




## Guideline

### Women and babies: Phototherapy – Nursing management of the neonate

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<b>Functional Sub-Group:</b>	Clinical Governance
<b>Summary:</b>	This guideline describes the devices currently used in RPA Newborn Care to deliver phototherapy. The guideline also discusses the nursing management of the newborn receiving phototherapy.
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**Note:** Sydney Local Health District (LHD) and South Western Sydney LHD were established on 1 July 2011, with the dissolution of the former Sydney South West Area Health Service (SSWAHS) in January 2011. The former SSWAHS was established on 1 January 2005 with the amalgamation of the former Central Sydney Area Health Service (CSAHS) and the former South Western Sydney Area Health Service (SWSAHS).

In the interim period between 1 January 2011 and the release of specific LHN policies (dated after 1 January 2011) and SLHD (dated after July 2011), the former SSWAHS, CSAHS and SWSAHS policies are applicable to the LHDs as follows:

Where there is a relevant SSWAHS policy, that policy will apply

Where there is no relevant SSWAHS policy, relevant CSAHS policies will apply to Sydney LHD; and relevant SWSAHS policies will apply to South Western Sydney LHD.

## **Women and babies: Phototherapy - Nursing management of the neonate**

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## Phototherapy - Nursing management of the neonate

### 1. Introduction

Phototherapy has been used since 1958 for the treatment of neonatal hyperbilirubinaemia (Cremer RJ, Perryman PW & Richards DH., 1958). Unconjugated bilirubin exposed to phototherapy changes to a water soluble form (lumirubin) that can be excreted in the urine and bile (Vreman HJ, Wong RJ, Stevenson DK., 2004; Maisels & McDonagh, 2008). The aim of phototherapy is to decrease the level of unconjugated bilirubin in order to prevent acute bilirubin encephalopathy, hearing loss and kernicterus (American Academy of Paediatrics (AAP), 2011)

Phototherapy is frequently used on the neonatal unit to reduce bilirubin levels in the sick and / or preterm infant. Phototherapy is also delivered on the postnatal wards and in the home for the otherwise well infant.

This guideline is to be used in conjunction with the following clinical practice guidelines:

- Jaundice
- Jaundice – conjugated
- Jaundice - haemolytic
- Exchange transfusion
- Use of the transcutaneous bilirubinometer (TcB)

#### The risks addressed in this policy:

- inadequate dose of phototherapy delivered
- inability to see infant's skin colour when under overhead phototherapy.
- airway obstruction from displaced eye mask
- skin rashes and excoriation to nappy area
- interruption to establishment of lactation
- maternal anxiety and distress due to infant/maternal separation

#### The aims / expected outcomes:

Nurses will be able to effectively and appropriately manage an infant receiving phototherapy

Nurses will be able to use phototherapy devices correctly

Nurses will be able to discuss management strategies with the family and ease concerns

## 2. Guideline Statement

This guideline will outline safe and effective nursing management and use of devices for the treatment of a neonate receiving phototherapy for hyperbilirubinaemia.

## 3. Principles / Guidelines

The aim of phototherapy is to decrease the level of unconjugated bilirubin in order to prevent acute bilirubin encephalopathy, hearing loss and kernicterus (American Academy of Paediatrics 2004)

Devices emitting light between 400 - 500 nanometres (peak at 460nm) are specifically used for administering phototherapy as bilirubin readily absorbs this wavelength of light. The light is visible blue light and contains no ultraviolet light (Vreman et al 2004).

Phototherapy is delivered on the postnatal wards and at home for the otherwise well late preterm and term infant. Phototherapy is frequently used on the neonatal unit and the following guidelines primarily relate to those infants admitted to Newborn Care for phototherapy management.

### 3.1 Phototherapy in Newborn Care

The decision to start phototherapy is based on the level and rate of rise of serum bilirubin, the gestational and postnatal age of the infant and the underlying cause of the hyperbilirubinaemia. Factors that influence the efficacy of phototherapy include: the light wavelength and irradiance, bilirubin level, birth weight, gestational age, postnatal age, surface area exposed, skin thickness and pigmentation and the aetiology of the jaundice (Vreman et al 2004; AAP 2011; Tan 1991).

Once the decision to administer phototherapy is taken, both the required dose and the most appropriate method of delivery should be determined. When phototherapy treatment is ordered in the medical record, *single lights* or *double lights* may be requested. This refers to the number of phototherapy devices to be used and in most instances a single light is adequate to slow the rise in physiological serum bilirubin. For rapidly rising bilirubin and to minimise the risk of exchange transfusion, double and even triple phototherapy can be used. Commencement of phototherapy is then documented on the Neonatal Jaundice Control form (MR535) and in the medical record

## 3.2. Phototherapy devices used in Newborn Care

### 3.2.1 Overhead phototherapy devices

**\*\*Eye protection and SpO<sub>2</sub> monitoring must be used for all infants managed using overhead phototherapy\*\*.**

*neoBLUE<sup>®</sup> LED (Light emitting diode) phototherapy system & neoBLUE<sup>®</sup> mini LED Phototherapy system (Natus) (for small babies < 1500gm or as 2<sup>nd</sup> light source)*

The LED phototherapy is as efficient if not more efficient than conventional phototherapy (fluorescent lamps) and halogen spotlights in terms of faster bilirubin photo degeneration (Belma, Ömer, Begum & Saadet 2007; Kumar, Chawla & Deorari 2011). Both systems deliver either conventional phototherapy (single output) <math>12\mu\text{w}/\text{cm}^2/\text{nm}</math> or intensive phototherapy at >math>30\mu\text{w}/\text{cm}^2/\text{nm}</math>. When using high intensity phototherapy the LED phototherapy has minimal heat production (Kumar et al 2011). In Newborn Care high dose phototherapy is routinely used for all infants. LED panels can be used for up to 10,000 hours and the system can be adjusted both horizontally and vertically. The manufacturer recommends a distance of 35 cm or closer in order to deliver a sufficient dose of phototherapy.

*Natus neoBLUE<sup>®</sup> overhead phototherapy unit*



*Dräger Phototherapy 4000 Unit.*

The fluorescent tubes in this system can deliver both blue and white phototherapy – the meter on the side of the unit measures the operating time of the blue lights and these must be replaced every 1000 operating hours by the biomedical technician. Lamps must be cooled for at least one

minute before switching lights back on. Recommended distance is 30 cm from the infant. The manufacturer reports the dose delivered at 30cms for 4 blue lights will be  $2.4 \text{ mW/cm}^2$  and for 6 blue lights  $1.8 \text{ mW/cm}^2$  (Dräger Medical, 2008).

#### *Dräger Phototherapy 4000 Unit*



#### 3.2.2 Phototherapy blankets

*neoBLUE® blanket LED phototherapy Natus* – For use and stored in special care nursery

A narrow band of high intensity blue light via a single LED is delivered. It can be used in a cot, open care system, incubator, or while holding the infant. Small and large pads are available. There are a few steps that need to be done before commencing phototherapy treatment with the neoBLUE blanket. Place the NeoBLUE fiberoptic pad with appropriately sized and correct brand disposable cover in the infant's bed, position the LED source so that the air vents have unobstructed air movement and insert cable into light box. After turning on the device measure the light intensity by placing the photometer (light meter) in the center of the light emitting pad according to manufacturer's instructions. The meter should reach  $30\text{--}35 \mu\text{W/cm}^2/\text{nm}$ . Place the infant unclothed with nappy on top of the neoBLUE pad. The infant may be swaddled or covered with a blanket during phototherapy. The neoBLUE system may be used in conjunction with overhead lights.

*neoBLUE® blanket LED phototherapy Natus*



*Bilisoft™ LED phototherapy system (GE) – For use and stored in high dependency/NICU*

This system can be used in the same way as the NeoBLUE blanket LED phototherapy. It comes with a small and large fibreoptic pad depending on the infant's size. The disposable cover has straps that may be used to swaddle the infant. Allow the system to run for 5 minutes and then check irradiance level before using on the infant. The fibreoptic pad has several positions to measure irradiance levels. Please refer to the manufacturer's manual (attached to device) for further information.

Small pad for babies < 1500 grams -  $35 \mu\text{W}\cdot\text{cm}^2/\text{nm}$   
Large pad for babies > 1500 grams -  $50 \mu\text{W}\cdot\text{cm}^2/\text{nm}$   
Wavelength: 430-490 nm (peak 440-460 nm)

*Bilisoft™ LED phototherapy system (GE)*



### **3.3 Irradiance / dose of phototherapy**

Irradiance (energy output) is measured with a light meter in microwatts per square centimeter per nanometer ( $\mu\text{W}/\text{cm}^2/\text{nm}$ ) over a wavelength (440-480nm) (Maisels & McDonagh 2008).

- The closer the light is to the neonate, the higher the irradiance. Manufacturers' guidelines for the distance between the light source and infant should be followed.
- Intensive phototherapy requires a spectral irradiance of 30 -  $40\mu\text{W}/\text{cm}^2/\text{nm}$  delivered over as much body surface as possible (Hart & Cameron 2005; AAP 2011).

*Ohmeda Biliblanket® meter II (light meter)*



*Procedure - using the Ohmeda Biliblanket® meter II (light meter):*

The light meters are located in the special care nursery and NICU. Please clean and return immediately after use.

- Turn machine on – with cap on
- Wait for machine to calibrate – **CAL – 0.0**
- Remove cap from light source and place sensor as close as possible to the phototherapy exposed surface of the infant
- Several measurements eg 3 should be taken in the illuminated area at the neonate's skin level and an average of the measurements should be made to determine an overall effective irradiance (Maisels & McDonagh 2008). You can freeze the display reading by pressing the button on the side of the machine to its inward position
- Document the average irradiance dose on the *Neonatal Jaundice Control Form (MR535)*
- If light irradiance is less than  $25\mu\text{W}/\text{cm}^2/\text{nm}$  remove device and use another – report to biomedical engineering (BEIMS)
- Clean the light meter with mild detergent wipes before and after use
- Measure the irradiance daily and record on the *Neonatal Jaundice Control Form (MR535)*

### **3.4 Parental Support**

The gestation, postnatal age and infant's general well being, along with the aetiology of jaundice, serum bilirubin levels and rate of rise will all influence the type of information given to support parents during their infant's phototherapy treatment.

Parents need a clear explanation of jaundice, how phototherapy works and what nursing care infants require while under "lights". Mothers should be encouraged and supported to continue feeding, caring for and interacting with their infants as appropriate.

### **3.5. Nursing management**

Infants will be nursed in an incubator, open care system or a cot. This will be dependent on gestation, weight, aetiology of jaundice and type of phototherapy system to be used.



- Incubators are used for the preterm, low birth weight and / or sick neonate.
- An open care system is used for the sick / high risk infant > 35 weeks to facilitate access and avoid overheating.

Both overhead lights and fibreoptic devices can be used in these environments.

- When serum bilirubin levels are not rising rapidly and the late / term infant is otherwise well, nurse in a cot and use the NeoBLUE blanket LED phototherapy or the Bilisoft LED phototherapy system to better facilitate parental access, care giving and infant settling.

### **3.5.1 Skin care**

A more rapid response to treatment can be achieved by exposing larger surface areas to the phototherapy light. For infants with a rapidly rising serum bilirubin level, for example ABO incompatibility, the maximum area of skin should be exposed. This may require use of *double phototherapy* and removal of the nappy (AAP 2011). The manufacturers' instructions for each device recommend the distance of lights from infant, usually 35 cm or less (Natus Pediatrics 2012; GE Health Care, 2013). When using overhead phototherapy, there should always be a protective plastic shield between the baby and overhead phototherapy unit (covering the light globes/tubes).

Preterm / term infants with physiological jaundice may have nappies left on if bilirubin is not rising rapidly (Pritchard, Beller and Norton, 2004).

Keep the infant clean and dry. The registered nurse/ enrolled nurse should be proactive with early use of barrier creams if stools are loose and green. Infants nursed in nappies or where the buttocks are not directly exposed to the phototherapy may have zinc and castor oil (Sudocrem®) applied to areas of skin excoriation. Oils and creams are not routinely applied to phototherapy exposed skin however if LED phototherapy is used, emollients and creams may be used with caution (LED technology uses "cold light").

For infants less than 27 weeks, the topical emollient Eucerin® when applied sparingly may be used while the infant is receiving phototherapy (Lane & Drost 1993). Monitor the infant's temperature frequently and observe for possible overheating.

### **3.5.2 Eye care**

There has been some speculation about an association between neonatal phototherapy and retinopathy of prematurity (ROP) however a Cochrane review reports that in the relevant reviewed studies no association was found (Okwundu,C.I, Okoromah,C.A.N.,& Shah P.S. 2012). For infant comfort, eye protection (phototherapy masks) must be used for all babies nursed under overhead phototherapy.

Phototherapy masks are recommended by the manufacturer to be used when babies are nursed in cots wrapped in a biliblanket for comfort however this can be at the nurses discretion i.e. if light escapes outside the baby's cuddly, a mask should be used. When on home phototherapy the infant does not require eye protection. Eyemax<sup>2</sup> (Fisher & Paykel) eye shields are used *Sizing*: 1- Micro size head circumference (HC) 20- 25cm; 2 - Preemie size HC 26-32cm; or 3 - Regular size (term infants) HC 33- 38cm.

### **3.5.3 Observations**

- Neonates must be weighed on admission to the nursery and then 2<sup>nd</sup> daily and documented as per protocol weight-length-head circumference on the *Neonatal Weight Chart (MR550)*.
- Monitor the infant's temperature more frequently when commencing phototherapy and once stabilised, record at least 4<sup>th</sup> hourly
- Preterm / unwell infants receiving phototherapy should have temperature, pulse, respiration rate and oxygen saturation monitored and documented 1- 4<sup>th</sup> hourly on the appropriate observation chart
- Otherwise well term infants may only need temperature monitored 4<sup>th</sup> hourly and as needed
- All infants managed with overhead phototherapy or with eye protection in place need a Masimo® saturation monitor (SpO<sub>2</sub>) to detect airway obstruction / apnoea.
- If an infant >35 weeks is nursed in any other position than supine or if the infant's colour is masked by the phototherapy a Masimo® SpO<sub>2</sub> monitor must be used to detect apnoea.
- The date and time phototherapy is commenced / discontinued, the type of phototherapy device (s) and the dose of phototherapy should be documented on the *Neonatal Jaundice Control Form (MR535)*. Serum bilirubin (SBR) and transcutaneous bilirubin (TcB) results are also recorded here – see *Use of transcutaneous bilirubinometer and Jaundice protocols*.

### **3.5.4 Feeding / fluid requirements**

All infants admitted to the newborn care for the management of jaundice will be seen by the high risk lactation specialists who will assist the nurse and mother to implement an individualised

feeding plan. This plan will be dependent on maternal choice, supply, method of feeding and the infant's general wellbeing. Some mothers may need to maintain / increase supply by expressing if their infant is sleepy or unwell.

Unless serum bilirubin levels are rising rapidly, phototherapy may be interrupted for breast feeds, parental visits and skin to skin care (Samra, El Taweel & Cadwell 2012; Bertini, Dani, Tronchin & Rubaltelli 2001).

It is essential the nurse accurately document fluid intake (enteral or intravenous) and output, recording urinalysis and specific gravity 8<sup>th</sup> hourly (each shift) and stool losses.

#### *Late preterm / term infants*

The breast fed infant should continue demand feeding if there is an adequate maternal supply, the infant is attaching and sucking well (code 5-6) and the infant remains active and demanding feeds. Sucking, attachment and mother's milk supply should be observed and documented on infant case history notes (MR 45). Complementary feeds with expressed breast milk or semi hydrolysed formula may be required if maternal supply is problematic, oral intake is insufficient or there is evidence of dehydration (Mehta, Kumar & Narang 2005).

Bottle fed infants should continue on the mother's formula of choice. Bottle fed infants should be fed on demand if their intake is adequate, they remain active and continue to demand feeds.

#### *Preterm neonates < 35 weeks*

Maintaining a good fluid balance is important for the preterm infant, as both excess fluid and dehydration can potentially cause problems. Measures such as fluid input and output, serum sodium levels and urine specific gravity are used to assess the fluid requirements for each preterm infant. Gestational age, postnatal age and ambient environment such as use of humidity will influence fluid requirements (Grunhagen, De Boer, Jan De Beaufort and Walther 2002). The need for additional fluid intake should be discussed with the admitting staff specialist / fellow and reviewed at least daily. Fluids are not routinely increased when phototherapy is commenced.

### **3.6 Possible complications**

Phototherapy has been used since the early 1958 and few side effects have been documented.

- *Poor feeding* – Infants with jaundice are often sleepy and do not wake for feeds. Assess infant attachment and suck and hydration on admission. Use of expressed breast milk via bottle or intra gastric tube may be necessary for some infants.
- *Skin rashes* – usually only temporary but if the phototherapy lights are too hot there is the potential to overheat the skin.
- *Temperature instability* – can occur in infants under radiant warmers or in closed care systems – monitor closely. Now less likely to occur with the LED phototherapy systems.
- *Loose stools and peri-anal excoriation* – due to transient lactose intolerance
- *Increased insensible water loss* – this can be managed by increasing the daily fluid requirements if required. This is assessed on a case by case basis.
- *Maternal-infant separation* – otherwise well late preterm / term infants should be managed on the postnatal ward when appropriate and safe to do so.

Parental access and continued care giving can be facilitated with the use of the NeoBLUE® blanket LED phototherapy or the Bilisoft™ LED phototherapy systems.

### **3.7 Phototherapy at home – Newborn Family Support Team (NFST) / Midwifery Discharge Support Programme (MDSP)**

Infants with moderate physiological jaundice may receive phototherapy at home under the observation of the NFST / MDSP domiciliary teams. The decision for home phototherapy must be made by the neonatal fellow or neonatologist in consultation with the team leaders NFST / MDSP and the management of jaundice should be consistent with the RPA Newborn Care Jaundice Guideline.

The neonatologist / fellow and relevant team need to discuss this treatment option with parents as soon as possible – some parents may choose to admit their infant to the nursery for phototherapy.

Home phototherapy can be considered either as a continuation of phototherapy commenced in hospital or as a new treatment in infants who have been discharged. NFST has three NeoBLUE® blanket LED phototherapy devices and MDSP has three Bilisoft™ LED phototherapy systems for this purpose.

The process should be initiated either through MDSP, for those babies on early discharge or going home from the postnatal wards or NFST for babies being reviewed in the jaundice clinic or being discharged home from the nurseries.

Home phototherapy cannot be offered for babies who live outside the area covered by MDSP. Liaise with NFST regarding their service areas.

*Contact details:*

NFST Office: (02) 9515 6435 or 9515 6436 (this one links to mobile phone)

Infants being considered for phototherapy at home should have the following investigations:

Full blood count and film

Total and indirect bilirubin level

Blood group and direct Coombs test (note maternal group)

G6PD in male babies of high risk ethnic groups including: Asian, Middle Eastern, Mediterranean and African ethnicity.

MDSP and NFST should liaise with the neonatal fellow or neonatologist on service for the timing of repeat SBR tests and when to discontinue phototherapy. Use of the TcB may help to reduce the number of SBRs performed (see TcB policy).

Repeat bilirubin tests should be done at home but if this is not possible the family will need to attend the morning Jaundice Clinic in Newborn Care. A copy of the Neonatal Jaundice Sheet (MR 535) with the infant's details and history of bilirubin results must be available at the front desk so the infant's history and progress is accessible for the appointment.

The infant will be reviewed by the neonatal fellow at 10:00hr prior to the Blood Collector taking the repeat bilirubin level. If it is necessary for the baby to come in for blood tests, then the baby will continue under the care of either MDSP or NFST in liaison with the neonatal fellow or neonatologist as above.

### **3.8 Cessation of phototherapy**

There is no consensus for the cessation of phototherapy (AAP, 2011). The following pragmatic criteria are used in Newborn Care:

*Term babies:*

Day 3: Stop at the discretion of the neonatologist as the jaundice is likely to be pathological

Day 4: Stop phototherapy when the SBR is 280 mmol/L or below for well term infants with physiological jaundice who have no additional risk factors i.e haemolysis, blood group incompatibility, hypo-albuminaemia

*Preterm babies:* Stop at the discretion of the neonatologist

#### 4. Performance Measures

Monitoring of Incidents/adverse events as reported in IIMS

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