



Our Lady's Children's Hospital, Crumlin		
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1.0 Introduction


Jaundice is a common condition in newborn infants and is a clinical sign of excess conjugated or unconjugated bilirubin (hyperbilirubinaemia). It is characterised by a yellow colouring of the infant's skin and other tissues caused by high levels of circulating unconjugated bilirubin due to the breakdown of red blood cells. Jaundice is present when serum bilirubin is > 85 micromols/l. There is a 60% incidence of jaundice in full term infants (1st week) and 80% incidence in preterm infants (Hellowell and Crathern 2011, NICE 2014).

Pathophysiology of Jaundice

During red cells breakdown, haemoglobin is converted into bilirubin and removed to the liver. Conjugated bilirubin is water soluble and is excreted by the liver (Alexander 2010). However unconjugated bilirubin is not water soluble and it cannot be excreted by the liver and it is toxic to the body in high levels. Physiological jaundice is due to a high level of unconjugated bilirubin together with an immature liver which causes a buildup of unconjugated bilirubin in the blood (hyperbilirubinaemia). Bilirubin is pigmented which causes a yellowing of the baby's skin and tissues. A low level of bilirubin is usually not a concern as most infants will experience a certain amount of physiological jaundice which results in no problems. However, if unconjugated bilirubin levels rise rapidly above a safe level and are left untreated the bilirubin can cross the blood-brain barrier and be deposited in the brain stem (basal ganglia) and cerebellum, disrupting cellular metabolism causing irreversible brain damage (bilirubin encephalopathy) leading to kernicterus. Bilirubin encephalopathy occurs first and later kernicterus (American Academy of Pediatrics (AAP) 2004, Great Ormond Street Hospital (GOSH) 2009).

Causes of Jaundice

- **Physiological Jaundice:** Occurs in 60% of term and 80% of preterm infants (AAP, 2004, Chowdhury 2007). The newborn has a high level of haemoglobin combined with a short red cell life leading to a high rate of haemolysis whilst the body mass bilirubin production is more than double in the neonate. This combined with other physiological changes that occur during transition from intra to extra-uterine life can force bilirubin to be processed at a challenging rate for the newborn. Jaundice usually occurs at 2-3 days of life and has resolved by 7-14 days of life. 3 weeks in preterm infant (University of Michigan Health System, UMHS 2005, RCH 2015a).
- **Breastfeeding Jaundice:** Occurs in 10% of newborns when the infant does not drink enough breast milk and is similar to physiological jaundice but is more pronounced. The mother may require assistance / support with breast feeding. May continue for a number of weeks and cessation of breast feeding is not recommended (Maisels *et al.* 2014, NICE 2014, RCH 2015a).
- **Breast-Milk Jaundice:** This occurs in 1-2% of breast fed babies and is caused by a substance that is produced in the breast milk. Enzyme activity in the infant's liver, slows the breakdown and secretion of bilirubin. Jaundice starts at 3-5 days of age and can last 3-12 weeks (occasionally up to 16 weeks). Breastfeeding does not need to be discontinued as there are no recorded cases of kernicterus resulting from this cause. The infant should however continue to be monitored for signs of improvement / worsening jaundice (Wong and Bhutani 2016).
- **ABO Blood Group Incompatibility and Rhesus Incompatibility (Haemolysis):** These can occur if the mother produces antibodies that destroy the newborn's red cells, resulting in haemolysis of the infant's blood. This leads to a sudden buildup of bilirubin in the infant's circulation during the first 24hrs of life. ABO incompatibility is less severe than Rhesus Incompatibility, however both varieties present with the most serious type of jaundice (UMHS 2005).

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- **Other Pathological Causes:** i.e. sepsis, endocrine /metabolic disorders, bile duct obstruction, G6PD deficiency.

Signs and Symptoms of Jaundice

- Yellowing of skin colour, soft palate and sclera of eyes
- Lethargy
- Poor feeding
- Darkened urine
- Dark or grey stools (Macqueen *et al.* 2012).

Jaundice is usually observed in the face and progresses gradually to the trunk and extremities. Therefore a thorough examination in bright natural light should be carried out where possible to determine the extent of jaundice.

Risk Factors for Jaundice

- Prematurity (under 38 weeks gestation)
- Hypoalbuminaemia
- Hypoxia
- Dehydration
- Hypothermia
- Acidosis
- Polycythemia
- Haemolytic Disease
- Bruising
- Hypoglycemia
- Hyperlipidaemia
- Sepsis
- Previous sibling with neonatal jaundice requiring phototherapy
- Exclusive breast feeding
- Visible jaundice within 24 hours (National Institute for Health and Clinical Excellence (NICE) 2010, GOSH 2014, NICE 2016)

Serum Bilirubin (SBR)

2 Types


- Unconjugated Bilirubin (Indirect)
- Conjugated Bilirubin (Direct)

Total bilirubin level (TSB) i.e. sum of unconjugated and conjugated serum bilirubin and is used when making decisions regarding management of unconjugated hyperbilirubinaemia (unconjugated fraction > 85% of total) (RCH 2015a, 2015b).

Diagnosis of Jaundice

A serum bilirubin level will be used in conjunction with signs and symptoms of jaundice. The serum bilirubin level along with the gestational age and postnatal age will be plotted on the 'Treatment Threshold Graph' developed by (NICE) 2010. This will be plotted by the neonatal/medical team.

NB: It is necessary to proceed more cautiously if the serum is above certain levels (i.e. conjugated bilirubin level greater than 25micromol /litre) due to the potential consequences of serious potentially

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irreversible liver disease. Pale stools / dark urine also indicates conjugated hyperbilirubinaemia (NICE 2010, RCH 2015a).

Exchange Transfusion

In severe cases of increased bilirubin where the level reaches exchange transfusion level on the NICE graph, the neonatal consultant must be immediately informed by the medical team. The neonatal consultant will make the final decision regarding exchange transfusion therapy, taking into account the serum bilirubin level, gestational age, clinical condition and risk factors involved (NICE 2010).

Exchange transfusion is a rapid and effective method of controlling unconjugated hyperbilirubinaemia and is used when phototherapy has been unsuccessful and there is a high risk of kernicterus developing (AAP 2004). Such infants are always transferred to PICU, because twice the infants circulating blood volume is progressively replaced with compatible whole blood, thereby removing the serum bilirubin. Exchange transfusion may be considered by the neonatal consultant, in the case of other causes of jaundice.

Audiology Screening for Infants with Hyperbilirubinaemia


High levels of bilirubin can damage the auditory nerve (similar to effects of high levels of gentamicin). When a bilirubin level is 400 mmols/l or greater, audiology screening is carried out as soon as possible and if damage to the auditory nerve is detected, the infant will be referred to DeafHear (Miletin 2011). DeafHear is an organisation which provides a range of services to deaf and hard of hearing people and their families. This application to DeafHear must be performed urgently before 8 weeks of age as late applications are not accepted for this disorder by DeafHear. In the rare event of intravenous immunoglobulin (IVIG) with levels 400mmols/L or greater or an exchange transfusion is required, an urgent audiology screening should be carried out.

Acute Bilirubin Encephalopathy (ABE) / Kernicterus

Acute bilirubin encephalopathy describes the acute manifestations of bilirubin toxicity (bilirubin induced neurologic dysfunction) (BIND), which is seen in the first week of life (AAP 2004, Wong and Bhutani 2016). Current UK incidence of acute bilirubin encephalopathy is 0.9/ 100,000 (Allen *et al.* 2009). Kernicterus is a pathologist's term describing the yellow deposits and brain cell death from extremely high levels of bilirubin, generally 425-510 mmols/l. It usually refers to the chronic or permanent clinical sequelae of bilirubin toxicity / BIND (Wong and Bhutani 2016). Kernicterus can lead to cerebral palsy, learning difficulties and nerve deafness and it can be fatal in up to 75% of cases. Although a rare occurrence, reported cases of kernicterus still occur. Approximately 6-7 kernicterus cases are reported in the UK annually (AAP 2004, Fellows 2005, NICE 2014).

Signs and Symptoms of Acute Bilirubin Encephalopathy / Kernicterus

- Abnormalities of tone, including increased tone (hypertonia), decreased tone (hypotonia)
- Arching the neck (retrocollis) or trunk (opisthotonus)
- Lethargy, difficulty in arousing the baby
- High-pitched cry
- 'Sunset eyes' once seizing
- Irritability
- Apnoea
- Fever
- Seizures
- Poor feeding / suck
- Sensorineural hearing loss

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Kernicterus

- Athetoid cerebral palsy
- Cognitive and motor delay
- Extrapyrmidal cerebral palsy disturbances
- Auditory dysfunction
- Gaze palsy
- Dental enamel dysplasia
- Intellectual impairment

(AAP 2004, Juretschke 2005, Nice 2010, QMNCG 2012).

Risk Factors for Adverse Sequale of Kernicterus

- Serum bilirubin > 340 mmols/l and < 37 weeks gestation
- Rapidly rising serum bilirubin > 8.5 mmols/l per hour
- Clinically signs and symptoms of kernicterus / acute bilirubin encephalopathy (NICE 2010).
- Pathological i.e. sepsis, endocrine, metabolic disorders, G6PD deficiency and bile duct obstruction

2.0 Determining Need for Phototherapy

Phototherapy is the application of fluorescent lights over the infant's skin to assist in reducing the serum bilirubin level in the infant's blood (Alexander 2010). Blue light waves 425-475nm (nanometers) from the fluorescent lights are absorbed by the infant's skin and blood; this converts the unconjugated bilirubin to conjugated bilirubin which can be eliminated by the body via urine and stool, thereby reducing the need for exchange transfusion and preventing the onset of kernicterus. The Giraffe Incubator has a SPOT PT Lite™ halogen phototherapy light. This is a high intensity natural broad spectrum white light which provides 30-40microwatts per centimetre squared per nanometer (uW/cm²/nm) in the blue-green spectrum at 38 centimetres (cms). Advantages include improved visualisation and assessment of the infant i.e. cyanosis, however it's less effective and only a fraction of light is absorbed by bilirubin compared to traditional blue light in the treatment of jaundice. Blue light is predominantly in the blue green spectrum and this light penetrates the infant's skin more easily and is absorbed maximally by bilirubin (Seidman *et al.* 2003, AAP 2004, Chowdhury *et al.* 2007, Alexandra 2010, Skinner 2010).

The effectiveness of phototherapy depends on the degree of the infant's surface area exposed to the lights. Single phototherapy is when one phototherapy unit is used. Double and triple phototherapy indicates the use of 2 or 3 units concurrently. Using one or more unit at one time allows as much of the infant's body-surface as possible to be exposed to the light. The light source would usually be placed both above (overhead lights) and beneath the infant (bili-blanket) (Sarici *et al.* 2000, AAP 2004, Hansen 2016). A bili-blanket is a fibre-optic light source transmitted via a cable which delivers a high intensity uniform light.

The duration of phototherapy treatment will be determined by the level of serum unconjugated bilirubin. Phototherapy may be discontinued when levels fall to at least 50micromols/l below threshold for phototherapy or as determined by the neonatology consultant (NICE 2014, 2016).

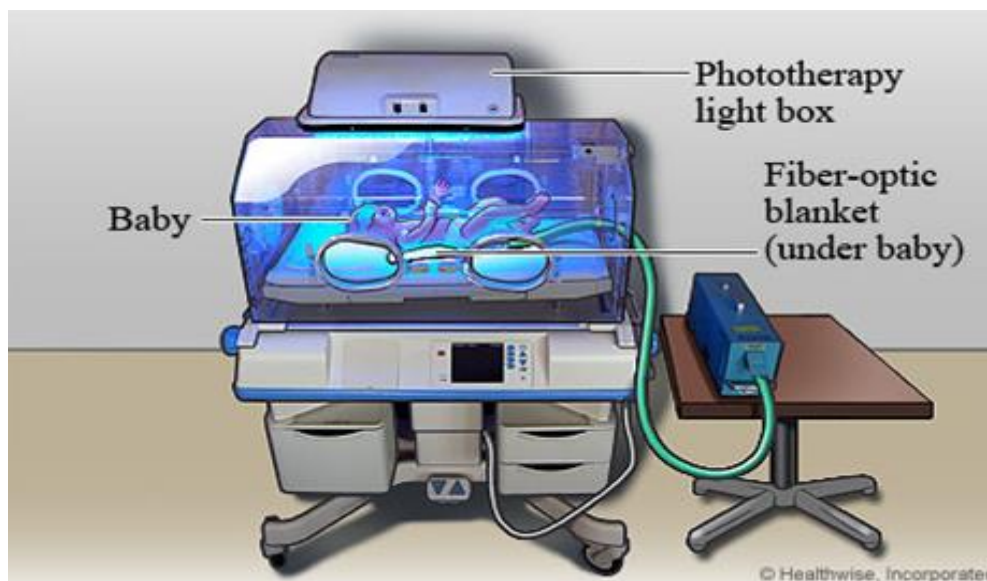



Figure 1: Infant receiving phototherapy using phototherapy light and Bili-Blanket (Healthwise Incorporated 2010)

ACTION	RATIONALE EVIDENCE and REFERENCE
Recognise the possible need for phototherapy based on risk factors listed above and blood testing.	This will assist in the prompt and timely detection and treatment of jaundice.
<p>Perform a physical assessment of the infant to assess for the presence of jaundice i.e. following performing vital signs.</p> <p>The infant should be stripped down to perform an accurate assessment.</p> <p>Where possible perform assessment in bright, natural daylight.</p> <p>Jaundice can be detected by blanching the skin with digital pressure.</p> <p>In non-Caucasian infants, the gums and sclera of the eyes should be observed. Also press lightly on the skin and observe 'branched skin' for jaundice.</p> <p>Jaundice appears first in the face and progresses caudally to the trunk and extremities.</p>	<p>Identifying signs will assist in determining the presence of jaundice</p> <p>Jaundice is usually first observed in the face and progresses gradually to the trunk and extremities. Therefore a thorough examination should be carried out to determine the extent of jaundice (AAP 2004).</p> <p>Artificial light can make it more difficult to accurately assess for jaundice (Alexander 2010, NICE 2016).</p> <p>This reveals the underlying colour of the skin and surrounding subcutaneous tissue (AAP 2004).</p> <p>Assessing these areas for jaundice is effective across all skin tones (Alexander 2010, NICE 2010, 2016).</p> <p>Visual identification although helpful is not considered reliable (AAP 2004, Simons 2005, QMNCG 2012).</p>
Observe for clinical features of jaundice as identified in Section 1	Identifying signs will assist in determining presence of jaundice (Cohen 2006).

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<p>A serum bilirubin level is taken on all infants within 2 hours, where jaundice is observed.</p> <p>Check blood glucose also.</p>	<p>Level must be determined prior to commencing phototherapy as prophylactic phototherapy before jaundice is ineffective (Truman 2003, NICE 2014, 2016).</p> <p>Undetected hypoglycaemia can be caused by metabolic disorders caused by liver diseases i.e. galactosamia (NICE 2014)</p>
<p>The serum bilirubin level along with the gestational age and postnatal age will be plotted on the appropriate gestational age graph developed by the National Institute for Health and Clinical Excellence in mmols / litre (NICE 2010). (Appendix 2)</p>	<p>This will determine and indicate need and level of treatment required (NICE 2010, 2014).</p>
<p>Document all nursing assessments, nursing care and bilirubin levels in nursing notes as appropriate.</p>	<p>To maintain accountability through accurate recording of clinical practice (NMBI 2015).</p>

3.0 Treatment of Jaundice with Overhead Phototherapy Lamps and Nursing Management


Equipment


- Phototherapy lamps
- Eye shields
- Scissors
- Incubator (warmed to appropriate temperature) see thermoregulation guidelines
- White linen
- Eye care tray
- Nappy scales (to accurately measure output)


ACTION	RATIONALE EVIDENCE and REFERENCE
<p>The decision to commence phototherapy is made by the neonatologist.</p> <p>Explain the need for phototherapy and the functions of the equipment to the parents as clinically indicated.</p> <p>Reassure them that their baby can be removed from the incubator for feeding and that they may still be involved in their infant's care as clinically indicated.</p> <p>Provide written information if appropriate.</p>	<p>Providing explanations and reassurance can reduce stress and anxiety whilst encouraging bonding (Macqueen <i>et al.</i> 2012, GOSH 2014).</p> <p>The nurse is encouraged to use clinical judgement to facilitate a break from phototherapy of up to 30 minutes for feeding / bonding (NICE 2014).</p>
<p>Wash hands (ANTT level 3) prior to commencing phototherapy and/or attending to care needs of the infant. Parents should also be advised on hand-washing techniques.</p>	<p>Prevention of cross infection (HSE 2009, OLCHC 2010, 2011).</p>

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<p>Temperature</p> <p>The infant will be nursed in an incubator or radiant warmer with only a nappy in place.</p> <p>The incubator should be dressed with white linen.</p>	<p>To ensure maximum exposure of the infant to phototherapy. A 'neutral thermal environment' can be achieved and maintained in an incubator / radiant warmer whilst having optimum exposure to lights (GOSH 2014).</p> <p>This allows for optimum reflection of phototherapy lights (NICE 2010).</p>
<p>The infant's temperature should be monitored and recorded at least 4 hourly or more frequently as clinically indicated.</p> <p>Observe skin temperature by "warm to touch" method or by peripheral skin probe measurement depending on clinical indication.</p> <p>Monitor and record incubator temperature hourly.</p>	<p>To ensure infant does not become cold stressed, hypothermic or hyperthermic due to removal of clothing or exposure to phototherapy lights (Walker <i>et al</i> 2007, OLCHC 2017).</p> <p>Environmental Hyperthermia can occur in an enclosed incubator space (OLCHC 2017).</p> <p>To monitor for incubator temperature fluctuations.</p>
<p>Position</p> <p>The phototherapy lamp should be positioned a minimum:</p> <ul style="list-style-type: none"> • 38cms (15inches) Giraffe Incubator Spotlight • 25cms (10inches) Medela Phototherapy Lamp. • 30cms (12 inches) Drager Phototherapy Lamp from the infant. <p>NB: There should be a 3cms distance between light and incubator.</p> <p>One or more units may be used at one time. The lamp should be positioned to allow for the coverage of the greatest surface area of the infant's body.</p>	<p>This is the optimum distance to allow effective use of the phototherapy unit. The spectral irradiance (intensity) of the light is reduced when the distance is increased, thus slowing bilirubin removal and reducing effectiveness of the phototherapy.</p> <p>Spot phototherapy lamp may increase risk of burns if it is positioned closer than the recommended manufacture distance (Wentworth 2005, GE Healthcare 2017a, Alexander 2010, Medela 2011, Hansen 2016).</p> <p>When the lamp is used with an incubator there must be enough room between the devices to ensure proper ventilation and prevent an accumulation of oxygen (Medela 2011).</p> <p>To increase spectral irradiance (AAP 2004, QMNCG 2012).</p>
<p>Nurse infant supine or prone if indicated with maximum skin exposure to the phototherapy lights. Change infant's position after care if appropriate.</p>	<p>To ensure effective phototherapy treatment is applied to maximum area of skin (Macqueen <i>et al.</i> 2012, GOSH 2014, NICE 2014, 2016).</p>
<p>Reposition the infant regularly during phototherapy. Be aware of infant positional boundaries pertaining to very sick and premature infants.</p>	<p>To prevent skin breakdown and the development of pressure sores (Cohen 2006, Alexander 2010).</p>

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<p>Eyes Eye shields (opaque) must be placed over the infant's eyes at all times during phototherapy.</p>	<p>As a prophylaxis and to protect against retinal damage that can occur due to irradiance from phototherapy light (Wentworth 2005, Maisels and McDonagh 2008, Stanford School of Medicine 2011, GOSH 2014, NICE 2014, Hansen 2016, NICE 2016). Ostrowski <i>et al.</i> 2000 warns that irradiance may still be high within the eye protectors.</p>
<p>The eye shields should be cut to the appropriate size and secured with the Velcro fastening.</p> <p>Ensure they do not slip or too tight.</p>  <p>Figure 2: Infant wearing Eye Shields (OLCHC)</p>	<p>To ensure safe and appropriate use to protect eyes as per manufacturer's instructions.</p> <p>Ensure the eye patches are not applied too tight, as they may apply undue pressure to the infant's delicate eye (Stokowski 2011)</p>
<p>Ensure the infant's eyes are closed when positioning the eye shields.</p>	<p>To prevent corneal abrasions (Alexander 2010).</p>
<p>Eye care should be performed 4-6 hourly and assess eyes for drainage, oedema and evidence of infection Allow visual stimulation at this time.</p>	<p>(Alexander 2010, Stokowski, 2011, OLCHC 2012).</p>
<p>NB: Ensure the phototherapy unit is switched off, before removing the eye shields.</p>	<p>To protect against retinal damage that can occur due to irradiance from phototherapy light (Wentworth 2005, Hansen 2016).</p>
<p>Fluids Monitor the infant's intake and output closely. Weigh nappies to monitor output. Maintain strict fluid balance chart.</p> <p>Refer infant to dietician as clinically indicated</p> <p>Discuss the infants' fluid requirements with neonatologist.</p> <p>Daily urinalysis for specific gravity i.e. > 1012 or</p>	<p>The infant may experience poor feeding due to lethargy caused by hyperbilirubinaemia and may require enteral feeding for a short period (Alexander 2010).</p> <p>To ensure adequate nutrition / calorie intake to maintain enzyme activity for degeneration of bilirubin.</p> <p>Phototherapy increases insensible water loss by 30 - 50% and poor hydration also slows bilirubin excretion. (NB: Currently overhead lamps in OLCHC are heat emitting)</p> <p>The fluid intake may need to be increased i.e. 20 –</p>

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signs of dehydration.	30% (Boyd 2004, Alexander 2010, Macqueen <i>et al.</i> 2012).
The infant's weight should be performed daily.	This aids with assessing fluid loss and calculating fluid requirements (Alexander 2010, GOSH 2014, NICE 2014).
Provide the mother who is breast feeding with the necessary support and advice to allow her to continue breastfeeding or to express milk if required. The infant may need to be breastfed 8-12 times a day.	Frequent feeding may help to break down the bilirubin if the cause of the jaundice is due to breast milk or breastfeeding (AAP 2004, Alexander 2010, NICE 2014, 2016). The newborn stomach has a capacity of 30mls approximately. It can also promote bonding.
Observe for frequent loose green stools.	Stools may be loose and green due to the enhanced excretion of unconjugated bilirubin in the stool from the phototherapy treatment. Increased faecal water loss may necessitate fluid supplementation (Alexander 2010).
Skin Care Cleanse skin thoroughly and change nappies when soiled. The use of creams, lotions or oils on the infant's skin is not recommended while undergoing phototherapy; however a barrier cream may be applied to the nappy area to maintain skin integrity.	To prevent nappy rash and maintain skin integrity (O'Brien 2007). These may cause burning to the skin (Alexander 2010, GOSH 2014).
Parents Encourage parents to be involved in cares	To promote bonding and facilitate family centred care (Skinner 2010). Difficulties in bonding may occur due to limitations in place as a result of phototherapy treatment.
Cluster cares as much as possible.	To ensure maximum exposure to phototherapy and minimal disruption to the infant (Alexander 2010).
Occupational Safety Avoid prolonged exposure of nurses to blue phototherapy lights. Caution in following groups: <ul style="list-style-type: none"> • Pre-existing ocular condition i.e. macular degeneration • Diabetic or other conditions predisposing to retinal damage. • Taking photo sensitising medication 	Headaches and eye irritation have been reported with prolonged contact. The retina may be harmed in some cases (Medela 2011, Stanford School of Medicine 2011). Nurses may be at increased risk of adverse effects in these identified groups (Medela 2011)

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<ul style="list-style-type: none"> • 55 years <p>NB: Consider proximity of infant to other infants in the ward / unit. Consider using a screen.</p> <p>Monitoring Serum Bilirubin (SBR) Obtain 6-24 hourly serum bilirubin level as determined by age and clinical condition of the infant as clinically indicated, following commencing phototherapy</p> <p>Turn off lights prior to obtaining sample.</p> <p>If serum bilirubin levels do not start to decrease or stabilise following commencement of phototherapy, inform neonatal / medical team immediately.</p> <p>Document all nursing assessment, nursing care and serum bilirubin levels in nursing notes as appropriate.</p> <p>Utilise NICE serum bilirubin level threshold chart for the gestational age of the infant (Appendix 2).</p> <p>NB: Further advice should be obtained and followed in relation to care for babies with a conjugated bilirubin level greater than 25 micromol / litre. Liaise with neonatal / medical team as paediatric liver referral may be required</p>	<p>Phototherapy lights can be severe on their eyes especially at night time as light intensifies. The lamp body in the Medela Phototherapy Lamp is equipped with a specially mirrored screen that directs light onto the child and limits light spread. This improves the therapeutic effect and protects surroundings from disturbing blue light (Medela 2011)</p> <p>To monitor and evaluate the effectiveness of treatment. NICE recommend 6 hourly testing for first 24 hours until SBR below treatment threshold or stable / falling (Royal Woman's Hospital 2007, NICE 2010, 2014, RCH 2015b, NICE 2016).</p> <p>Conjugated and unconjugated bilirubin are photo-oxidized when exposed to white or ultraviolet lights and haemolysis can give false lower results (Skinner 2010, QMNCG 2012, RCH 2015b).</p> <p>This may indicate a need for continuous multiple phototherapy with no interruption for feeding (NICE 2010).</p> <p>To maintain accountability and continuity of care through accurate recording of clinical practice (NMBI 2015).</p> <p>(NICE 2010).</p> <p>This may indicate serious liver disease. (NICE 2010, 2014).</p>
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Medical Investigations

Further laboratory testing varies on the infant's specific situation and test results, i.e. the possible cause of the jaundice should be sought for babies who require treatment or whose total bilirubin levels are rising more rapidly than expected.

Tests that may be done include:

- Complete full blood count (FBC) including packed cell volume (PCV), white cell count (WCC) and reticulocyte count
- Coomb's test
- TORCH screening
- Measurement of levels of specific types of bilirubin

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- Blood group of mother and infant
- Albumin level -. Low albumin levels may increase the risk of damage from excessive jaundice
- Thyroid function and LFTs in cases of prolonged jaundice
- Glucose-6-phosphate dehydrogenase (G6PD) screening (31% of kernicterus patients have G6PD deficiency)
- In suspected sepsis i.e. blood cultures, Polymerase Chain Reaction (PCR)
- Urine for metabolic screening

(AAP.2004, NICE 2010).

4.0 Treatment of Jaundice with a 'Bili-blanket'

Equipment

- Incubator / radiant warmer/ cot (Incubator should be warmed to appropriate temperature)
- Light source box with fibre optic bili-blanket (Ohmeda Biliblanket)
- Disposable cover
- Nappy scales (to accurately monitor output)


The Bili-blanket has been in use since 1990 and is an effective and safe method of treating phototherapy. A fibre optic light source is transmitted via a cable which delivers a high intensity of uniform light (blue halogen) only and there is no ultraviolet light. The potential complications of conventional phototherapy are minimised.




Figure 3: Ohmeda Biliblanket, Bilblanket Plus (GE Healthcare 2017b)

Advantages of the Bili-blanket

- Infant can be held with no discontinuation of treatment
- Can be nursed in cot instead of incubator
- Encourages infant/maternal bonding
- No heat/electrical dangers
- No insensible water loss
- Blanket more flexible/comfortable
- No discontinuation of treatment for procedures
- Compact and easily transported

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<p>The bili-blanket should NOT be used when:</p> <ul style="list-style-type: none"> • Infant is <28 weeks • Infant has broken/reduced skin integrity <p>Explain the need for phototherapy and the functions of the equipment to the parents as clinically indicated.</p> <p>Reassure them that their baby can be removed from the incubator/radiant warmer/cot for feeding and that they may still be involved in their infant's care as clinically indicated.</p> <p>Provide written information as appropriate.</p>	<p>There is a risk of dermal damage</p> <p>Providing explanations and reassurance can reduce stress and anxiety whilst encouraging bonding (GOSH 2014).</p>
<p>Hand-washing at ANTT level 3 should be carried out prior to commencing phototherapy and/or attending to care needs of the infant.</p> <p>Parents should also be advised on hand-washing techniques.</p>	<p>Prevention of cross infection (HSE 2009, OLCHC 2010, OLCHC 2011a).</p>
<p>The light source box for the bili-blanket should be placed on a firm flat surface.</p> <p>NB: The cot or top of incubator are not suitable places to position the box.</p>	<p>To ensure health and safety (OLCHC 2015).</p> <p>The phototherapy unit should not be placed on the same surface as the infant due to the electrical current.</p>
<p>A disposable cover should be placed over the fibre-optic pad of the bili-blanket as per manufacturer's guidelines.</p> <p>Ensure the illumination side of the panel faces the correct way.</p> <p>This should be changed as required.</p>	<p>To prevent cross infection (OLCHC 2015)</p>
<p>The fibre-optic pad must be placed directly on the skin.</p> <p>Clothing may be worn over this.</p>	<p>By facilitating maximum exposure to the bili-blanket, the breakdown of bilirubin should occur at a faster rate (Kunde 2014).</p> <p>To maintain temperature within normal ranges and provide dignity for infant by dressing in appropriate clothing.</p>
<p>There are 3 light settings on the unit:</p> <ul style="list-style-type: none"> • Low • Medium • High <p>The setting at which the intensity of the light box should be set must be clarified with the neonatal team</p>	<p>To gain optimum light from source (UMHS 2005).</p>

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and documented in medical notes.	
The infant does not require eye protection while on bili-blanket however the infant's eyes should not be exposed to the covered light pad	The light can be toxic to the immature retina of a newborn's eyes
Ensure the infant is placed on pad only and not the lead from the phototherapy unit.	To prevent pressure areas developing on the infant's skin.
The light pad may be left in situ during feeding, changing nappies and cuddling the infant	Ensures continuous exposure to the light source. The use of fibre optic blankets will also permit close and more frequent contact between parents and infants (Mills and Tudehope 2001, Maisels and Watchko 2003).
Monitor temperature, intake and output, skin integrity and serum bilirubin levels as above.	


5.0 Discontinuing Phototherapy

ACTION	RATIONALE EVIDENCE and REFERENCE
Continue to observe for signs of jaundice once phototherapy has been discontinued.	To monitor for rebound jaundice which may require further phototherapy (NICE 2010, Hansen 2016).
Check serum bilirubin levels 12 hourly post cessation of treatment and as clinically indicated.	To assess for rebound hyperbilirubinaemia (RCH 2015b, NICE 2016).
The neonatal medical team should explain the risk of rebound hyperbilirubinaemia to the infant's parents as clinically indicated.	This is a rare occurrence however rebound hyperbilirubinaemia may occur when phototherapy has been discontinued as bilirubin moves from the tissue into the blood. Explanation will help relieve parental/guardian anxiety should rebound jaundice occur.
Continue to regularly assess and monitor the infant's peripheral and core temperature after phototherapy has been discontinued.	Phototherapy lights are a heat source therefore the infant may become develop cold stress or hypothermic when the phototherapy lights / bili-blanket is discontinued.
Ensure adequate clothing/blankets without over heating	Adhere to the nursing guidelines for transfer of infant from incubator to cot (OLCHC 2017).

Storage and Maintenance of Phototherapy Lamps

When more than one phototherapy lamp is required, additional lamps can be accessed from clinical engineer department.

The lamp bulbs are checked 6 monthly by the clinical engineers as they lose their effectiveness over time. A record of their use is maintained and manufacturer's recommendations for changing bulbs followed. The health care assistants on the ward will clean the units as per hospital policy (OLCHC 2006).

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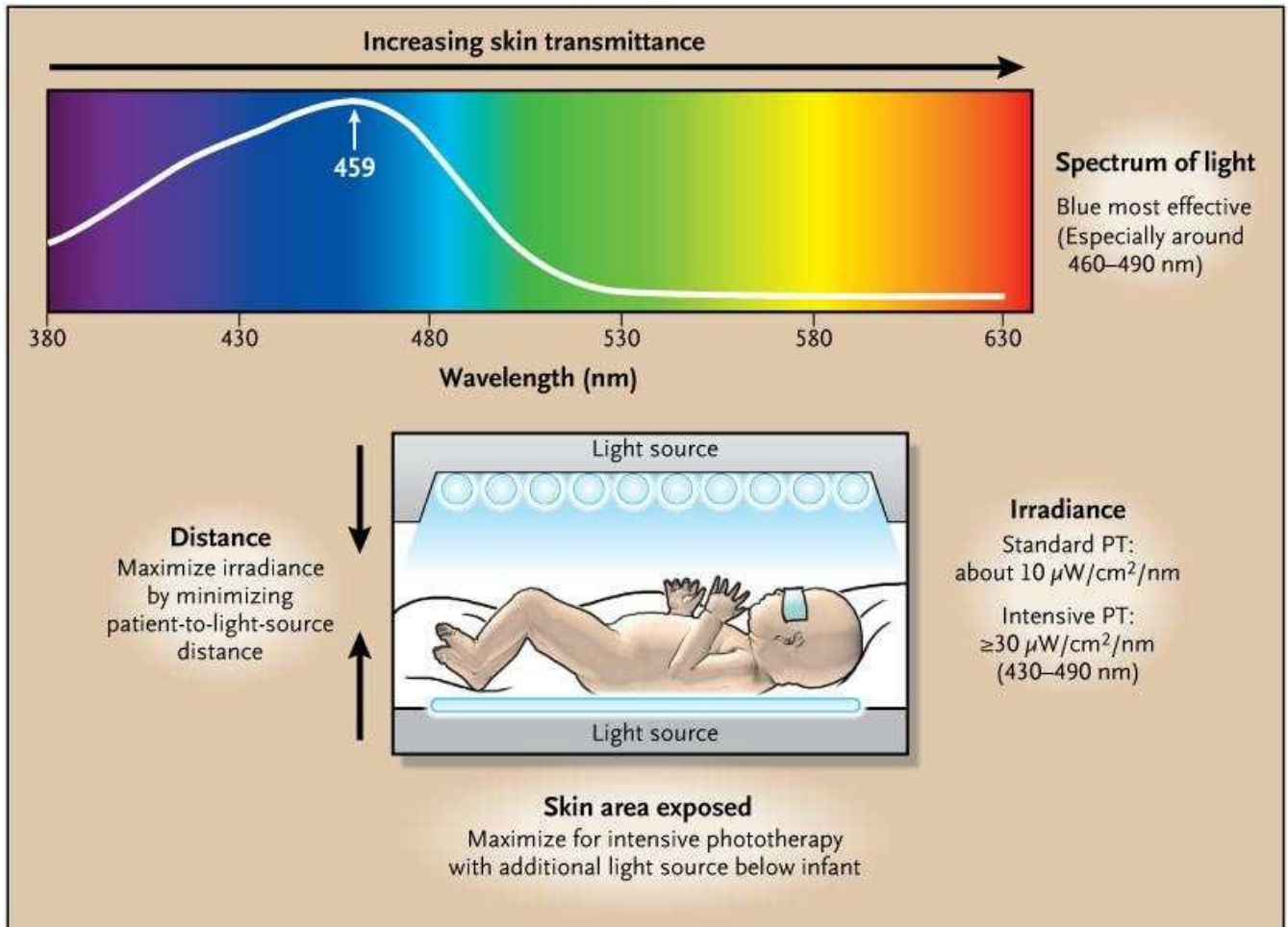
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7. APPENDICES

Appendix 1

Factors Contributing to the Efficacy and Effectiveness of Phototherapy.



(Maisels and McDonagh 2008)

Appendix 2

Instructions and Sample Graphs for Plotting Serum Bilirubin (Nice 2010)

Instructions

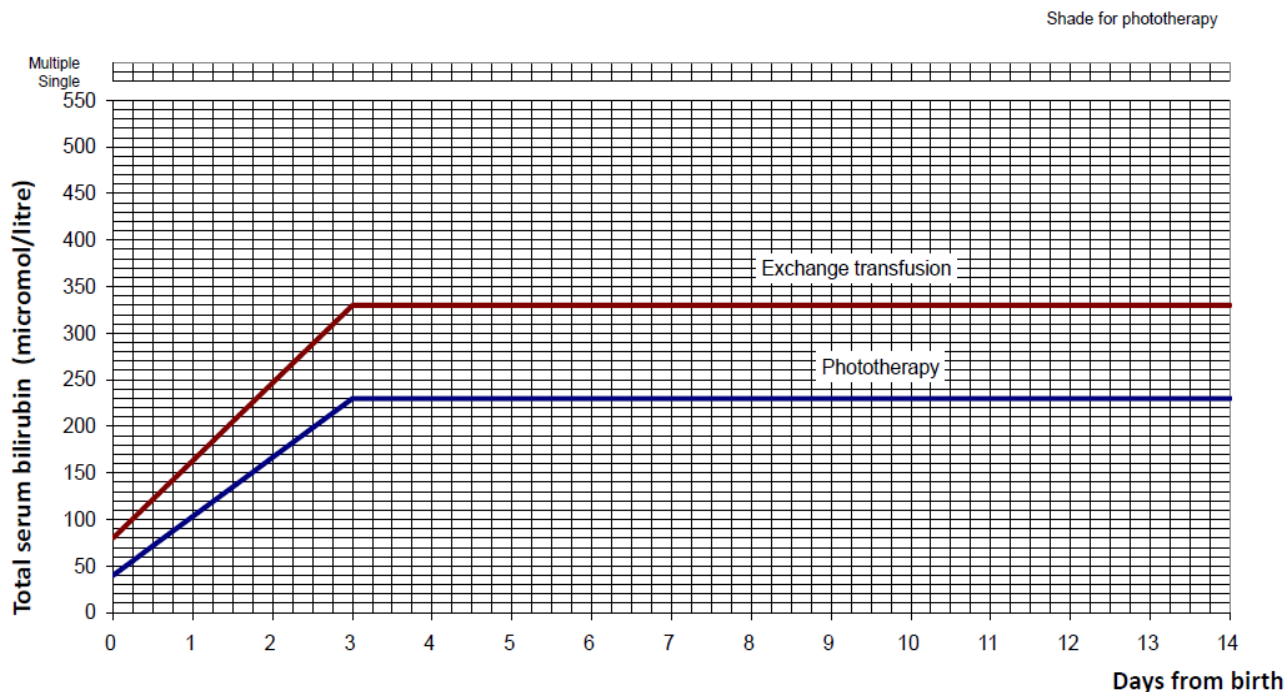
Click on the 'Treatment threshold graphs' tab to access the graphs. The sheet contains a treatment graph for each gestational age. Before printing, use the drop-down menu that is marked in red to choose the graph for the correct gestational age for each baby with jaundice.

Print off the graph and keep it with the baby's notes. Plot the baby's bilirubin level on the graph each time it is measured, against the baby's age. Assess whether the threshold for either phototherapy or exchange transfusion has been reached. Refer to the NICE neonatal jaundice guideline for detailed recommendations about the treatment of neonatal jaundice.


Sample Graphs:

Bilirubin Thresholds for Phototherapy and Exchange Transfusion in Babies with Hyperbilirubinaemia

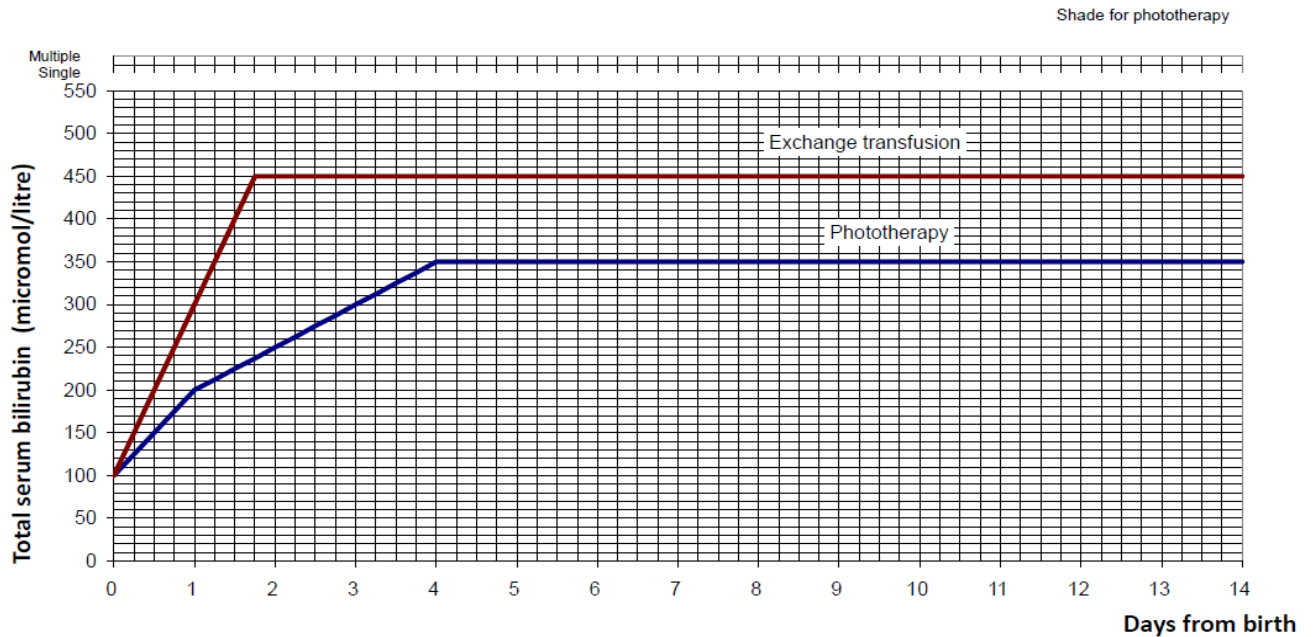
Baby's name _____ Date of birth _____
 Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____ **33 weeks gestation**



Baby's blood group _____ Mother's blood group _____

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Baby's name _____ Date of birth _____
 Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____ **>=38 weeks gestation**




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