Neonatal Jaundice/ hyperbilirubinemia and phototherapy treatment

Study module

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1. Introduction

Neonatal jaundice

Jaundice is one of the most common conditions requiring medical attention in newborn babies. Approximately 60% of term and 80% of preterm babies develop jaundice in the first week of life, and about 10% of breastfed babies are still jaundiced at 1 month of age. In most babies with jaundice there is no underlying disease, and this early jaundice (termed 'physiological jaundice') is generally harmless. However, there are pathological causes of jaundice in the newborn, which, although rare, need to be detected. Such pathological jaundice may co-exist with physiological jaundice.

Neonatal jaundice refers to yellow coloration of the skin and the sclera (whites of the eyes) of newborn babies that results from accumulation of bilirubin in the skin and mucous membranes. This is associated with a raised level of bilirubin in the circulation, a condition known as hyperbilirubinaemia.

Bilirubin

Bilirubin is a breakdown product of the red cells in the blood. Red cell breakdown produces unconjugated (or 'indirect') bilirubin, which is mostly bound to albumin. Unconjugated bilirubin is metabolized in the liver to produce conjugated (or 'direct') bilirubin, which then passes through the gut and is excreted in the stool. Bilirubin can be reabsorbed again from stools remaining in the gut.

Newborn babies' red blood cells have a shorter lifespan than those of adults. The concentration of red blood cells in the circulation is also higher in newborns than it is in adults, so bilirubin levels are higher than they are later in life. The metabolism, circulation and excretion of bilirubin are also slower than in adults. Thus a degree of hyperbilirubinaemia occurring as a result of this normal physiological mechanism is common in newborn babies and usually harmless. It is sometimes difficult to tell which babies are at risk of developing high levels of bilirubin that could become dangerous, or who have a serious problem as the explanation for their jaundice, which is why this guideline has been developed.

Physiological jaundice

Breastfed babies are more likely than bottle-fed babies to develop physiological jaundice within the first week of life but the appearance of jaundice is not a reason to stop breastfeeding. Physiological jaundice refers to the common, generally harmless, jaundice seen in many newborn babies in the first weeks of life and for which there is no underlying cause. The reasons for the association between breastfeeding and neonatal jaundice have not yet been fully elucidated but may include inadequate breastfeeding support leading to a reduced intake, sluggish gut action leading to an increase in the entero-hepatic circulation of bilirubin, or unidentified factors in breast milk. Finally, it may be that there is a relative reduction of bilirubin levels in formula-fed babies due to increased clearance of bilirubin from the gut. Current NHS practice of early postnatal discharge, often within 24 hours, reduces the opportunity to assess whether successful lactation has been established and to provide adequate breastfeeding support and advice. Existing guidelines, including 'Routine postnatal care of women and their babies', NICE clinical guideline 37 (2006) (www.nice.org.uk/CG37), deal with breastfeeding and lactation/feeding support and have been referred to wherever appropriate.

Prolonged jaundice

Prolonged jaundice, that is jaundice persisting beyond the first 14 days, is also seen more commonly in term breastfed babies completely understood and the condition appears to be generally harmless. However, prolonged jaundice can be a clue to serious underlying liver disease and should be assessed carefully.

Causes of pathological jaundice

Jaundice may also have other, non-physiological, causes, including blood group incompatibility (most commonly Rhesus or ABO incompatibility), other causes of hemolysis, sepsis, and bruising and metabolic disorders. Gilbert syndrome and Crigler –Najjar syndromes are rare causes of neonatal jaundice and are caused by liver enzyme problems. Deficiency of a particular enzyme, glucose-6-phosphate dehydrogenase (G6PD), can cause severe neonatal jaundice. G6PD deficiency is more common in certain ethnic groups and is familial. Congenital obstruction and malformations of the biliary system, such as biliary atresia, cause an obstructive jaundice with conjugated hyperbilirubinaemia. This condition needs specialist investigation and early surgical treatment, preferably before 8 weeks of life.

Bilirubin encephalopathy and kernicterus

In young babies, unconjugated bilirubin can penetrate the membrane that lies between the brain and the blood (the blood–brain barrier). Unconjugated bilirubin is potentially toxic to neural tissue (brain and spinal cord). Entry of unconjugated bilirubin into the brain can cause both short-term and long-term neurological dysfunction. Acute features include lethargy, irritability, abnormal muscle tone and posture, temporary cessation of breathing (apnea) and convulsions. This presentation is known as acute bilirubin encephalopathy. Bilirubin is deposited particularly in a part of the brain known as the Globus pallidus, part of the 'deep grey matter' of the brain. On pathological examination of the brain, this produces yellow staining; this staining is referred to as kernicterus. The term kernicterus is also used to denote the clinical features of acute or chronic bilirubin encephalopathy. Features of the latter include athetoid cerebral palsy, hearing loss, and visual and dental problems. The exact level of bilirubin that is likely to cause neurotoxicity in any individual baby varies, and depends on the interplay of multiple factors which include acidosis, gestational and postnatal age, and rate of rise of serum bilirubin, serum albumin concentration, and concurrent illness (including infection).

Although neonatal jaundice is very common, kernicterus is very rare. There is a poor correlation between levels of circulating bilirubin and the occurrence of bilirubin encephalopathy. There seems to be tremendous variability in susceptibility towards bilirubin encephalopathy among newborns for a variety of unexplained reasons. However, there are certain factors that probably influence the passage of bilirubin into the brain and hence increase the risk of acute bilirubin encephalopathy. These include preterm birth, sepsis, hypoxia, seizures, acidosis and hypoalbuminaemia. The rate of rise of the level of bilirubin is probably important, hence the increased risk of kernicterus in babies with hemolytic disease such as G6PD deficiency, ABO or Rhesus hemolytic disease.

Kernicterus in healthy term babies with none of the above factors is virtually unknown below a serum bilirubin concentration of 450 micromoles of bilirubin per liter (micromole/liter), but the incidence increases above this threshold level and the risk of kernicterus is greatly increased in term babies with bilirubin levels above 515 micromol /liter. Kernicterus is also known to occur at lower levels of bilirubin in

preterm and in term babies who have any of the factors described above.

Treatment of jaundice

Levels of bilirubin can be controlled by placing the baby under a lamp emitting light in the blue spectrum, which is known as phototherapy. Light energy of the appropriate wavelength converts the bilirubin in the skin to a harmless form that can be excreted in the urine. Phototherapy has proved to be a safe and effective treatment for jaundice in newborn babies, reducing the need to perform an exchange transfusion of blood (the only other means of removing bilirubin from the body).

Clinical recognition and assessment of jaundice can be difficult. This is particularly so in babies with darker skin. Once jaundice is recognized, there is uncertainty about when to treat. Currently, there is widespread variation in the use of phototherapy, exchange transfusion and other treatments when using charts, but there is already a degree of consistency in the NHS about treatment thresholds when healthcare professionals base their decisions on a formula that uses gestational age. There is a need for more uniform, evidence-based practice, and for consensus- based practice where such evidence is lacking, hence the importance of this guideline.

2. Purpose of the guideline

Clinical guidelines have been defined as 'systematically developed statements which assist clinicians and patients in making decisions about appropriate treatment for specific conditions. This clinical guideline concerns the management of neonatal jaundice in babies from birth up to 28 days of age. This guideline has been developed with the aim of providing guidance on: , recognition and assessment , prediction of later significant hyperbilirubinemias and adverse sequelae, treatment , information and education for parents/carers of babies with jaundice.

3 Definitions:

Conventional phototherapy: Phototherapy given using a single light source that is positioned above the baby.

Direct Coombs test: Also known as the direct Antiglobulin test. Used to detect antibodies or complement proteins that are bound to the surface of red blood cells

Fibrotic phototherapy: Phototherapy given using single light source that comprises a light generator, a fiber optic cable through which the light is carried and a flexible light pad, on which the baby is placed or wrapped around the baby.

Multiple phototherapy: Phototherapy that is given using more than one light source simultaneously, for example two or more conventional units

Near-term (late preterm): infants 35 weeks to 36.6 days gestational age

Preterm: less than 37 weeks gestational age

Prolonged jaundice: jaundice lasting more than 14 days in term infants and more than 21 days in preterm infants

Significant hyperbilirubinaemia: An elevation of the serum bilirubin to a level requiring treatment

Term: infants more than 37 weeks gestation

Visible jaundice: jaundice detected by a visual inspection

Intensive phototherapy 360 degrees: refers to an equipment that is build like a incubator that has intensive phototherapy sources exposing infant to the blue lights all around the infant.

4. Information for parents and carers

Offer parents information about neonatal jaundice that is tailored to their needs and expressed concerns. This information should be provided through verbal discussion backed up by written information. Care should be taken to avoid causing unnecessary anxiety to parents or carers. Information should include:

- Factors that influence the development of significant hyperbilirubinaemia
- How to check the baby for jaundice (education should be given to parents that take infants home soon after birth- early discharge)
- What to do if they suspect jaundice
- The importance of recognizing jaundice in the first 24 hours and of seeking urgent medical advice
- The importance of checking the baby's nappies for dark urine or pale chalky stools
- The fact that neonatal jaundice is common, and reassurance that it is usually transient and harmless
- Reassurance that breastfeeding can usually continue
- Offer parents or carers verbal and written information on phototherapy including all of the following:
- Why phototherapy is being considered
- Why phototherapy may be needed to treat significant hyperbilirubinaemia
- The possible adverse effects of phototherapy
- The need for eye protection and routine eye care
- Reassurance that short breaks for feeding, nappy changing and cuddles will be encouraged
- What might happen if phototherapy fails
- Rebound jaundice
- Potential impact on breastfeeding and how to minimize this.

5. Care for all babies

- Identify babies as being more likely to develop significant hyperbilirubinaemia if they have any of the following factors:

- Gestational age under 36 weeks

- Previous sibling with neonatal jaundice requiring phototherapy

- Visible jaundice in the first 24 hours of life.

5.1 Important for caregivers :

In all babies:

- Check whether there are factors associated with an increased likelihood of developing significant hyperbilirubinaemia soon after birth
- Examine the baby for jaundice at every opportunity especially in the first 72 hours
- When looking for jaundice (visual inspection):

- Check the naked baby in bright and preferably natural light
- Examination of the sclera, gums and blanched skin is useful across all skin tones.
- **Additional care** Ensure babies with factors associated with an increased likelihood of developing significant hyperbilirubinaemia receive an additional visual inspection by a healthcare professional
- During the first 48 hours of life.
- Do not rely on visual inspection alone to estimate the bilirubin level in a baby with jaundice.
- Do not use sunlight as treatment for hyperbilirubinamia

5.2 How to measure the bilirubin level

- Use a transcutaneous bilirubin meter in babies with a gestational age of 35 weeks or more and postnatal age of more than 24 hours (Most of the Blood gas machines in KAAUH will have the function of checking the bilirubin level through a capillary sample
- If blood gas machines are not available, measure the serum bilirubin and send to the lab.
- Always use serum bilirubin measurement to determine the bilirubin level in babies that shows signs of jaundice in the first 24 hours of life
- Always use serum bilirubin measurement to determine the bilirubin level in babies less than 35 weeks gestational age
- Do not use fibreoptic phototherapy as first line treatment for infants with jaundice with gestational age less than 37 weeks
- Heal prick is the preferred method to obtain blood to measure the bilirubin levels by using heparinized capillary gas stick

5.3 How to manage hyperbilirubinaemia

- Use the bilirubin level to determine the management of hyperbilirubinaemia in all babies (see threshold table) The chart will be available in NICU for all infants from 25 week gestation up to term)

- The charts will be available on Trakcare (Patient electronic records), and during downtime, manual documentation will be acceptable.
- Ensure the appropriate chart is used for the gestational age of the baby
- Fill out the chart, by using micromillimol/liter measurement.
- Each big block indicates one day (24 hours).
- Count the infants hours of life after birth. Document the level of each measurement taken with a dark x mark, to indicate the latest serum level

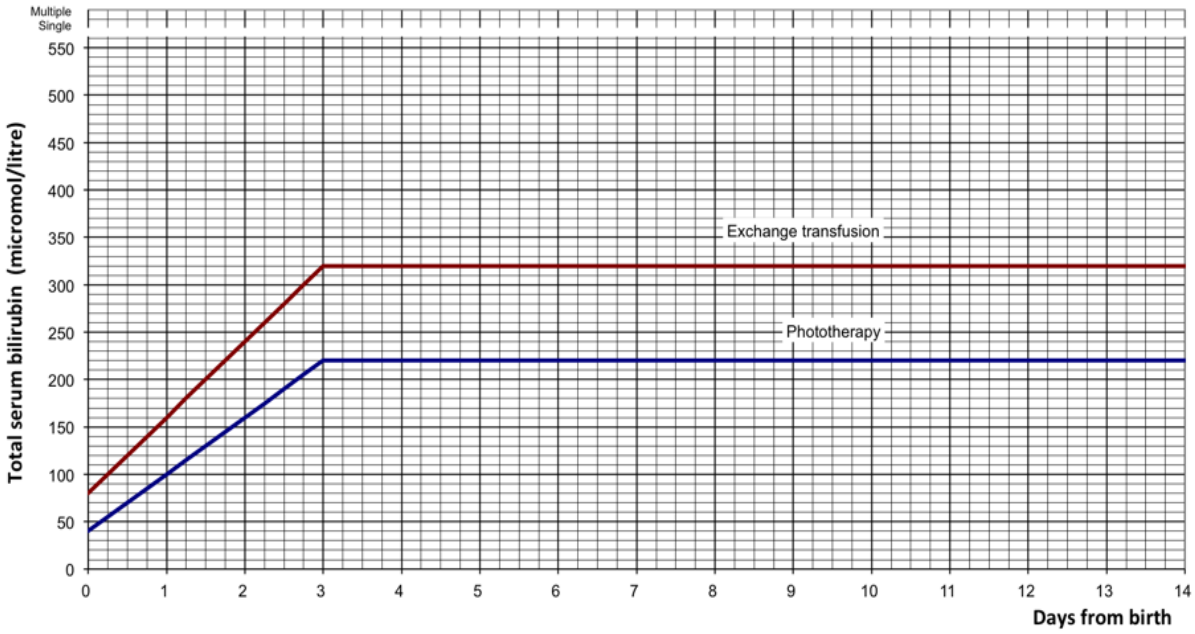


Figure1. (This is an example of the threshold table for 32 wks. gestational age (NNS national institute for healthcare excellence

6. General care of the baby during phototherapy

Prior starting phototherapy: In addition to a full clinical examination by a suitably trained healthcare professional, carry ou

All of the following tests in babies with significant hyperbilirubinaemia as part of an assessment

For underlying disease together with serum bilirubin (for baseline level to assess response to treatment)

- Blood packed cell volume (CBC)
- Blood group (mother and baby)
- DAT (Combs' test). Interpret the result taking account of the strength of reaction, and whether

Mother received prophylactic anti-D immunoglobulin during pregnancy.

- Blood glucose-6-phosphate dehydrogenase levels, taking account of ethnic origin
- Microbiological cultures of blood, urine and/or cerebrospinal fluid (if infection is suspected).

During phototherapy:

- Place the baby in a supine, abdomen or side lying position unless other clinical conditions

Prevent this, ensure flexed limbs, boundaries and comfort continuously.

- Ensure treatment is applied to the maximum area of skin, the size and shape of nappy can be modified that does prevent maximum penetration of the lights on the skin
- Monitor the baby's temperature and ensure the baby is kept in an environment that will minimize
- Energy expenditure (thermo neutral environment)
- Monitor hydration by daily weighing of the baby and assessing wet nappies
- Support parents and carers and encourage them to interact with the baby.
- Ensure routine infant care continue, optimal fluid and electrolyte balance is maintained.
- Measure intake and output as routine protocol
- Measure vital signs routinely
- If infant is lethargic, and not sucking adequately, give additional iv fluids as per doctor order
- Infants that receives multiple phototherapy lights – requires additional fluids – best to give iv fluids 10-20 mlkg day extra

In addition to enteral feeding

Ensure total eye protection by using the approved eye masks and continue routine eye care during phototherapy.

- Using clinical judgment, encourage short breaks (of up to 30 minutes) for breastfeeding, nappy
- Changing and cuddles
- Continue lactation/feeding support (breastfeeding and or formula feeding as per doctors order)
- During multiple phototherapy:
- Continue lactation/feeding support so that breastfeeding can start again when treatment stops.
- Maternal expressed milk is the additional feed of choice if available, and when additional feeds are

Indicated.

- Repeat serum bilirubin measurement 4-6 hours after initiating phototherapy
- Repeat serum bilirubin, every 6-12 hours when the serum bilirubin is stable or falling.

Intensive phototherapy 360 degree:

When a infant has significant high bilirubin level within the first 24 hours of life or the conventional multi system

Phototherapy lights is not adequate in decreasing the bilirubin level down, the doctor might order to place

The infant under the intensive 360-degree phototherapy device. Remember to repeat the levels at least 4 hours after

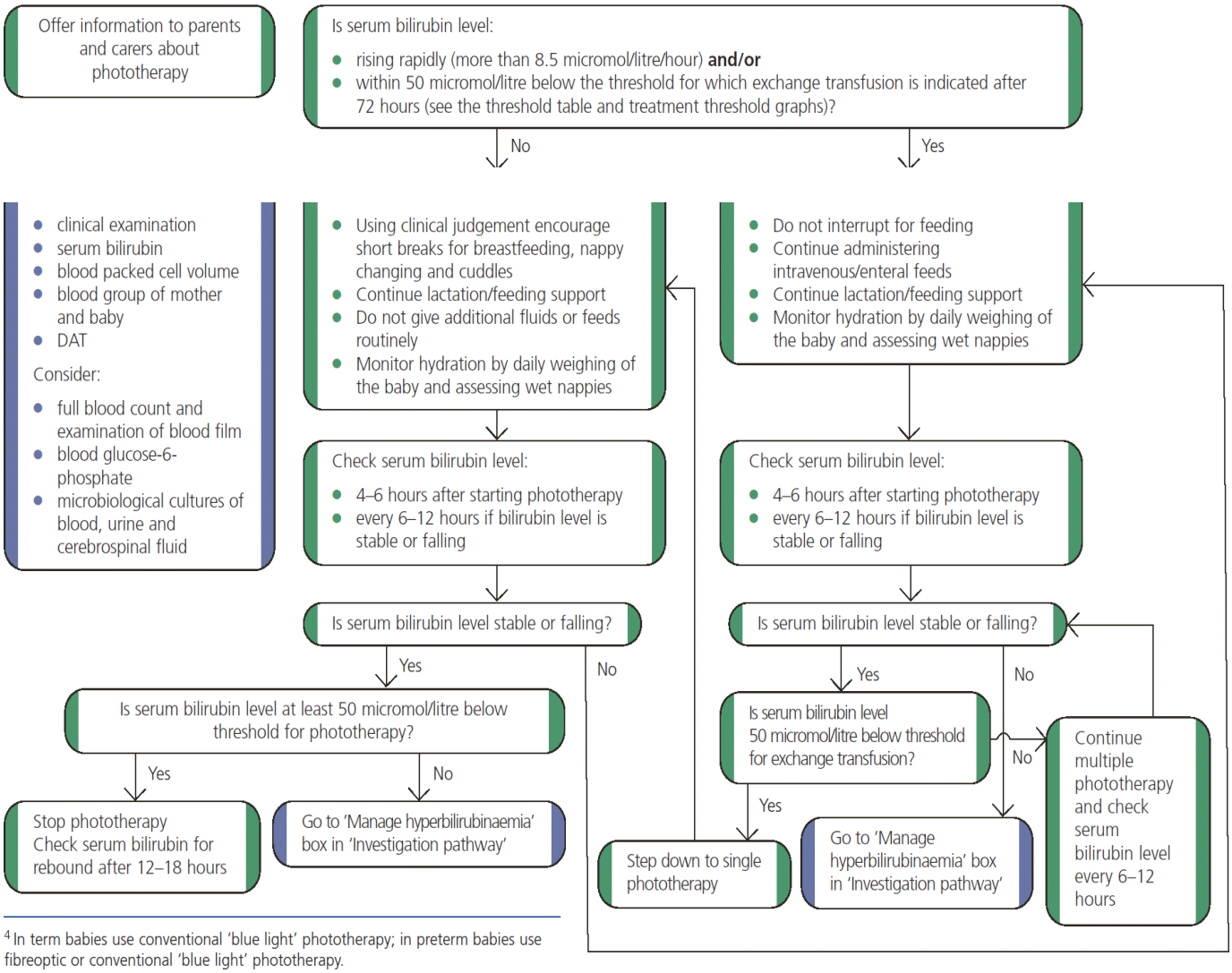
Initiating the treatment. Do not place infants under this therapy more than 6 hours continuously.

Stopping phototherapy

- Stop phototherapy once serum bilirubin has fallen to a level at least 50 micromol /liter below the phototherapy Threshold
- Check for rebound of significant hyperbilirubinaemia with a repeat serum bilirubin measurement 12–18 hours
- After stopping phototherapy, babies can go home if they reach the discharge criteria, ensuring parents received
- Adequate information about signs of rebound jaundice and when to repeat the subsequent bilirubin tests if needed

7. Phototherapy pathway

Phototherapy pathway



[4] In term babies use conventional 'blue light' phototherapy; in preterm babies use fibreoptic or conventional 'blue light' phototherapy.

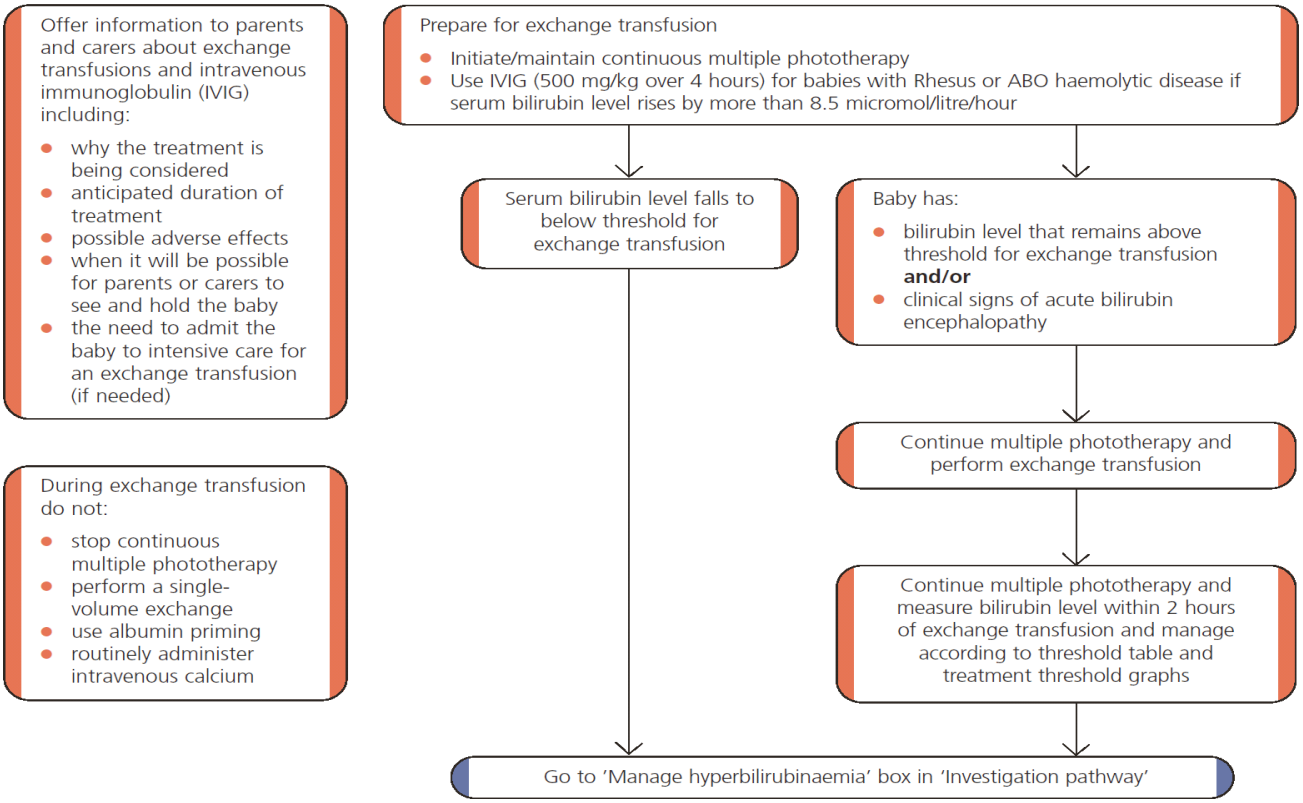
8.Factors that influence the risk of kernicterus

Identify babies with hyperbilirubinaemia as being at increased risk of developing kernicterus if they have any of the following:

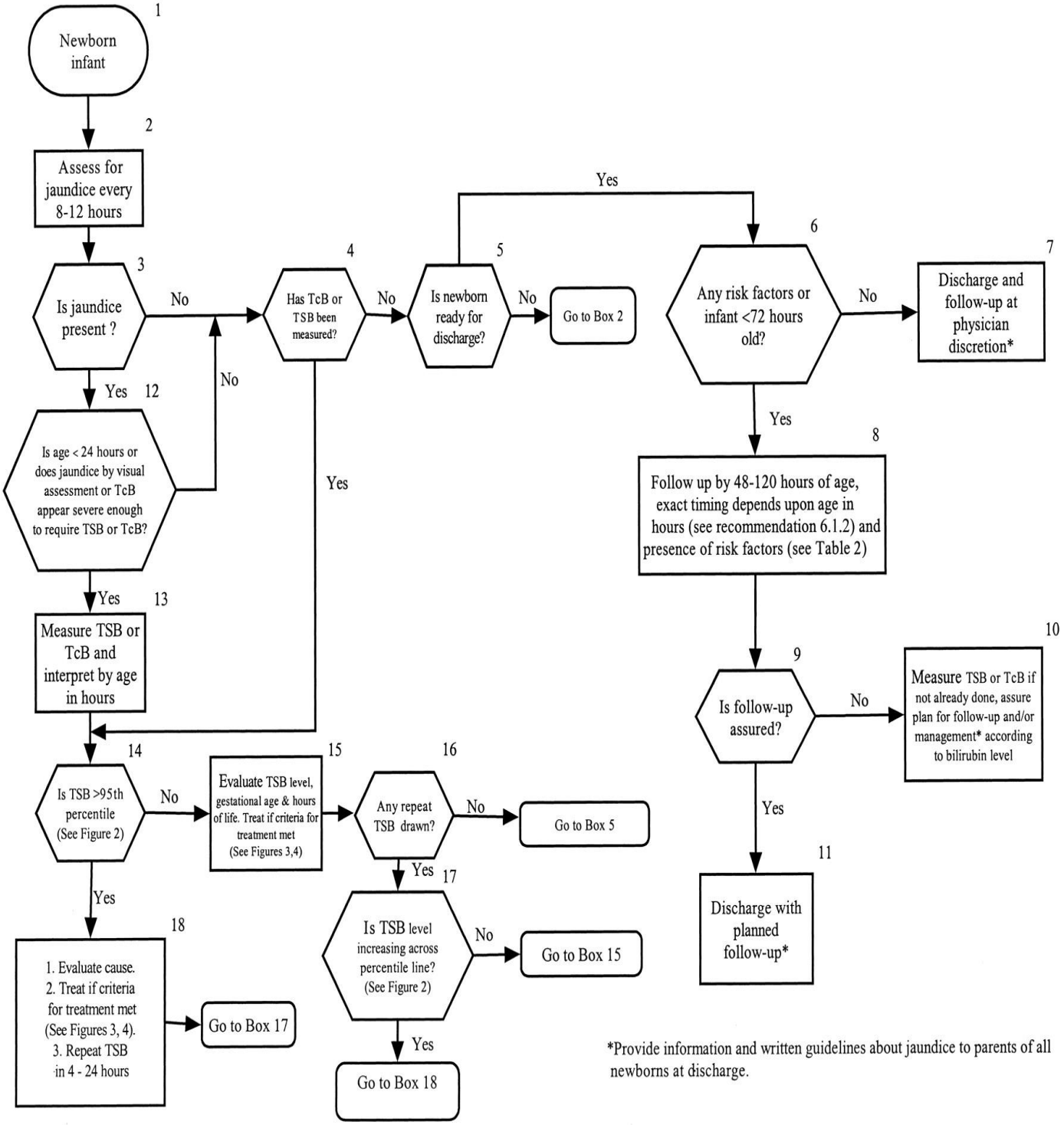
- serum bilirubin level greater than 340 micromol /litre in babies with a gestational age of 37 weeks or more
- A rapidly rising bilirubin level of greater than 8.5 micromol /litre per hour
- Clinical features of acute bilirubin encephalopathy.

- **Formal assessment for underlying disease**
- In addition to a full clinical examination by a suitably trained healthcare professional, carry out
- all of the following tests in babies with significant hyperbilirubinaemia as part of an assessment
- for underlying disease

Exchange transfusion pathway



9 Algorithm for management of jaundice in the newborn nursery.



10. Reference

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COMPETENCY-BASED CHECK OFF

TITLE: Care of infant with neonatal jaundice and phototherapy treatment

COMPETENCY STATEMENT: The nurse demonstrates competence in caring for infant with hyperbilirubinemia and with phototherapy treatment

Standards As per JCIA:

Care of patients, Assessment of patients
Quality, safety and environment
Patient and Family Education

PERFORMANCE CRITERIA:	**4**	**3**	**2**	**1**
Communication and Interpersonal Skills				
1. Displays effective verbal and non-verbal communication: a. Acknowledge the patient (Privacy, Dignity, Culturally sensitive caring, aware on patients' Bill of Rights)				
b. Introduce her/himself to the patient				
c. Verbalize the reason for the procedure/intervention				
d. Explain the duration and outcome of the procedure				
e. Educates patient and family / caregiver (where appropriate)				
Psychomotor Skill				
2. Perform hand hygiene before, during and after patient contact.				
3. Identify the patient (Verified the correct child/neonate using two identifiers)				
4. Verbalize the concept physiological jaundice and pathological jaundice				
5. Identify the those infants at risk for hyperbilirubinemia				
6 identify the need for phototherapy from bilirubin level chart (example chart will be given)				
7. Demonstrate if needed how heal prick capillary sample will be taken for serum bilirubin level measurement				
8 Prepare equipment's that will be used (correct size eye mask, incubator if double phototherapy lights will be used)				
9. Check light source and keep distance between 50-80 cm above patient				
10. Checks bulbs are all functioning				
11. Informs Biomed if PPE needs to be done for light source that run more than 2500 hours (or as per manufactures advice)				

12. Checks plexi glass is not cracked and in good condition				
13.Ensure the light does not affect nearby infants				
14. Assessed the patient's vital signs. (Knows the importance of keeping infant in neutral thermal environment.				
15. Checks temperature more frequently to prevent hyperthermia				
16. Verbalize importance of ensuring optimal fluid and electrolyte (either by additional iv fluids or enteral feeding)				
17. Verbalize the importance of allowing breaks for 30 minutes every 4 hours for that will allow cuddles, by parents and re- positioning of infant				
18. Verbalize the risk factors of Infant kernicterus				
19. Verbalize the clinical pathway of initial assessment of infant with signs of jaundice (identifies the blood test needed to be send.)				
20. How to start phototherapy and discontinue phototherapy (including how often the serum bilirubin levels needs to be checked)				
21. Explains the need for 360 degree intensive therapy and explains the care of those infants and how often the serum levels needed to be repeated				
22. Explains the parent education that will be given to the parents				
23. Continue routine infant care throughout treatment				
24. Ensure developmental care principles are adhere to throughout the treatment				
25. Document the procedure, blood results, vital signs, response to treatment and other necessary documentation in the neonate's record.				
Critical Thinking				
26. Responds appropriately to scenario and questions presented				
27. Explains the concept of holistic care as related to the patient				
Documentation				
28. Documents appropriately and inform the physician of any abnormality				

COMMENTS:

_____

RN Signature: _____ ID#_____ Date: _____

Evaluators Signature: _____ ID#_____ Date: _____

Note:

During 'orientation' the Competency Based Check off is used as a reference only. When the competency is successfully completed the Assessor signs the Mandatory Competency Assessment Record (MCAR) and places it in the employee's file.

Should a learner be found not competent the learner will repeat the Competency Based Check Off and "Competency Not Met" forms are completed and placed in the employee's Portfolio.