaundice	Yellow colouration of the skin and the sclera that results from accumulation of bilirubin in the skin and mucous membranes.
Kernicterus	Yellow staining of the brain caused by unbound, unconjugated bilirubin crossing the blood brain barrier - may lead to bilirubin encephalopathy.
LFTs	Liver Function Tests – GGT, ALT, AST, ALP,
Medical Staff	Includes Nurse Practitioner, Clinical Nurse Specialist, Registrar and SMO.
MRI	Magnetic resonance imaging
Neonatal Jaundice	A common condition in newborn babies and is usually mild and physiological, however it can also be a sign of underlying disease. Jaundice that is early in onset (first 24 hours), rises rapidly, late in onset (>7 days) or prolonged (>14 days) falls outside the definition of physiological jaundice and needs careful evaluation
NICU	Neonatal Intensive Care Unit
NP	Nurse Practitioner
Pathological Jaundice	Jaundice within the first 24 hours after birth, or jaundice that rises rapidly, or bilirubin levels that are abnormally high
Phototherapy	Light is used to convert unconjugated bilirubin in to by-products which can be directly excreted through the intestines and kidneys. Phototherapy provided by light source(s) with irradiance of 25–30 microW cm nm over the waveband interval 460–490 nm
Physiological Jaundice	Onset day 2-5 after birth in an otherwise well baby. Affects about 60% of term and 80% of preterm babies in the first few days after birth. Even physiological jaundice can reach levels requiring phototherapy
POCT	Point Of Care Test
Prolonged Jaundice	Jaundice that persists after day 14 in term babies and day 21 in preterm babies and is more common in breast fed babies.
Radiometer	An instrument for detecting or measuring the intensity of radiation

RMO	Registered Medical Officer
SBR	Serum bilirubin reports the unconjugated and conjugated bilirubin levels.
SCORTCH screen	Syphilis, Cytomegalovirus, Other (Parvovirus, Enterovirus, Zika virus), Rubella, Toxoplasmosis, Chicken pox, HSV (and other blood borne viruses Hepatitis/HIV)
SMO	Senior Medical Officer
TcB	Transcutaneous Bilirubin meter
TFT	Thyroid Function Test

1.6 Classification according to time of onset

See Appendix A for Causes of jaundice.

Onset less than 24 hours of age **Requires URGENT review** Nearly always pathological	• Haemolysis (Most commonly) • Rhesus disease • Other blood group incompatibilities • Rarer, red cell enzyme defects (e.g. G6PD deficiency) • Rarer, red cell membrane defects (e.g. spherocytosis, elliptocytosis) • Uncommonly due to sepsis
Onset between 24 hours and 10 days	• Physiological jaundice • Prematurity • Haemolysis • ABO incompatibility • Breakdown of extravasated blood • Cephalo-haematoma • Severe bruising • IVH • Increased enterohepatic circulation due to • Inadequate feeding • GI obstruction • Sepsis • Breast milk jaundice
Onset or persistence greater than 10 days	Refer to Conjugated Hyperbilirubinaemia in Newborn Intensive Care Unit, Management of Ref 1486 *Continued over page*

	Consider: • Breast milk jaundice (diagnosis of exclusion) • Haemolysis • Rhesus disease • ABO incompatibility • Other blood group incompatibilities • Rarer, red cell enzyme defects (e.g. G6PD deficiency) • Rarer, red cell membrane defects (e.g. spherocytosis, elliptocytosis) • Sepsis (particularly urinary tract infections) • Hypothyroidism • Galactosaemia

2 Clinical management

2.1 Guideline

2.1.1 Risk Factors (for jaundice requiring treatment)

- Maternal

  Blood group 'O'

  Rhesus D (RhD) negative

  Red cell antibodies positive – D, C, c, E, e, K and others

  Previous baby requiring phototherapy or exchange transfusion

  Diabetes – High red call mass in a baby with poorly controlled maternal diabetes of any type

  East Asian, Mediterranean

  Family history of inherited haemolytic disorders e.g. G6PD deficiency, spherocytosis

  Smoking

- Neonatal

  Blood group incompatibility and positive DAT test

  Prematurity < 36 weeks - due to the immaturity of RBC, liver, and gastrointestinal tracts

  Cephal-haematoma or significant bruising

  Macrosomic infant of diabetic mother (high red cell mass)

  (severe) Foetal growth restriction

  Prolonged parenteral nutrition (>14 days)

  Bowel obstruction

Infection

Delayed cord clamping

Breast milk

- β glucuronidase in breast milk increases the breakdown of conjugated bilirubin to unconjugated bilirubin in the gut
- Lipoprotein lipase and nonesterified fatty acids in breast milk may inhibit normal bilirubin metabolism
- Factors that delay normal colonisation with gut bacteria resulting in high concentration of bilirubin in the gut
- Low breastmilk supply (may be due to delayed milk production) or formula intake leading to dehydration and increased enterohepatic circulation thus resulting in increased concentration of bilirubin

- High risk factors

  These conditions reduce blood-brain barrier function increasing risk of bilirubin encephalopathy

  <28 week GA

  Metabolic acidosis

  Rh / ABO haemolysis

  Sepsis

  Known IVH

  Extensive bruising

2.1.2 Clinical Examination

- Visual estimation of jaundice levels are unreliable, particularly in darker skin tones and should not be used to determine treatment.
- Assess feeding pattern and volume for adequate intake
- Assess stooling pattern and colour - Three to four stools per day by the fourth day of age are usual. Stools change from meconium to mustard yellow by third day of age. Pale stools and jaundice are key indicators of liver disease and need urgent evaluation.
- Assess urine volume and colour - Four or more wet nappies per day by 72 hours of age indicates adequate milk intake. Dark urine may be indicative of conjugated hyperbilirubinaemia. Urates are commonly present in the urine of newborn babies up to 96 hours of age.
- Weight loss - Loss of up to 10% of birth weight is acceptable in first week of age, usually return to birth weight by 7–10 days of age. Weight loss should not be used in isolation to assess the severity of hyperbilirubinemia, as it may be a sign of dehydration, which can also raise the bilirubin level.

- Bruising, pallor and/or plethora may offer clues to causation.
- Assess for signs of being unwell such as lethargy, poor responsiveness, temperature instability, poor feeding, cyanosis, apnoea, bradycardia and mottled skin. This should prompt urgent investigations.
- A differential diagnosis of sepsis, metabolic disturbances or other serious disorders should always be considered and ruled out.

Acute encephalopathy - potential signs include lethargy, poor feeding, vomiting, high pitched cry, hypotonia followed by hypertonia, opisthotonus, and seizures.

2.1.3 Investigations

The urgency of investigations and treatment depends on the clinical presentation of the baby. An unwell baby requires more urgent investigation and treatment as the underlying aetiology can be associated with a variety of pathological causes.

The level of jaundice cannot be estimated by clinical examination of colour. Level of SBR can be screened for by a transcutaneous bilirubinometer and definitively by measuring blood bilirubin level or serum bilirubin by suitable point of care testing (POCT) or formally via the laboratory.

Transcutaneous bilirubinometer

Bilirubin levels can be measured by a Transcutaneous Bilirubinometer (TcB). (Guideline under development – link to be inserted when available).

Do not use TcB to assess jaundice in the first 24 hours or if phototherapy has been used within the previous 72 hours.

If TcB is greater than 250 micromol/L, correlation between TcB and SBR is needed. TcB is useful for trending jaundice levels BEFORE phototherapy has started.

Total Serum Bilirubin (SBR):

- Gold standard for diagnosing hyperbilirubinaemia
- Point of care (e.g. blood gas analyser) and formal testing measure the sum of conjugated and unconjugated bilirubin in serum

POCT can read high, particularly if elevated Hb (over 200 g/L) – check formal SBR level prior to initiating phototherapy.

2.1.4 Prolonged Jaundice

- Use clinical judgement to determine the investigations required for a term baby who continues to be jaundiced after 10–14 days or after three weeks for a preterm baby.
- The most common cause of prolonged jaundice is breast milk jaundice occurring in up to 30% well breastfeeding babies. Occurs in well babies with adequate weight gain. SBR peaks between days five and six and generally does not exceed 200 micromol/L. Self-limiting, usually resolves by 12 weeks of age. Do not advise to stop breastfeeding as the risk of breast milk jaundice does not outweigh the benefits.
- May be an indication of infection, haemolysis and sepsis
- Investigations:

  Clinical examination

  Conjugated and total serum bilirubin levels – If total conjugated bilirubin >20 umol/L and conjugated bilirubin >20% total bilirubin, refer to Conjugated Hyperbilirubinaemia in Newborn Intensive Care Unit, Management of (Ref. 1486)

  Stool colour assessment - pale stool and dark urine suggests Biliary Atresia (stool chart).

2.1.5 Conjugated Hyperbilirubinemia

Consult Conjugated Hyperbilirubinaemia in Newborn Intensive Care Unit, Management of (Ref. 1486) for investigations and management.

2.1.6 Blood sampling:

First line investigations:

- Cord bloods: Maternal risk for haemolytic disease should have cord bloods including: Blood group & DAT, baseline SBR and CBC
- Blood group
- DAT to check for ABO incompatibility and Rhesus disease
- Blood gas (check for acidosis)
- Complete Blood Count (CBC) with differential
- Electrolytes (Na, K)
- Formal SBR level to determine treatment modality. (Gas Bilirubin may show falsely elevated levels if Hb is over 200 g/L)

Second line investigations:

If jaundice early or severe, abnormal examination findings or unwell

- Blood culture and urine specimen if infection suspected.
- Thyroid Function Tests (TFT): TSH & T4
- National Testing Card (NTC) to assess for inborn errors of metabolism or congenital infection.

Third line investigations:

- After discussion with SMO: toxoplasmosis, rubella, cytomegalovirus (CMV), herpes simplex virus (HSV) and syphilis (SCORTCH screen).

2.1.7 Nomograms

Management of hyperbilirubinemia involves interpretation of SBR trends using a nomogram based on gestation. POCT and formal SBR results are differentiated by colour and plotted according to the age in hours (usually POCT=blue, formal=red). See NICE.org.uk for specific gestation graphs.

An unwell neonate or the presence of risk factors (confirmed sepsis, haemolysis, acidosis or asphyxia) increases the risk of bilirubin encephalopathy at a lower SBR. In these situations intensive phototherapy should be commenced earlier (discuss with SMO).

2.1.8 SBR monitoring

Repeat SBR measurements are based on the current level, rate of rise of bilirubin, cause of jaundice and clinical situation. A suggested guide is below:

Normogram level	SBR (micromole / litre)	Action	Phototherapy
	Below the treatment threshold but within 50	Repeat SBR: - With risk factors: 8 Hours - Without risk factors: 24 Hours	No
Phototherapy treatment threshold	Less than 30 above the treatment threshold	Repeat SBR in 24 hours	Yes, if other risk factors present
	More than 30 above the treatment threshold and rising, but more than 30 below exchange threshold	Repeat SBR in 12 hours	Yes
	Within 30 of the exchange transfusion threshold	Repeat SBR 6 hourly until the rise is known to be controlled	Yes, intensive (See prescription section below)
Exchange transfusion threshold	When SBR is not expected to be below the exchange threshold after six hours of intensive phototherapy	Exchange transfusion Consider IVIG transfusion	Yes, intensive (See prescription section below)
	Signs of bilirubin encephalopathy	An immediate exchange transfusion is recommended **Consult urgently with a Neonatologist.**	
Stop phototherapy when SBR is more than 50 micromol/L below phototherapy threshold.			
Check for rebound of the SBR 12–24 hours after stopping phototherapy. Babies do not necessarily have to remain in hospital for this to be done if their LMC is willing to take responsibility for following up testing and appropriate referral.			
Re-commence phototherapy if rebound SBR >20 above treatment threshold or rate of rise more than >8 micromol/L/hour.			

2.2 Phototherapy

Phototherapy is the first line treatment for neonatal jaundice and is effective in most babies in stabilising or reducing SBR level. Phototherapy should be initiated when the SBR is above the phototherapy threshold shown on the nomogram appropriate to the baby's gestation at birth and postnatal age.

To be most effective, the more skin consistently exposed, the faster the SBR will be reduced.

River Ridge Birth Centre (Hamilton), Tokoroa Hospital and Thames Hospital may have phototherapy available if it is deemed appropriate for the baby to managed outside of NICU, but this should be discussed with the Medical team first.

2.2.1 Preparation

- Explain procedure and proposed treatment to parents/whanau, provide pamphlet "Newborn Unit Jaundice" (G1901HWF) and emotional support. Encourage parents to continue to provide cares including feeds and nappy changes etc.
- Undress the baby - Baby may keep nappy on as it does not prolong physiological jaundice and may aid self-regulated infant behaviour in the short term. Use the smallest nappy to cover infant, only up to the groin area or leave nappy open.
- Commence phototherapy as prescribed by the medical team on the General Treatment Sheet.

2.2.2 Equipment

- Phototherapy light (BiliSoft™ with cover and/or BiliLux™)
- Radiometer
- Eye shield
- Thermometer
- Individualised Treatment Threshold Graph for Babies with Neonatal Jaundice (Nomogram) See Link

BiliLux	Can be placed on the incubator hood or mounted with the spring arm to the incubator or radiant warmer.	Used for all infants Irradiance that can be adjusted in 20% increments
Bilisoft	Soft and flexible pad that can be used with a radiant warmer, incubator, bassinet, or during cuddles.	Used for infants over 1500g

2.2.3 Prescription

Phototherapy is prescribed on the General Treatment Sheet.

SBR <30 above treatment threshold	Bilisoft **or** BiliLux™ at 60% Consider risk factors for haemolysis or rate of rise (> 8 micromol/L/hour), in which case manage as if SBR >30 above treatment threshold
SBR >30 above treatment threshold **or** jaundice within 24 hours **or** high-risk neonate	Bilisoft **and/or** BiliLux™ at 60%
SBR above exchange transfusion threshold	Intensive phototherapy using Bilisoft™ **AND** BiliLux™ at 100% Consider a second Bililux for maximum skin coverage (often referred to as 'triple therapy').

Consider an additional phototherapy unit if any of the following:

- One Bililux not providing adequate coverage from head to toe. A large or term baby may benefit from a BiliLux™ light directed from each side to ensure greater coverage of lateral sides
- Rapidly rising bilirubin level (> 8 micromol/L/hour).

2.2.4 Initiating therapy

Radiant warmer caution

Position the BiliLuxTM from the side and not directly under the radiant heat source to prevent fire and burning of the phototherapy unit.

- Do not cover the BiliLux light with any linen/blanket or an incubator cover as it is a fire hazard.
- Use an infant eye shield for comfort and protection to prevent retinal damage
- Do not use baby oil, creams or lotions to avoid possibility of burns to the skin. **Cosi 2 coconut oil** can be used with phototherapy.

Equipment	Procedure
BiliLux™ phototherapy	• Can be placed directly on top of the incubator or attached to the spring arm for use with a cot or radiant warmer. • Secure unit or position on top of incubator before plugging cord into light. • Turn phototherapy unit on using switch at the rear. • Press the start key to commence or pause the phototherapy. • Adjust the irradiance setting using the two lightbulb keys to increase or decrease in 20% increments according to the prescription. • Check correct irradiance with radiometer. Plug radiometer into rear of BilliLux™, select the radiometer screen, position the sensor next to the skin (without touching the infant), press store button on radiometer or screen. This should be done 24 hourly or 8 hourly if at exchange threshold. • Ensure the distance between the light and the baby is 30cm minimum. • Ensure the light shines on infant's head and body to ensure maximum exposure to phototherapy. • Check infant's temperature one hour after commencement of phototherapy, and thereafter 3-4 hourly. LED phototherapy should not cause a change in the baby's temperature, however increasing exposed surface area can cause the temperature to drop.
BiliSoft™ phototherapy	• Place the light box on a stable surface where it will not be knocked over or fall off. • Cover the light pad with a disposable cover, ensuring the illuminated side is facing up. • Settle the infant on the light pad with the fibre-optic cord at the foot end. • Swaddle around the outside of the light pad if needed to settle the infant. • If in a cot: Place a sheet or quilt on top of infant to provide warmth. • Plug the light pad into the light box, then plug in the power cord. • Turn on using the switch on the front of the light box.

2.2.5 Potential complications

- Water loss from increased peripheral blood flow and diarrhoea (if present)
- Hyperthermia
- Lethargy
- Diarrhoea from intestinal hyper motility and/or temporary lactose intolerance
- Interference with maternal-infant bonding
- Disorder of circadian rhythms
- Ileus (preterm infants)
- Rash
- Retinal damage
- 'Bronzing' of neonates with conjugated hyperbilirubinaemia

2.2.6 Monitoring

- Document phototherapy setting on observation chart
- Monitor baby's temperature 3-4 hourly to ensure the infant's axilla temperature is within 36.7 – 37.2°C.
- Monitor and record respiratory rate and heart rate 3-4 hourly.
- Monitor fluid balance: record all intake and output and weigh all nappies as required. Phototherapy increases insensible fluid loss.
- Turn infant 3-4-hourly during cares and assess pressure areas.
- Turn off phototherapy and remove eye shield to perform eye care 3-4 hourly. Provide infant with visual stimulation and interaction with parents, and check for eye infection and irritation.
- Maintain perianal skin cleanliness to prevent skin breakdown. Increased bile flow during phototherapy appears to stimulate the gastrointestinal tract resulting in increased loose stools.
- Monitor blood sugar levels as directed: hypoglycaemia can be caused by liver disease, e.g. galactosaemia
- Monitor SBR as directed by medical team. (See 2.4.8 "SBR monitoring" above.)
- Record baby's blood results on the individualised Treatment Threshold Graph for Babies with Neonatal Jaundice.

2.3 Exchange transfusion

This must always be in consultation with the SMO when the SBR is not expected to be below the exchange level after 6 hours of phototherapy or there are signs of bilirubin encephalopathy.

The following investigations must be completed before performing an exchange transfusion:

- Serum albumin level (low albumin levels may be a risk factor for kernicterus)
- CBC
- Sodium, potassium, creatinine, albumin, glucose
- Liver function tests (LFT)
- Conjugated bilirubin
- Newborn Testing Card (NTC) for metabolic screening
- G6PD test

See Exchange and Reduction Transfusions in Neonates (Ref. 1646)

2.4 Nutrition/fluids

Feeding:

- Continue breastfeeding if possible, consider adequate supply and intake of breast milk.
- Ensure adequate hydration - may require supplemental formula if low milk supply is identified
- Time out from phototherapy depends on the severity of jaundice:
  - When the SBR is in the phototherapy zone, breast/bottle feeds should be limited to 30 minutes or the baby should remain on a Bilisoft/phototherapy blanket during the feed so that phototherapy can be continued.
  - When the SBR is above exchange transfusion threshold, the baby must remain under phototherapy **at all times**. Use bottle/nasogastric feeds of expressed breast milk/formula or IV Fluids.
- The mother may require support with expressing and re-establishing breastfeeding.
- Referral to Lactation Consultant recommended.

IV fluids:

- Not routinely required, consider for correction of dehydration, hypovolemia and/or hypernatremia, if oral intake is inadequate or if receiving intensive phototherapy with SBR above exchange transfusion threshold.

2.5 Intravenous immunoglobulin

Use intravenous immunoglobulin (IVIG) (500-1000mg/kg over 4-6 hours) as an adjunct to continuous intensive phototherapy in cases of rhesus haemolytic disease or ABO haemolytic disease when the SBR continues to rise by more than 8 micromol/litre per hour. This may help reduce the need for an exchange transfusion and/or allow time for exchange transfusion to be organised.

See Intravenous Immunoglobulin in Neonates in Newborn Intensive Care Unit (NICU) (Ref. 1607)

3 Follow up/discharge

Jaundice type/level	Follow up	
	Who	**What**
Non-haemolytic jaundice (Phototherapy alone)	• LMC/GP	• General f/up
Haemolytic jaundice	• SMO • LMC\GP	• Advice as reqd. by GP/LMC • Weekly CBC (until Hb stable/rising)
Exchange level Bilirubin	• SMO • CDC (GMA & BSID) • LMC\GP • High risk audiology	• OPC - up to 2 years • GMA / BSID / etc. • General f/up
Encephalopathy	• SMO • CDC (GMA & BSID) • LMC\GP • High risk audiology	• OPC - up to 2 years + consider Neurology referral + MRI at 3 months • GMA / BSID / etc. • General f/up

- Lactation support as needed
- All newborns that are visibly jaundiced in the first 24 hours of birth must be investigated as per this guideline and must not be discharged until cause is known and jaundice trend is reducing.
- LMC and/or GP must be contacted by the discharging NP/RMO by phone and handed over responsibility for ongoing monitoring of Hb after discharge. Hand over must be documented in the discharge summary.

Parents **should** be advised to contact a healthcare professional (LMC/GP) if:

- Baby becomes more jaundiced
- Jaundice is persisting beyond 14 days of birth
- Baby is passing pale stools

4 Patient information

- Pamphlet “Newborn Unit Jaundice”. G1901HWF

5 Evidence base

5.1 Bibliography / References

- BiliLux™ user manual https://www.draeger.com/Products/Content/bililux-sw-1n-ifumu26125-en.pdf
- BiliSoft™ user manual
- https://www.nice.org.uk/guidance/cg98/chapter/Recommendations#measuring-and-monitoring-bilirubin-thresholds-before-and-during-phototherapy
- Kemper, A.R., et al (2022). Clinical practice guideline revision: Management of hyperbilirubinemia in the newborn infant 35 or more weeks of gestation. Pediatrics August 2022; 150 (3): e2022058859. 10.1542/peds.2022-058859
- National Institute for Health and Clinical Excellence (2016). Jaundice in newborn babies under 28 days. Retrieved November, 2020 from https://www.nice.org.uk/guidance/cg98/resources/jaundice-in-newborn-babiesunder-28-days-pdf-975756073669
- Neonatal Jaundice (2010) National Collaborating Centre for Women’s and Children’s Health. Retrieved from: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.nice.org.uk/guidance/cg98/evidence/full-guideline-245411821
- Neonatal Jaundice. Queensland Clinical Guidelines. Translating Evidence into best clinical practice (2022). Retrieved from chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.health.qld.gov.au/__data/assets/pdf_file/0018/142038/g-jaundice.pdf
- Phototherapy Treatment Flowchart – Waitemata
- Treatment threshold graph for babies with neonatal jaundice. National Institute for Health and Care Excellence. Downloaded from: https://www.nice.org.uk/guidance/cg98/resources/treatment-threshold-graphs-excel-544300525
- Yang WC, Zhao LL, Li YC, Chen CH, Chang YJ, Fu YC, Wu HP. Bodyweight loss in predicting neonatal hyperbilirubinemia 72 hours after birth in term newborn infants. BMC Pediatr. 2013 Sep 21;13:145. doi: 10.1186/1471-2431-13-145. PMID: 24053490; PMCID: PMC3849505.

5.2 Associated Health NZ Waikato Documents

- Care of the late preterm/growth restricted neonates on the postnatal ward 3285 (Ref. 3285)
- Conjugated Hyperbilirubinaemia in Newborn Intensive Care Unit (Ref. 1486)
- Exchange Transfusion and Reduction Exchange Transfusion - Nursing Management in the Newborn Intensive Care Unit (NICU) (Ref. 2616)
- Intravenous Immunoglobulin in Neonates in Newborn Intensive Care Unit (NICU) (Ref. 1607)
- Newborn Unit Jaundice G1901HWF
- Supplementing the Breastfed baby (Ref. 6379)

Appendix A – Causes of Jaundice

Causes of Pathological Jaundice

Pathogenesis	Common Cause	Less common
Haemolysis	• Blood extravasation 1. Bruising/birth trauma • Haemorrhage (e.g. cerebral, pulmonary, intra-abdominal) • Isoimmunisation 1. ABO (low risk) or Rh D (high risk) alloantibodies 2. Other blood group alloantibodies–Kell and Rh C and E are the most common	• RBC enzyme defects: 1. G6PD deficiency 2. Pyruvate kinase deficiency • Hereditary RBC membrane abnormalities: 1. Spherocytosis 2. Elliptocytosis • Haemoglobinopathies 1. Alpha thalassaemia • Infection
Decreased conjugation of bilirubin in the liver	• Gilbert Syndrome (glucuronyl transferase deficiency disorder) • Congenital hypothyroidism	• Other glucuronyl transferase deficiency disorders 1. Crigler-Najjar Syndrome 2. Transient familial neonatal hyperbilirubinaemia/Lucey Driscoll syndrome (may be severe) • Congenital hypopituitarism
Decreased excretion of bilirubin	• Abnormal biliary ducts (e.g. intrahepatic biliary atresia or extrahepatic biliary stenosis or atresia) • Cystic fibrosis	• Conditions causing abnormal biliary ducts, (e.g. Alagille Syndrome, choledochal cyst) • Increased enterohepatic bilirubin recirculation 1. Bowel obstruction, pyloric stenosis • Meconium ileus or plug, cystic fibrosis
Liver cell damage (may cause combination of decreased bilirubin uptake, conjugation and/or excretion)	• Congenital infections: 1. Cytomegalovirus (CMV),Herpes simplex virus (HSV) 2. Toxoplasmosis, rubella, syphilis, varicella zoster, parvovirus B19 causing hepatitis • Inborn errors of metabolism (e.g. urea cycle defects, galactosaemia, fatty acid oxidation defects)	

Causes of physiological jaundice

Aspect	Consideration
Context	• Physiological jaundice is transient, mild unconjugated hyperbilirubinaemia • More common in first born babies • Mostly benign
Causes	Increased bilirubin levels secondary to an increase in the volume and a decrease in the life span of RBC, and an immature liver with reduced enzyme activity • Normal population variation in maturation of bile metabolism after birth • More common in breastfed baby where there is inadequate milk intake • If baby unwell, has risk factors for underlying disorder or has a TSB above the treatment line, consider pathological causes
Characteristics	• Usually first seen on day two of age • Peaks on day three in term babies and days five to six in preterm babies • Usually resolves in the first week to 10 days of life in a term baby or within three weeks in a preterm baby
Management	• Usually does not require treatment • Reassure the parents and monitor the baby • Investigate unwell jaundiced baby for underlying disease • Treat any pathological cause if identified

Causes of prolonged jaundice

Aspect	Common causes	Less common causes
Unconjugated hyperbilirubinaemia	• Inadequate nutrition and hydration more common in exclusively breastfeeding baby (e.g. breastmilk jaundice ○ Commonly presents between days four and seven with a peak at two to three weeks of age, and resolves by three months of age	• Infection • G6PD deficiency • Spherocytosis • Pyloric stenosis • Inherited disorders (e.g. Gilbert's Syndrome) • Congenital hypothyroidism
Conjugated hyperbilirubinaemia		• Biliary atresia4 • Idiopathic neonatal cholestasis • Inherited disorders (e.g. Alagille Syndrome) • Congenital hypopituitarism • Congenital CMV

Unconjugated and/or conjugated hyperbilirubinaemia	• Congenital hypothyroidism
	• Haemolysis
	  ○ Rh D or other haemolytic disease
	  ○ Usually unconjugated initially then conjugated bilirubin levels rise
	• G6PD deficiency
	  ○ Can cause episodic or prolonged jaundice depending on oxidant exposure
		• Infection
		• Metabolic disorders
		• Congenital hypopituitarism
		• Parenteral nutrition • Inborn errors of metabolism