

PHOTOTHERAPY FOR NEONATAL JAUNDICE - CICU - SCH

PRACTICE GUIDELINE[®]

DOCUMENT SUMMARY/KEY POINTS

- Phototherapy is used to treat unconjugated hyperbilirubinemia and jaundice in the newborn infant. Phototherapy uses visible blue spectrum light which photo-isomerises unconjugated bilirubin into a water soluble form which can be excreted without conjugation by the liver.
- The bilirubin level should then be checked 6 hours after phototherapy commences and every 12 hours thereafter.
- Different methods of administering phototherapy deliver different doses of spectral irradiance such as single or double light therapy.

CHANGE SUMMARY

- This is a new document

READ ACKNOWLEDGEMENT

- Read Acknowledge Only -Nursing staff looking after the neonate requiring phototherapy.

This document reflects what is currently regarded as safe practice. However, as in any clinical situation, there may be factors which cannot be covered by a single set of guidelines. This document does not replace the need for the application of clinical judgement to each individual presentation.

Approved by:	SCHN Policy, procedure and Guideline Committee	
Date Effective:	1 st November 2022	Review Period: 3 years
Team Leader:	Research Nurse	Area/Dept: CICU SCH

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What is Jaundice?

Neonatal jaundice (Hyperbilirubinemia) is an elevated level of bilirubin within the blood. This is demonstrated by yellow discolouration of the skin and sclera of newborns and jaundice occurs when excess bilirubin is deposited in fatty tissues.

Neonatal jaundice is common due to the breakdown of foetal haemoglobin, the increased production of bilirubin and the reduction of clearance due to the immature liver function.

Physiological jaundice usually appears within the first 2-4 days of life and in most newborns disappears 1-2 weeks later without needing any treatment. However, jaundice is the most common occurring condition requiring medical intervention in newborns. There are some additional risk factors that would increase the incidence of some neonates developing prolonged jaundice requiring treatment (see appendix C).

The liver metabolises unconjugated bilirubin into a conjugated form that is non-toxic, water soluble and unable to cross the blood-brain barrier. Conjugated bilirubin can then be excreted from the body via the biliary and intestinal tract.

Unconjugated bilirubin is lipid soluble and can easily pass into the central nervous system. High levels of unconjugated bilirubin are toxic to the brain and can cause long term neurological problems and irreversible brain damage known as kernicterus.

What is Phototherapy?

Phototherapy is used to treat unconjugated hyperbilirubinemia and jaundice in the newborn infant. Phototherapy uses visible blue spectrum light which photo-isomerises unconjugated bilirubin into a water soluble form which can be excreted without conjugation by the liver. The efficacy of phototherapy depends upon light wavelength, irradiance, exposed surface area and distance of the light from the infant. The aim of phototherapy is to reduce the level of unconjugated bilirubin to prevent bilirubin encephalopathy and kernicterus.

Bilirubin measurement

- The total serum bilirubin should be measured on all infants jaundiced within the first 24 hours of life.
- Infants receiving phototherapy should have a serum bilirubin level taken prior to treatment.
- The bilirubin level should then be checked 6 hours after phototherapy commences and every 12 hours thereafter.
- When calculating bilirubin levels for phototherapy treatment, the conjugated (direct) bilirubin shouldn't be subtracted from the total. Bilirubin levels should be calculated according to the infant's age in hours not days.
- Recheck serum bilirubin 12 – 24 hours after finishing phototherapy to detect rebound hyperbilirubinemia.

- Visual estimations of bilirubin levels are not reliable.
- Ensure that serum bilirubin levels are plotted on an age appropriate phototherapy chart (see appendix B) and filed in the patient notes. Charts are available for babies born 33/40 to >38/40 gestation.
- When performing a heel prick or venous stab for blood sampling administer sucrose as per [Sucrose - Management of Short Duration Procedural Pain in Infants](#)
- Turn off the phototherapy lights when collecting blood. Blue light may interact with bilirubin pigments in the blood sample, giving inaccurate results.

Phototherapy

DELIVERING PHOTOTHERAPY EFFECTIVELY:

Light intensity (Spectral Irradiance)

- Different methods of administering phototherapy deliver different doses of spectral irradiance or light intensity.
- Bilirubin absorbs light more strongly in the blue light spectrum near 445 - 470nm. Lights producing wavelengths in the blue spectrum between 460nm to 490nm are the most effective.
- Higher levels of spectral irradiance deliver more effective phototherapy, leading to a faster decline in bilirubin.
- The only way to establish the dose of phototherapy is to measure the light irradiance using a radiometer. Intensive phototherapy requires an irradiance level of at least 30 $\mu\text{W}/\text{cm}^2/\text{nm}$ whilst standard phototherapy requires a minimum of 12 $\mu\text{W}/\text{cm}^2/\text{nm}$.

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

Indications for phototherapy

Bilirubin threshold charts identify at what serum bilirubin level (SBR) the neonate should commence phototherapy, the level is determined by gestational age and day of life. The neonates SBR will be plotted on the graph and if they sit above the acceptable level therapy will commence. See appendix for chart.

Consider the requirement for single or double lights as per the indication below (NSW Health):

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 and urgent medical review should occur

Contraindications to phototherapy include:

- Neonates with congenital porphyria
- Family history of porphyria
- Concurrent treatment with photosensitising drugs

Methods of delivery and Phototherapy set up

- Ensure a medical officer has documented the need for phototherapy treatment in the patient notes, specifying the use of either single or double lights.
- Record a baseline temperature and then remove the infant's clothes. Unfasten or roll down the nappy to expose as much skin as possible. The bilirubin level will decline faster with more skin exposed.
- There is no need to remove the nappy unless bilirubin levels are approaching the exchange transfusion range.
- Remove any oils or creams from the infant's skin to avoid the risk of burn injuries.
- Gently cover the infant's eyes with an appropriately sized protective eye mask to protect against possible retinal damage. Take care not to apply too much pressure or occlude the nares. The eyes should be covered at all times when using the phototherapy light or the biliblanket.
- Select the appropriate light source and position the infant accordingly either under the light or in the blanket.
- Ideally, infants in CICU should be nursed in an open care system and have their temperature monitored constantly on servo control mode. Preterm and low birth weight need continuous temperature monitoring due to immature and unstable thermoregulatory control.
- Manually take the infants temperature every hour after commencing phototherapy until stable and then at least every 4 hours.

- All infants receiving phototherapy must have continuous saturation monitoring for patient safety as it is difficult to assess their colour under the blue lights. Ensure that the oxygen saturation probe is covered with an opaque material to avoid light interference.
- Continue to monitor all other observations as per [Clinical Observations in CICU](#) in accordance with the infant's condition.

neoBLUE LED phototherapy light



- This light is the **first choice** for providing phototherapy in CICU.
- It delivers a narrow band of high intensity blue light between 450-475nm with a peak wavelength 458nm at which bilirubin is broken down.
- It has 2 different settings to switch between - standard ($15 \mu\text{W}/\text{cm}^2/\text{nm}$) and intensive ($35 \mu\text{W}/\text{cm}^2/\text{nm}$). Commence with intensive light.
- Ideally, the neoBLUE LED should be positioned directly above the infant. The light can be adjusted both horizontally and vertically using adjustment screws on the stand. **Do not place the light directly under a radiant warmer.**
- When using an infant warmer, the NeoBlue LED should be positioned to the side of the infant and tilted at a 40 degree angle. This prevents the phototherapy unit overheating and prevents the disruption of heat to the infant. The NeoBlue LED is tilted by grasping either side of the unit and tilting in an upwards motion.
- Be aware that tilting the light will increase the distance to the infant and reduce the light intensity. **The light must be no further than 30.5cm from the infant.**
- If necessary, the neoBLUE LED can be placed directly on top of an incubator. The rubber feet on the bottom of the unit provide stability and enable sufficient. Be aware that the distance from the infant may be too great to achieve intensive phototherapy.
- Turn on the power switch. This is the green switch in the centre of the front panel.

- Press the target illumination switch (right hand side of front panel) on the neoBLUE LED to position the lights correctly. The red target illumination light should be focused over the infant's torso. The default is to select the high setting for intensive phototherapy or unless the low setting for standard phototherapy as specified by the medical officer (control switch is on the left side of front panel).
- Measure the level of irradiance (light intensity) delivered by the phototherapy lights and document on the CICU flowchart and in the patient notes.

Measuring light irradiance (intensity)

- Light irradiance is measured with the neoBLUE radiometer.
- The neoBLUE radiometer should only be used to measure irradiance on the neoBLUE LED phototherapy light
- To measure light irradiance using the neoBLUE radiometer, ensure that both the phototherapy light and the radiometer are turned on.
- Hold the radiometer under the phototherapy light near the infant's skin (over the torso). Press and hold the button on the front panel whilst waiting for the reading to stabilise. Release the button to lock the final reading.
- Measure the light irradiance on a daily basis during treatment and document the phototherapy dosage on the CICU observation chart.

BiliSoft LED blanket (Biliblanket)

- Delivers narrow band of high intensity blue light between 430-490nm and provides an irradiance between 35 $\mu\text{W}/\text{cm}^2/\text{nm}$ (large pad) and 50 $\mu\text{W}/\text{cm}^2/\text{nm}$ (small pad). The large pads are currently used in CICU.
- It can be used alone for standard phototherapy or in conjunction with the NeoBlue LED phototherapy light for double light phototherapy treatment.
- Promotes developmental care and parental bonding as the infant can be swaddled, held or fed during phototherapy treatment. Protective goggles must be worn when the lights are on.

BiliSoft LED blanket (Biliblanket)

- The BiliSoft LED blanket can be used alone for standard phototherapy or in combination with overhead lights to provide double phototherapy treatment.
- Ensure that a new protective cover is used for each infant. The covers are single patient use and slide over the BiliSoft fibre optic pad. The cover should be changed if it becomes soiled.
- Insert the fibre optic cable into the BiliSoft box and turn the box on using the switch on the front.
- There are two sides to the BiliSoft LED blanket. **Ensure that the illuminated area (brightest side) faces upwards and is in direct contact with the infant's skin.**
- The biliblanket alone does not keep the infant warm. Depending upon the infant's condition, they can either be nursed under a radiant warmer, in an incubator or swaddled in blankets. Blankets and nesting materials can be wrapped around the outside of the biliblanket. A hat may be worn to reduce infant heat loss. **Do not place blankets between the baby and the biliblanket.**
- Monitor temperature hourly until stable and then at least every 4 hours.
- Document on the CICU flowchart and in the patient notes that the BiliSoft LED is being used. Continue to monitor observations as per [Clinical Observations in CICU](#) and in accordance with the infant's condition.
- The BiliSoft LED blanket is x-ray compatible therefore the infant is not required to be removed from the blanket for an x-ray.

Nursing Considerations for a neonate under phototherapy lights.

Surface Area

- The baby should be undressed to expose as much skin as possible to the phototherapy lights. The greater the surface area exposed, the more effective phototherapy treatment is.
- When bilirubin levels are extremely high, as much surface area should be exposed as possible. This can be achieved by laying the baby on top of the biliblanket and using the bililights from above the baby.

Light sensitive goggles should be used at all times by all staff caring for the child receiving phototherapy.

Fluids and hydration

- Additional fluids or supplementation during phototherapy aren't necessary unless there are signs of dehydration. There is no evidence that excessive fluid administration affects the serum bilirubin concentration.
- The fluid requirements for each infant receiving phototherapy should be individualised and enteral feeds / breastfeeds should continue where possible.
- Accurately document fluid balance. Bilirubin is excreted in the urine / stools so maintaining adequate hydration and urine output helps improve the efficacy of phototherapy.
- The urine may appear darker with bilirubin excretion. Perform a urinalysis each shift to check the specific gravity. A specific gravity of 1.010 or greater may indicate the need to increase fluid input.
- Assess and record stools. Phototherapy can cause loose, dark green stools. Pale stools may indicate obstructive jaundice which requires further investigation.

Skin Care

- Use warm water to clean the infant and dry afterwards to help maintain skin integrity. Creams and oils should not be used on exposed skin during phototherapy.
- Check the infant's buttocks during nappy changes for signs of excoriation. Creams may be applied to the nappy area as this area is not exposed to the lights. If the nappy is removed during intensive phototherapy, ensure that any creams are also removed.
- Observe skin colour and document any rashes or skin irritation that may arise during phototherapy treatment.

- Change the infant's position with cares as per [Paediatric Intensive Care Patient - Patient Care in CICU - SCH](#). More frequent turning has not shown to improve the effectiveness of phototherapy.

Eye Care

- Eye shields must be worn when phototherapy lights or the biliblanket are in use.
- Always turn the phototherapy lights off before performing eye care.
- Remove eye shields every 4-6 hours and cleanse the eyes as per [Paediatric Intensive Care Patient - Patient Care in CICU - SCH](#), observe eyes for any irritation or discharge and document accordingly.

FAMILY CENTRED NURSING CARE

- Ensure family understand why phototherapy treatment is necessary for their baby and what hyperbilirubinemia entails.
- Encourage parents to participate in their baby's cares and feeds, touch and comfort their baby. Under the guidance of medical team, phototherapy may be interrupted briefly for breastfeeds.
- Treatment should not be interrupted when bilirubin levels are approaching the exchange transfusion level.

Ceasing phototherapy

Once the infant's serum bilirubin is at least below 50micromol/L the phototherapy treatment can be ceased. Depending on the mode of delivery, this may indicate the removal of the blanket or the removal of the lights if both blanket and light are used together.

Rebound hyperbilirubinemia can occur within 12-24 hours following the cessation of phototherapy. Repeat serum bilirubin 12-24 hours after ceasing phototherapy lights, there is an expectation that the infants serum bilirubin will rise by 10%.

Exchange Transfusion

Exchange transfusion is the preferred method of treatment for severe hyperbilirubinemia.

Please refer to Exchange Transfusion section of [Jaundice - Neonatal Care - GCNC - CHW](#).

Appendix

A

	Time of birth _____ Baby's blood group _____ Direct antiglobulin test _____ Mother's blood group _____	Initial Serum Bilirubin (SBR) Date ____/____/____ Time taken ____:____ Result _____	FAMILY NAME _____ GIVEN NAMES _____ D.O.B. ____/____/____ M.O. ____ ADDRESS _____ LOCATION / WARD _____	MRU _____ <input type="checkbox"/> MALE <input type="checkbox"/> FEMALE
NEONATAL JAUNDICE TREATMENT THRESHOLD GRAPH ≥38 WEEKS GESTATION				
Blood test if performed FBC <input type="checkbox"/> YES <input type="checkbox"/> NO DATE ____/____/____ G8PD Screen <input type="checkbox"/> YES <input type="checkbox"/> NO DATE ____/____/____ Reticulocyte Count <input type="checkbox"/> YES <input type="checkbox"/> NO DATE ____/____/____				
Refer to GL2016_027 Neonatal - Jaundice identification and management of neonates ≥32 weeks				
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"> <p>LEGEND</p> <ul style="list-style-type: none"> — Red exchange transfusion treatment threshold line — Purple phototherapy treatment threshold line Plot the bilirubin measurement X indicates total serum bilirubin (SBR) O indicates transcutaneous bilirubin (TcB) See Guideline for urgent medical review criteria </div> <div style="width: 65%;"> </div> </div>				
Use the graph corresponding to gestation at birth. Do not change graph for corrected gestation.				
Adapted from the National Institute for Health Care Excellence (NICE) May 2010				
Time from birth NEONATAL JAUNDICE TREATMENT THRESHOLD GRAPH ≥38 WEEKS GESTATION SMR110.456				

B

	<p>NEONATAL JAUNDICE TREATMENT THRESHOLD GRAPH ≥ 38 WEEKS GESTATION</p> <p>Neonate with jaundice <24 hours of age or greater than 14 days of age should have urgent medical review and</p> <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> o Additional investigations (see Table B) o Transfer to a higher level facility if appropriate <p>Neonate with jaundice ≥24 hours of age</p> <ul style="list-style-type: none"> • Do a transcutaneous bilirubin (TcB) if well and >35 weeks or • Do an SBR if <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> o After 6 hours to ensure SBR is stable or falling, then o Every 12-24 hours for the duration of treatment • Consider <ul style="list-style-type: none"> o Additional investigations (see Table B) o Transfer to a higher level facility if appropriate 	<p>Use single light phototherapy if</p> <ul style="list-style-type: none"> • SBR is at or above the phototherapy treatment threshold line <p>Use multiple light phototherapy if</p> <ul style="list-style-type: none"> • 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 <p>If the SBR is rapidly rising or approaching the RED exchange transfusion treatment threshold line an urgent medical review should occur</p>	<p>Family Name</p> <p>Given Names</p> <p>D.O.B. ____/____/____ M.O.</p> <p>Address</p> <p>Location / Ward</p> <p>MRN</p> <p><input type="checkbox"/> MALE <input type="checkbox"/> FEMALE</p> <p>COMPLETE ALL DETAILS OR AFFIX PATIENT LABEL HERE</p>						
<p>Table A Risk Factors and Causes of Neonatal Jaundice</p> <p>Jaundice <24 hours of age - Suspect haemolysis until proven otherwise</p> <p>Immune - e.g. ABO blood group incompatibility, Rhesus disease, Kell, Duffy, anti-E</p> <p>Non-immune - e.g. G6PD</p> <p>Individual neonatal risk factors</p> <ul style="list-style-type: none"> • 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 		<p>Table B Additional Investigations</p> <table border="1"> <thead> <tr> <th>Clinical Feature</th> <th>Investigation</th> </tr> </thead> <tbody> <tr> <td>Neonate of Rhesus negative mother</td> <td>Blood Group Direct Antiglobulin Test (DAT) An immediate SBR is required if the DAT is positive and the SBR is unknown</td> </tr> <tr> <td>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</td> <td>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</td> </tr> </tbody> </table> <p>Identification of maternal blood group should also be considered with the above investigations</p> <ul style="list-style-type: none"> • Neonate with a total SBR approaching exchange transfusion thresholds <ul style="list-style-type: none"> • Serum albumin level • Liver function tests • Conjugated bilirubin <p>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)</p>		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
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C

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	<ul style="list-style-type: none"> • 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
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Linked documents

- [Neonatal Admission Pathway](#)
- [Sucrose - Management of Short Duration Procedural Pain in Infants](#)
- [Clinical Observations in CICU](#)
- [Paediatric Intensive Care Patient - Patient Care in CICU](#)
- [Hand Hygiene](#)
- [Jaundice - Neonatal Care - GCNC - CHW](#)

References

1. Jardine, L.A and Woodgate, P. (2015) Neonatal Jaundice: phototherapy. *Clinical Evidence* 05:319.
2. Olusanyqa, B.O, Kaplan, M. and Hansen, T. W. R (2018) Neonatal hyperbilirubinaemia: a global perspective. *The Lancet Child & Adolescent Health*, 2:8. P 610-620.
3. GE Healthcare. Bilisoft Phototherapy system. Available at http://www3.gehealthcare.com/en/products/categories/maternal-infant_care/phototherapy/bilisoft_phototherapy_system <Accessed 2021, December>
4. Lauer, B, J. and Spector, N. D. (2011) Hyperbilirubinemia in the newborn. *Pediatrics in Review*, 32, 8, 341-349.
5. Natus Medical Incorporated. NeoBlue LED Phototherapy, Hospital Inservice Brochure. Available at http://www.natus.com/documents/051693H_Neoblue_in_service.pdf <Accessed 2021, December>
6. Natus Medical Incorporated. NeoBlue radiometer information. Available at http://www.natus.com/documents/000629C_neoBLUE_Radiometer_EN_US_lo_res.pdf <Accessed 2021, December>
7. NSW Health (2016) Neonatal – Jaundice Identification and Management in Neonates ≤ 32 Weeks Gestation. Clinical Guideline.
8. Royal Prince Alfred Hospital. Newborn Care Protocol Book. *Phototherapy*. <http://www.slhd.nsw.gov.au/rpa/neonatal%5Ccontent/pdf/guidelines/phototherapy.pdf> <Accessed 2016, February 1>
9. Schwartz, H. P., Haberman, B. E. and Ruddy, R. M. (2011) Hyperbilirubinemia, Current guidelines and emerging therapies. *Pediatric Emergency Care*, 27, 9, 884-889.
10. Stokowski, L.A. (2011) Fundamentals of phototherapy for neonatal jaundice. *Advances in Neonatal Care*, 6, 6, 303-312.