Jaundice Management of the Neonate :

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Authors Name:	Zuzanna Gawlowski
Authors Job Title:	Consultant Paediatrician
Authors Division:	Women and Children's Health
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Scope:
This guideline applies to all neonates born to families within the care of MKUH. This includes both term and preterm neonates nursed within the Maternity and Neonatal Departments, their parents and all members of the multidisciplinary team, hospital based Midwives, Nursery Nurses, Community based Midwives and Maternity Care Workers

To be read in conjunction with the following documents:

- Milton Keynes University Hospital NHS Foundation Trust. Assessment of neonatal jaundice in community setting: standard operating procedure. Version 1, 2017
- Milton Keynes University Hospital NHS Foundation Trust. Haemolytic disease of the newborn (HDN): patient information. PAED/PI/064. Version 2.1, 2016.
- Milton Keynes University Hospital NHS Foundation Trust. Jaundice in newborn babies: patient information. 2017.
- Milton Keynes University Hospital NHS Foundation Trust. Neonatal jaundice: standard operating procedure. Version 1, 2018
- Milton Keynes University Hospital NHS Foundation Trust. Newborn feeding policy. DOC155. Version 1, 2017.
- Milton Keynes University Hospitals NHS Foundation Trust. Transcutaneous Bilirubinometers.; Standard Operating Procedure. 2018

CQC Fundamental standards:
Outcome 1, 4, 6, 7, 10, 13, 16

Disclaimer

Since every patient's history is different, and even the most exhaustive sources of information cannot cover every possible eventuality, you should be aware that all information is provided in this document on the basis that the healthcare professionals responsible for patient care will retain full and sole responsibility for decisions relating to patient care; the document is intended to supplement, not substitute for, the expertise and judgment of physicians, pharmacists or other healthcare professionals and should not be taken as an indication of suitability of a particular treatment for a particular individual.
The ultimate responsibility for the use of the guideline, dosage of drugs and correct following of instructions as well as the interpretation of the published material **lies solely with you** as the medical practitioner.

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Guideline Statement

This guideline aims to ensure that jaundice is effectively identified and managed in both Maternity and Neonatal settings. This is to ensure that infants including sick and premature infants receiving phototherapy and cared for within the South Central Neonatal Network receive an equal standard of highest quality, evidence-based care. Where evidence does not exist, currently accepted 'best practice' will be offered as the alternative of choice.

Executive Summary

- This guideline covers the investigation and management of physiological and pathological jaundice (early, prolonged and conjugated jaundice). It covers the initiation of and caring for babies receiving phototherapy and the process of performing an exchange transfusion.

- Early detection, investigation and treatment of pathological jaundice is vital to ensure good outcomes and minimise complications of severe hyperbilirubinaemia especially kernicterus (bilirubin induced neurologic dysfunction – BIND).

Definitions

Neonatal Hyperbilirubinaemia (jaundice) is very common and affects approximately 60% (NICE 2010; updated 2016) of full term infants and 80% of preterm infants in the first three days of life (Nets, Victoria, 2007 and Trueman, 2006). It accounts for up to 75% of all hospital readmissions in the first week after birth (Melton, 1999).

Jaundice refers to the yellow discolouration of the skin and sclerae due to increased serum bilirubin levels (hyperbilirubinaemia). It can be difficult to recognise in those of different ethnicities such as African and Asian backgrounds

There are two different types of jaundice: **Physiological** and **Pathological**.

Background

Physiological Jaundice is the most common type of jaundice affecting neonates. This is as a result of increased haemolysis (breakdown) of fetal haemoglobin (red blood cells), resulting in increased production of bilirubin.
In utero the fetus will excrete bilirubin via the maternal blood and hepatic systems. After birth the baby's own liver takes over the process transporting the unconjugated (fat soluble) bilirubin, bound to albumin in the bloodstream, converting it to conjugated (water soluble) bilirubin by a complex process of enzyme activity. It is then excreted via the biliary system into the intestines as a waste product. Due to the immaturity of the neonatal liver and the sluggish intestinal transit the bilirubin breakdown process may be slow and unable to keep up with the rate of production. Unconjugated bilirubin can become toxic to the body if it remains at high levels.

Factors predisposing to Physiological Jaundice:

1. Babies <38 weeks gestational age
2. Previous sibling with Neonatal jaundice requiring phototherapy
3. The exclusively breastfed infant
4. Maternal history of antibodies or O-type blood group suggesting shortened lifespan of red blood cells
5. Polycythaemia from placental transfusion (delayed cord clamping, materno-fetal transfusion and recipient of twin-to-twin transfusion)
6. Extravasation of blood:
    - Bruising
    - Birth trauma
    - Internal haemorrhage
    - Dehydration
7. Delayed intestinal transit time / passage of meconium
8. Sepsis (may interfere with normal liver processes and increase haemolysis)

Early, frequent and effective breastfeeding will help prevent / reduce the severity of neonatal jaundice in breastfed babies. Therefore, it is imperative to provide breastfeeding support to mothers with jaundiced babies.

NB

Be aware of Breastmilk Jaundice, a type of neonatal jaundice associated with breastfeeding. It is characterised by indirect hyperbilirubinemia in a breastfed newborn that develops **after** the first 4-7 days of life, persists longer than physiologic jaundice and has no other identifiable cause (Deshpande et al., 2017). These babies will be referred to the prolonged jaundice clinic. Around 10% of breastfed babies remain jaundiced at 1 month of age, and breast milk jaundice remains the most common cause of prolonged jaundice.

Pathological jaundice is that which is considered to be outside of the normal process such as that which arises within 24 hours after birth or rate of rise of bilirubin levels is greater than 8.5µMol/L/hr; or persists after 14 days of age in term babies and 21 days in preterm babies; or if there is conjugated jaundice. It is due to factors which interfere with the usual processes involved in bilirubin metabolism such as in the case of blood group incompatibilities, resulting in accelerated breakdown of red blood cells, or metabolic disorders, or obstruction to excretion of conjugated bilirubin from the liver (Wentworth, 2005). Jaundice presenting within 24 hours of birth is potentially very serious and needs urgent investigation and monitoring. These babies are NOT suitable for early discharge.

Factors suggesting Pathological Jaundice:

- Onset before 24 hours of age.
- Deep jaundice of trunk, hands and feet.
- Unwell baby with ANY of the following: pallor, poor feeding, vomiting, irritability, pyrexia, abdominal distension.
- Jaundice still present beyond 14 days of age in term baby or 21 days in preterm baby.
- Failure to regain birth weight by 10 -14 days of age or subsequent poor weight gain on growth chart.
- Presence of pale stools and/or dark urine.
- Conjugated serum bilirubin fraction > 25µMol/L.

1.0 Roles and Responsibilities:

1.1 Chief Executive

The Chief Executive has overall accountability for ensuring that the Trust meets its statutory and non-statutory obligations in respect of maintaining appropriate standards of patient care. The Chief Executive devolves the responsibilities for monitoring and compliance to the medical and executive nursing directors.

1.2 Directors

Directors are responsible for ensuring that the requirements of this guideline are effectively managed within their directorate and that their staff are aware of, and implement those requirements.

1.3 Chief Nurse / Medical Director

The Chief Nurse and Medical Director are responsible for ensuring that Trust staff upholds the principles of this guideline and those procedures are developed, maintained, and communicated throughout the organisation in co-ordination with other relevant organisations and stakeholders.

1.4 CSU Responsibilities

CSU leads are responsible for ensuring that the guideline is communicated and implemented within their areas of responsibility. Any incident arising from the use of this guideline must be documented on an incident form and investigated at a local level and actions taken to prevent reoccurrence and to minimise risk. Documentation should be copied to the Risk Management Department to allow completion and closure of the incident. Any action plans should be shared at the appropriate forum and the Clinical Incidents Group (CIG) meeting. Any on-going risks should be registered on the CSU / Trust Risk register as appropriate.

1.5 NNU Lead Nurse, Senior Sisters/ Senior Midwives / Operational Manager / Matron Responsibilities

It is the NNU Lead Nurse, Senior Sisters/ Senior Midwives / Operational Managers / Matron's responsibility to ensure that staff are made aware of this guideline, and that they attend training and are competent to provide evidence based best practice to their babies. This guideline should be included in the induction training of all NNU staff who may be involved in the on-going care of a baby within NNU.

1.6 Medical Staff Responsibilities

All medical staff should ensure that they are familiar with the guideline's recommendations. Medical staff of registrar level or above who are responsible for the supervision and training of junior doctors should ensure that junior medical staff are aware of their role, and that they understand how to use kangaroo care to deliver safe and effective care.

1.7 All Staff

It is the responsibility of every Registered Nurse and Midwife to ensure this guideline is adhered to when caring for babies on NNU, in Community and on Maternity Wards 9 and 10. All staff should report any incidents arising from use of this guideline via the Risk Management route. The Unit Manager should be informed of the incident.

1.8 Risk Management

The Clinical Risk Management Department will record on the Trust database all incidents reported through the risk reporting route. This data will be included in the monthly reports to the Heads of Departments and discussed at the Paediatric CSU Risk Management meetings. All untreated risks will be reported to the Trusts Risk Management Committee which reports to the Trust Clinical Governance Committee.

2.0 Implementation and dissemination of document

The guideline will be accessible from the Trust's intranet. Staff will be made aware of the guideline through the Clinical Improvement Group meetings and the Paediatrics & Neonatal Newsletter and the Maternity newsletter.

The staff involved will be trained and competence will be monitored by the NNU Lead Nurse and senior staff.

3.0 Processes and procedures

3.1 Diagnosis

The most common and accurate method of diagnosing hyperbilirubinaemia at present is by blood sampling to check serum bilirubin (SBR) levels in the laboratory. However Transcutaneous Bilirubinometers can be useful for initial assessment of jaundice in babies of ≥35 weeks gestation, after 24 hours of age. Different plotting charts are used to plot the serum bilirubin levels (see Appendix 11). These are related to gestational age for safe serum levels. When the SBR is above the recommended treatment level the baby will need to be commenced on phototherapy treatment, or, in severe cases, may require an exchange transfusion.

3.2 Phototherapy

Phototherapy is the use of visible light for the treatment of neonatal unconjugated hyperbilirubinaemia (Stokowski, 2011).

It decreases the serum bilirubin level by converting bilirubin into water-soluble isomers that can be eliminated via the kidneys without conjugation in the liver. The dose of phototherapy determines how quickly it works and the dose is determined by the wavelength of the light, the intensity (irradiance), the distance between the light and the neonate and the baby surface area exposure. Suggestions in the literature advise that bilirubin breakdown is most sensitive to blue and blue-green colour regions of the visible spectrum (Wentworth, 2005). Fibre optic phototherapy has also been suggested as greatly increasing effectiveness when combined with other phototherapy units in reducing jaundice levels. The amount of phototherapy lights used will be dependent on the individual SBR level.

3.3 Exchange Transfusion

Where SBR levels are close to or above exchange levels on the treatment charts, more aggressive treatment is recommended in the way of extra phototherapy lights and extra fluids as discussed with the medical staff. Blood may need to be ordered in preparation for an exchange transfusion. Further investigations will need to be performed to ensure that there is not an underlying pathological cause for the hyperbilirubinaemia. See Sections 3.6.4 and 3.8.1 for further details

3.4 Complications of Not Treating hyperbilirubinaemia as soon as it is recognised / diagnosed

This includes the baby developing 'kernicterus' (bilirubin encephalopathy or bilirubin induced neurologic dysfunction). This is a condition triggered by high levels of unconjugated bilirubin crossing the blood-brain barrier, entering the basal ganglia and cerebellum and disrupting cellular metabolism and reducing protein synthesis in the mitochondria. Symptoms include the baby becoming lethargic, hypertonic and irritable and may develop seizures and respiratory disorders as a result of the kernicterus. Long term complications of kernicterus include deafness, athetoid cerebral palsy and neurodevelopmental problems.

This emphasises the importance of early treatment and recognition of jaundice to prevent it reaching this dangerous level.

Early recognition, investigation and treatment of prolonged, especially conjugated, hyperbilirubinaemia can also not be over-emphasised as certain conditions, which if not detected early on and treated, can have significantly detrimental outcomes. See Sections 3.6 and 3.7.

Furthermore, liver impairment/failure due to an underlying condition could result in Vitamin K deficiency leading to potential bleeding. Early recognition and treatment with additional Vitamin K could be life-saving.

3.5 Care for All Babies

The initial newborn examination carried out by the delivering midwife will include a visual inspection of skin colour. Any baby who leaves the hospital prior to 24 hours of age needs to be seen by a midwife and visually inspected for neonatal jaundice as part the postnatal First Baby Assessment and documented in the notes.

Examine every baby for jaundice at every opportunity, especially in the first 72 hours. All babies will be examined the day after discharge from the hospital or homebirth delivery. This should be documented by the community midwife in the baby's postnatal records.

Ensure that adequate support is offered to all women with infant feeding and if breastfeeding, Breastfeeding Assessments are completed as per policy. To be read in conjunction with the following documents section on p.1 (Milton Keynes University Hospital NHS Foundation Trust. Newborn feeding policy. DOC155. Version 1, 2017)

Ensure parents are given information on how to check their baby / babies for jaundice and how to seek advice, especially if detected within 24 hours of birth.

Any baby admitted to the Neonatal Unit should similarly undergo visual inspection for jaundice and, if noted, escalated to the Paediatric team.

3.5.1 Visual Inspection and History

The neonate should be examined in bright, natural light if possible, Examine the sclera, skin and gums (across all skin tones). Clinical estimation of bilirubin level by visual estimation alone is difficult therefore should not be relied upon for clinical decision making.

It is vital to take a good history of jaundice:

- Age in hours at onset of jaundice
- Method and quality of feeding
- Has a Breastfeeding Assessment been completed (as per policy)
- Any signs or symptoms suggestive of infection
- Stool and urine colour
- Mother's blood group and antibody status
- Ethnic background of both parents
- Any perinatal trauma e.g. cephalhaematoma, bruising
- Family history of neonatal jaundice, especially in a sibling, requiring phototherapy

Should a maternity care assistant (MCA) identify a neonate in community who is visibly jaundiced to ANY degree, this should be discussed with a Community Midwife for appropriate care planning and recorded in the neonatal handheld notes A review by the community midwife needs to be carried out on the same day. This may need to be done by the on call community midwife.

When undertaking a visual inspection, all staff should be aware of the risk factors which may exaggerate jaundice and require early treatment:

- Gestational age <38/40 weeks
- The exclusively breastfed infant
- A previous sibling with neonatal jaundice requiring phototherapy
- Haemolysis
- ABO Incompatibility
- Birth Trauma
- Asphyxia
- Prematurity
- Hypoxia
- Hypercarbia
- Acidosis
- Sepsis

NB This list is not exhaustive.

ANY baby with ANY of the above risk factors needs to have additional visual inspections by a health care professional regularly for the first 48 hours of life.

ANY baby noted to be jaundiced with any of the above risk factors needs to be escalated to the Paediatric team as soon as possible.

3.5.2 Investigations and Management

- For an initial assessment of bilirubin in babies ≥35 weeks gestational age and > 24 hours old, a transcutaneous bilirubinometer (TCB) may be used if available. However, always obtain appropriate paediatric review and use serum bilirubin measurement (SBR) when:

  - Jaundiced in the first 24 hours of life.
  - <35 weeks gestation at birth.
  - Transcutaneous bilirubinometer (TCB) measurement indicates a bilirubin level greater than 250 micromol/litre.
  - Babies are at, or above the treatment threshold

- When selecting SBR on eCare, use ***total bilirubin level*** to determine management of hyperbilirubinemia in all babies. Do not use albumin - bilirubin ratio or subtract conjugated bilirubin from total serum bilirubin.

- **Any staff member performing SBRs must have been trained and assessed as competent to:**

  - Take blood specimen
  - Read the SBR result
  - Accurately document the result according to local practice
  - Pass the result on to the medical team

It is recommended babies requiring blood tests should be comforted with a breastfeed. If not breastfed, oral sucrose can be used as pain management during and after the procedure (if in hospital). Try to group blood tests that the baby requires so that they are disturbed less and experience less discomfort.

- Maternity staff should escalate to the paediatric team in the following circumstances:
  - Clinical jaundice in first 24 hours
  - Rapidly rising bilirubin level >8.5µMol/L/hour
  - Exaggerated physiological jaundice above gestation corrected treatment level as per treatment threshold table (Appendix 1) and charts (Appendix 11)
  - Clinical features of acute bilirubin encephalopathy (kernicterus)
  - Prolonged jaundice (>2 weeks in term and >3 weeks in preterm)
  - Conjugated bilirubin >25 µmol/L

3.6 Babies ≥38 weeks gestation, more than 24 hours old with Jaundice

3.6.1 Midwifery management

If baby is ≥38 weeks gestation, more than 24 hours old and bilirubin is below phototherapy treatment level but within 50 µMol/L of the treatment line, repeat a bilirubin level at 18 hours (if risk factors present see section 3.5.1) If bilirubin level is more than 50 µMol/L below the treatment line, do not repeat the bilirubin level.

Do not measure bilirubin levels routinely in babies who are not visibly jaundiced.

Do not advise families to place their infant in sunlight as this has no benefit to reducing jaundice.

How to measure the bilirubin level:

- Transcutaneous bilirubinometer (TCB) measurement can be used in babies >/= 35 weeks gestation after 24 hours of birth. Only staff trained to do so should use a TCB. See Transcutaneous Bilirubinometer (TCB) Standard Operating Procedure (SOP) on TCB's for further information.
- TCB measurement should be plotted against the appropriate column in the Threshold Table according to neonatal age. SBR results should be also plotted on the appropriate gestational age treatment threshold graphs (TTC) (see Appendix 11). All actions should be followed according to the charts and accompanying flow charts (see Appendices 2 & 3).
- If TCB is unavailable, or not suitable, and jaundice is suspected then an SBR should be taken. Community staff can then contact Ward 10 for the results.
- Always use a SBR measurement for babies at or above the relevant treatment threshold for their postnatal age and for all subsequent measurements.
- If the threshold for further investigation is met or exceeded, an urgent review by paediatrician is indicated. Refer to Paediatric Section 3.6.2 of this guideline for investigation and management plan.
- If the TCB / gas bilirubin measurement is above the treatment threshold, commence phototherapy as soon as feasibly possible while awaiting confirmation of the level via a serum sample as TCB readings at high levels of bilirubin tend to underestimate the serum level.

If baby is ≥38 weeks gestation, more than 24 hours old and bilirubin is below phototherapy treatment level but within 50 µMol/L of the treatment line, repeat a bilirubin level at 18 hours (if risk factors present. If the bilirubin level is more than 50 µMol/L below the treatment line, do not repeat the bilirubin level.

Information for Parents

Information should be provided for all parents which includes:

- Factors that influence the development of significant hyperbilirubinaemia.
- How to check the baby for jaundice.
- What to do if they suspect jaundice.
- The importance of recognising 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.
- Encourage mothers of breastfed babies with jaundice to breastfeed frequently, use breast compressions when feeding, and to wake the baby for feeds if necessary.
- Lactation/feeding support should be provided for breastfeeding mothers whose baby is visibly jaundiced.

3.6.2 Paediatric Management

Any baby requiring phototherapy, or where the bilirubin level is <50 micromol/L from the 'phototherapy line' in the chart, should be referred to the Paediatric Team for advice on further management.

Any baby requiring phototherapy, or where the bilirubin level is <50 micromol/L from the 'phototherapy line' in the chart, will need the following investigations:

- SBR (if not already done i.e. initial measurement was using a transcutaneous bilirubinometer)
- Baby's blood group and DAT (direct antiglobulin test). NB: interpret positive DAT with caution if mother has had anti-D immunoglobulin. Also check mother's blood group and antibody status.
- Full blood count, haematocrit and film
- Reticulocyte count
- Full sepsis screen if baby unwell
- G6PD (glucose 6 phosphate dehydrogenase) assay - depending on ethnicity and family history.

3.6.3 Pre-Term Babies ≥35 weeks gestation with jaundice at more than 24 hours old

This applies to babies without evidence of sepsis or haemolysis

History and investigations: as for well babies ≥ 38 weeks gestation (Section 3.6.2 and Appendix 2)

Provided there are no other reasons requiring admission to the Neonatal Unit, preterm babies more than 35 weeks gestation, can continue to be cared for on the postnatal ward with their mothers, including receiving single and double phototherapy if required.

Preterm babies less than 35 weeks gestation would usually be admitted to the Neonatal Unit on account of their prematurity and / or low birth weight. Specific approach to management of jaundice would be as outlined above (Section 3.6.2).

Use the age appropriate treatment threshold graphs – see Appendix 11.

3.6.4 Management of babies with jaundice at less than 24 hours of age

These babies fall outside the scope of Midwifery practice. An urgent serum bilirubin should be done within 2 hours of identifying the jaundice. The SBR should be taken by the midwife whilst awaiting Paediatric review. See Appendix 4 for flow chart of management.

This group of babies can be unwell with signs of sepsis or have evidence of haemolysis: early onset jaundice <24 hours of age, positive DAT test, rapidly rising serum bilirubin >8.5µMol/L/hr.

Those babies at significant risk of haemolytic disease should have been discussed antenatally. There should be a Baby Alert form completed for these babies. The haematology laboratory and blood bank should be warned of the impending delivery so that blood is available for immediate transfusion if required.

Rhesus incompatibility develops between a Rhesus negative mother who has been previously sensitised to Rhesus antigen (usually by a previous Rhesus positive baby) and her Rhesus positive baby. The DAT test is usually positive. The degree of haemolysis tends to worsen with subsequent Rhesus positive pregnancies. There are also other blood group antibodies which can produce significant haemolysis in babies: anti C, anti c, anti E, anti e, Kell and Duffy antibodies.

ABO incompatibility occurs with a Group O mother and Group A or B baby. It can affect firstborn babies and the DAT test may not always be positive. Anaemia is usually late in onset.

Investigations:

- SBR
- Check maternal blood group, Rhesus and antibody status
- Baby's blood group and Rhesus status
- DAT test
- FBC and film, reticulocyte count and haematocrit / packed cell volume
- Baby's urea & electrolytes, liver function tests – if indicated
- Sepsis screen if unwell
- G6PD screen – if appropriate

3.6.4.1 Haemolytic Disease

If haemolytic disease is anticipated antenatally (maternal antibodies identified antenatally), cord blood must be taken for haemoglobin, reticulocyte count, group and DAT and bilirubin levels. If unable to obtain cord blood the baby needs to have these bloods done as soon as possible after birth. Do not wait for a rise in bilirubin. If cord haemoglobin is ≤100g/L, or bilirubin level is ≥100 µMol/L, then exchange transfusion should be strongly considered in order to remove the antibodies. See Section 3.8 and Appendix 5. If an exchange transfusion is anticipated, the baby should not be fed and an intravenous fluid infusion needs to be started to ensure adequate hydration. Phototherapy needs to be started as soon as possible.

The Department of Health and recent NICE 2016 guidelines recommend giving intravenous immunoglobulin (IVIG) for Rhesus and ABO incompatibility and when the SBR continues to rise >8.5 micromol/L/hour in addition to continuous intensified phototherapy. The dose of IVIG used is 500mg/kg infused over 4 hours. IVIG could also be considered if the bilirubin level reaches the exchange transfusion line and there is Rhesus incompatibility. The parents have to be informed why IVIG is being given and of the potential adverse effects as IVIG is a blood product.

If the rate of rise of bilirubin is ≥ 8.5 µMol/L/hr or a rapidly falling haemoglobin despite intensive phototherapy, then an exchange transfusion needs to be considered. See Section 3.8 for the process. The bilirubin levels should be repeated every 2-4 hours in these cases whilst the levels are still rising.

Follow up:

These babies should be started on folic acid at 500 microgram once daily when able to tolerate oral medication and this should be continued until they are reviewed in the Nurse Led Haemolytic Clinic as there can be ongoing low grade haemolysis due to persistent antibodies for up to 3 months of age. The folic acid needs to be prescribed as a TTO (to take out) prescription so that Ward 9 / 10 staff and mothers can administer to the baby. Ensure parents have been given the Haemolytic Disease of the Newborn Patient Information Leaflet – to be read in conjunction with the following documents section on page 1.

These babies should all be referred to the Neonatal Community Nursing team for follow up.

If a baby requires a top-up transfusion for subsequent anaemia, they should be admitted to the Paediatric ward after liaising with the General Paediatric Team.

3.7 Phototherapy

3.7.1 Practice Guidelines

Do not use sunlight as treatment for hyperbilirubinaemia (NICE 2016).

It is important to plot the bilirubin correctly on the appropriate chart dependent on the gestation and age of the baby in hours before considering the need for phototherapy treatment (see Appendix11).

Single and double phototherapy can be delivered on the postnatal ward, thereby ensuring mothers and babies can be kept together as much as possible.

3.7.2 Communication with Parents

Ensuring that Parents understand what is planned for their baby and gaining informed consent is extremely important prior to commencing phototherapy.
Best practice would suggest that wherever possible staff should:

- Explain jaundice, the care involved with phototherapy and the plan of treatment for their baby including potential side effects of phototherapy. Specific points to cover include:
  - Why phototherapy is being considered
  - Why phototherapy may be needed to treat significant hyperbilirubinaemia
  - Possible adverse effects of phototherapy
  - Need for eye protection and routine eye care
  - What might happen if phototherapy fails
  - Rebound hyperbilirubinaemia
  - Potential long term adverse effects of phototherapy
- Provide parents with written information to back up verbal information and for parents to take away. (see MKUH patient information leaflet on Jaundice in Newborn Babies)
- Keep parents informed about their baby's progress.
- Encourage and support parents to interact with, and care for their baby whilst they are receiving phototherapy.
- All care options should be discussed with the parents to ensure they make informed choices
- Support mothers to express breast milk if they are not able to breastfeed their babies during phototherapy.
- Explain to the parents why it is important that their baby stays under the phototherapy for the majority of the time
- If the baby is bottle fed or receiving supplementation whilst on a constant phototherapy regime, ensure the baby is not left in supine position and ensure the majority of feeds are given by the mother.
- Explain the ways in which parents can still be involved in their baby's care.
- Babies under constant phototherapy still require close and loving relationships, this is facilitated by carers talking to and holding the baby during feeds where a breastfeed is not possible.

3.7.3 Prior to Commencing phototherapy

Staff should consider thermoregulation, as the baby's clothing MUST be removed for treatment Phototherapy is a heat source therefore consideration should be given to the environment, either by removing blankets and sheets or use of an incubator (if in NNU).

- Measure and record the baby's temperature before commencing phototherapy.
- Any obvious cream or oil residue visible on the baby's skin should be gently wiped off using cotton wool and water. This is because there is a risk that the cream or oil may exacerbate the effect of heat from the phototherapy and/or the light wavelengths emitted and cause the baby's skin to be burnt.
- NNU Staff should make themselves aware of the unit's policy for fluid management when a baby is commenced on phototherapy

3.7.4 Types of Phototherapy

Bili-bed phototherapy.
Gather a clean bili-bed and a clean bili-combi-baby suit
Attach suit to bed base using velcro fastenings
Dress baby into suit- ensure the front fastenings are closed
The baby should be nursed only in a nappy within the suit
The use of eye shields is recommended for babies on a bili-bed, by the manufacturers of the bed.
The bili-bed should be sited securely in a cot with deep enough sides to prevent any risk of the bili-bed moving. This usually requires the mattress to be removed from the cot.
The baby should be monitored on an apnoea monitor, of the type that adheres to the abdomen. If none of this type is available then pulse-oximetry monitoring will be required.

Bili-blanket phototherapy.
Place a clean disposable cover on the bili-blanket
The bili-blanket can be used either in a cot or an incubator.
Ensure the light pad is positioned so that the correct surface is positioned facing towards the baby's skin.
The generator box which powers the bili-blanket must not be placed on top of the incubator if a baby is nursed in an incubator, due to the high levels of noise and vibration that it emits.
The cooling fan vent of the generator box must not be obstructed.
Take care when positioning the baby onto the light pad, as it has a firm surface and the baby is at risk of pressure sores on its bony surfaces, such as elbows, knees, head and pelvis.
The baby should be monitored using an apnoea monitor if not already having pulse oximetry monitoring. However, the firm surface of the light pad may reduce the effectiveness of the 'mattress style' apnoea monitor If this occurs pulse-oximetry monitoring must be used instead.
Position the baby on the light pad to give maximum exposure to and contact with the pad.
Consider using eye protecting pads for the baby. If the baby is small enough that their face or eyes will be near the light pad then eye pads will be needed.
Overhead phototherapy.
Place baby in a supine position unless other clinical conditions prevent this.
The overhead light should be positioned as close as possible to the baby without causing risk of burning or overheating. For appropriate distances see manufacturer's guidelines for different types of overhead phototherapy unit.
All babies will require eye protection pads (the baby's eyes should be closed before these are put on the baby.) or tinted headboxes in babies over 37 weeks gestation. (ensure mask is removed for feeding).
Remove all of the baby's clothing except for the nappy before commencing phototherapy.
The baby should wear the smallest appropriate nappy to maximise skin exposure. If the jaundice level is very high then the baby may be cared for on a flattened open nappy or absorbent pad. There is no risk to the gonads of chromatic radiance damage if there is a layer of perspex between the phototherapy bulb and the baby
Perspex is fitted on all commonly used overhead units.
Ensure the baby is positioned under the central focus of the phototherapy light.
Where more than one overhead phototherapy light unit is being used together the lights should be positioned around the baby to provide an even distribution of irradiance on the exposed surfaces of the baby. Seek advice from more experienced colleagues if uncertain about correct positioning.

The NICE guidelines (2010; updated 2016) accept that multiple phototherapies will be required in certain clinical circumstances.

These are when the baby's SBR is:

- Rising rapidly (>8.5 µMol/L/hr),
- The SBR is with 50 µMol/L of exchange transfusion level- after 72hrs of age,
- And/or the SBR has failed to respond to single phototherapy: the bilirubin level continues to rise / does not fall within 6 hours of commencing phototherapy.

If multiple/intensified (more than double phototherapy) phototherapy treatment is commenced and the SBR subsequently falls to a level of 50 µMol/L below the threshold for exchange transfusion, then a 'step down' can be made by removing one phototherapy unit at a time to single phototherapy.

Multiple/intensified phototherapy is defined by (NICE 2010; updated 2016) as phototherapy that is given using more than one light source simultaneously; for example, two or more conventional units or a combination of conventional unit and fibre optic units. Any baby requiring multiple/intensified phototherapy (more than double phototherapy) will need admission to the Neonatal Unit. Once baby has stepped down to single phototherapy, baby can be transferred back to the postnatal ward if mother is still an inpatient.

During multiple/intensified phototherapy (NICE 2016):

- Do not interrupt phototherapy for feeding but continue administering intravenous / enteral feeds.
- Continue lactation support so that breastfeeding can start again when treatment stops.
- Maternal expressed milk is the additional feed of choice if additional feeds are indicated.

3.7.5 General Care

- Nesting and comfort measures are very important for babies exposed for phototherapy as the babies feel very vulnerable without clothes, bedding and the usual contact with parents or carers.
- Nesting may encircle the baby but must not be positioned so it obstructs the light. Commercially available nests are often very deep and may not be suitable for use with phototherapy however effective nests can be made using rolled up blankets or towels.
- Remember that babies receiving phototherapy commonly pass very loose and watery stools so are likely to need their nappies changing more often. They also have an elevated risk of getting peri-anal excoriation. (See the South Central Neonatal Network Guideline for Skin Integrity)
- Making up a baby's bed using white sheets will increase the overall amount of phototherapy that a baby receives (irradiance) as the light bounces off the white sheets, when compared to coloured bedding.
- Do not use white curtains routinely around the cot as this may impair observation of the baby.
- Staff should remember that as a baby's SBR falls parents should be able to have longer and more frequent opportunities for cuddles and kangaroo care, - dependent on the baby's condition.

3.7.6 Temperature regulation

- Measure and record the baby's temperature prior to commencing phototherapy.
- Re check the baby's temperature within 1 hour of commencing phototherapy.
- Monitor and record the baby's temperature at least every 4 hours- more frequently if required.
- Aim to keep the baby's temperature between 36.6 and 37.2 C
- There is a high possibility that the baby's incubator will become warmer with the use of phototherapy and that the incubator temperature will need to be reduced to ensure the baby does not overheat.
- There is a high possibility that babies cared for in exposed open cots will lose heat and may require the room/bay temperature to be increased to ensure the baby's temperature does not drop.
- The likely changes in the baby's temperature are affected by the number of phototherapy units in use and also the particular model. For example, LED type overhead phototherapy produces almost no heat.

3.7.7 Eye care

There is no current evidence to show that light exposure in neonates damages the eyes or contributes to the development of retinopathy of prematurity (ROP.) However, it is clear that exposure to bright lights is unpleasant and uncomfortable for all humans and disturbs sleep patterns and reduces the ability to sleep at all.

In addition, physiology of the preterm infant means that their eyelids are very thin and allow light through, they are unable to effectively contract their pupils and will often sleep with their eyes partly open.

For all these reasons, it is very important to protect the eyes of babies effectively while on phototherapy from excessive light exposure.

- For babies 37 weeks gestation and upwards, a tinted facial shield may be used to protect the eyes of babies, but only under conventional blue light therapy.
- Eye protection pads are the preferred option for protecting a baby's eyes from the phototherapy. This is because they**;**
  - Stay in place despite movement by the baby
  - Allow exposure of the maximum amount of skin
  - Are more effective than eye shields at blocking light from the eyes.
- Eye protection pads carry risks of complications for the baby so must be used with care. Complications noted include;
  - Apnoea due to pads slipping and obstructing the nostrils
  - Eye irritation
  - Corneal abrasion
  - Blocked tear ducts
  - Conjunctivitis

Ensure eye pads are removed when away from the lights.

Good practice when using eye protection pads includes;

- Using pads designed for the purpose
- Not altering the pads in any way
- Choosing the correct size pads for the baby
- Not securing the pads too tightly (to avoid damage and discomfort)
- Never securing the pads to the face with tape to stop them moving
- Replacing the pads over the baby's eyes as soon as noted to be dislodged
- Checking the internal aspect of the pads for signs of eye discharge or other contaminants and changing pads if contamination noted
- Removing the pads with cares to check the baby's eyes for evidence of swelling, redness, oedema, abrasion or infection.
- Giving the baby opportunity with cares (even if only briefly) to open their eyes and look around.

Good practice for babies neighbouring phototherapy but not receiving it themselves includes;

- Ensuring the incubator cover (for babies nursed in incubators) is positioned so that it blocks the phototherapy from shining into the incubator. It must also be large enough that it is still being effective at blocking other light sources from the room.
- A dark cover can be hung from the actual overhead phototherapy unit, to prevent it spreading light into the room; however, care must be taken that the air vents are not blocked by the cover.
- Babies in cots should have a cot canopy to protect them from stray phototherapy light.

Staff with specific medical problems that may make them sensitive to the phototherapy lights should be referred to occupational health for advice and information.

- There should be acknowledgement and provision made for staff or visitors who may (rarely) be adversely affected by the phototherapy lights. Consider contacting ophthalmology or occupational health for advice.

Consider using the white light bulb as well as the blue phototherapy light to reduce the glare for staff and visitors and other babies. This option is only available when using certain models of overhead phototherapy unit, which have this facility.

3.7.8 Fluid balance

The choices available for feeding any baby receiving phototherapy are affected by the level of a baby's serum bilirubin (SBR) level and the current trend of the SBR which could be up, down or static and changing rapidly or steadily. Examples of common practice are tabulated below.

Some studies have found babies receiving phototherapy have side effects of increased fluid loss from evaporation and loose stools due to increased bowel transit time. Therefore, babies receiving phototherapy should have their fluid balance monitored and any changes or concerns reported to the medical team. In maternity this would involve monitoring of urine and stool output rather than a formal fluid balance chart.

Aspects to monitor and record include;

- Urine volume, frequency and urine analysis (bilirubin may be present)
- Stool volume, frequency and consistency.
- Daily weighing of baby.

Baby has a very high SBR for their age and gestation and/or their SBR is rising very rapidly
Baby must stay under phototherapy at all times, including during medical procedures or nappy changes • Feeds must either be by tube, or bottle with the baby being bottle fed **in** the cot or incubator (ensure this is not done in a supine position) • The baby may not come out for cuddles (ensure baby can be touched and spoken to by their parents in these situations • The use of intravenous fluids is likely, to help 'dilute' the SBR and perhaps to speed up the hydration of a dehydrated baby. • It is important to support mothers with expressing breastmilk 8-10 times in 24 hours including at least once at night, to maintain milk supply
Baby has a high SBR for their age and gestation but the level is being well controlled
• Feed times out from under the phototherapy are time limited, ie 5-40 mins maximum. • Whilst breast or bottle feeding the baby is kept on the bili blanket which comes out of the bed with them • No cuddle times except for during feeds, although if the baby is not being fed then a short cuddle is acceptable (ensure baby can be touched and spoken to by their parents in these situations • All basic medical procedures and nappy changes to occur under the lights preferably by the parents
Baby has a moderate or low SBR, which is well controlled and the level is falling
• A full feed can take place out of the lights, but parents should be encouraged to put the baby back under the phototherapy after this time. • If possible, the baby coming out of bed for a feed should still be nursed on the bili blanket/. • Continue breastfeeding support. • Do not routinely give additional feeds to babies who are breastfed. If required, maternal expressed breastmilk is the milk of choice.

Babies who require phototherapy should be monitored for indicators of dehydration, which include;

- Weight loss
- Poor urine output, or urine with a high specific gravity
- Wrinkled skin with poor skin turgor
- Sunken eyes
- Sunken fontanelle
- Dry mucosa

3.7.9 Skin care

- Rashes and spots can develop or become more prominent, usually only temporarily. But if the phototherapy lights are too hot or too close to the baby there is a risk of overheating the skin.
- Avoid the use of skin creams or oils on skin exposed to the phototherapy light
- Clean skin only with water
- Be vigilant about skin preparation products that may get left on the skin, i.e. chlorhexidine or betadine. These should be removed fully after use.
- Be aware of pressure areas for all babies nursed on a bili blanket or bili bed, particularly premature infants who have very little subcutaneous fat to protect them from the firm surfaces.
- Babies receiving overhead phototherapy should have as much skin as possible exposed to the light, so hats and bed covering should not be used.
- Babies receiving only bili bed or bili blanket phototherapy can have bed covers and hats.

3.7.10 Equipment

For guidance on the safe use of:

- Transcutaneous Bilirubinometers (TCB) – see Standard Operating Procedure
- individual types of phototherapy refer to manufacturer's guidelines for use.

Equipment used for monitoring jaundice and administering phototherapy, should be regularly serviced and well maintained. Daily cleaning as per manufacturer and Trust recommendations MUST be undertaken.

There is no difference in the effectiveness of conventional blue light and LED phototherapy. However, most users find the LED phototherapy easier to use.

In addition, babies have less need for additional fluids, because there is no heat output from the LED phototherapy.

3.7.11 Cessation of phototherapy

It is common practice to stop phototherapy treatment when a baby's SBR level has fallen ≥50 µMol/L below the treatment level for their age and gestation. These treatment levels are dictated by the NICE guideline CG98 on jaundice in newborn babies under 28 days (2010; updated 2016).

However, it is not uncommon for the baby's SBR level to 'rebound', or rise back above the treatment level when phototherapy is discontinued. In order to take account of this it is accepted practice to;

- Ensure SBR is on a downward trend before stopping phototherapy
- Recheck the SBR level 12-14 hours of stopping phototherapy or as clinically indicated, in case of rebound. Be aware that an SBR level can rise days after phototherapy has been discontinued. Babies do not need to remain in hospital to await the rebound bilirubin test but parents need to be cautioned regarding risk of readmission if the rebound level exceeds phototherapy treatment levels.

As when commencing phototherapy, temperature instability is common. When phototherapy is ceased due to the removal of an additional heat source it is most likely that a baby will get cold. With awareness of this it is important to;

- Measure and record the baby's temperature prior to ceasing phototherapy.
- Recheck the baby's temperature within 1 hour of ceasing phototherapy.
- Aim to keep the baby's temperature between 36.6 and 37.2 C

If baby is being cared for in an incubator there is a high possibility that this will become cooler with the cessation of phototherapy and that the incubator temperature may need to be increased to ensure the baby does not get cold.

If a biliblanket has been used, consider that the baby may require more bedding or clothing

3.7.12 Documentation

- Use local phototherapy care plan Record SBR results as soon as available, using the NICE threshold tables (Appendix 1) and age appropriate treatment graphs (Appendix 11). Additional sites for documentation are likely to include; in the current page of the medical notes and on the general blood results grid.
- Document all observations as per the guideline (temperature, fluid balance, changes in baby's condition) in the baby's notes (separate set if on postnatal ward – not purple postnatal notes).
- Document any changes in phototherapy treatment, for example use of additional phototherapy or current plan for time baby allowed out from phototherapy-if at all.

3.8 Exchange Transfusion

Exchange transfusion is the process of exchanging the baby's blood, which has very high levels of bilirubin, with donor blood, which has normal levels of bilirubin, thereby lowering the baby's own level of bilirubin. It is performed to remove the haemolytic antibodies and correct the anaemia.

The Paediatric consultant on call MUST be informed and kept up to date about any baby whose serum bilirubin is above the exchange transfusion line. If this is a significant possibility, consider early transfer to a tertiary Neonatal Intensive Care Unit unless the situation is life threatening or there may be significant delay in transferring the baby. Any baby whose serum bilirubin level is more than 50 micromol/L (five boxes) above the exchange transfusion line MUST be discussed with the Neonatal Team at the John Radcliffe Hospital with the view to performing an exchange transfusion.

Any baby whose bilirubin is >600 micromol/L will almost certainly develop kernicterus. Exchange transfusion as soon as possible is therefore imperative in this group of babies.

It is important to know that exchange transfusion is associated with significant morbidity. 6% of exchange transfusions are associated with:

- Apnoeas
- Bradycardia
- Vasospasm
- Thrombosis
- Other risks associated with transfusion of blood products.

It is also important to inform blood bank at the earliest opportunity about a potential high risk delivery of a baby with haemolytic disease or when the procedure is anticipated. Whilst waiting for blood for an exchange transfusion, consider giving immunoglobulin infusion.

Indications for exchange transfusion:

- Rhesus haemolytic disease
- Unconjugated hyperbilirubinaemia from other antibodies
- Sepsis or DIC
- Inborn errors of metabolism

If it is anticipated that an exchange transfusion may need to be performed, it is advised to wrap the cord in sterile gauze moistened with sterile water in order to facilitate umbilical catheter insertion once a decision to proceed with exchange transfusion is made.

3.8.1 Process for carrying out an exchange transfusion

Discussion with parents

- Inform the parents and explain the indications for exchange transfusion.
- Signed consent is not necessary.

Cross-matching of blood

- Volume requested is usually 180 ml/kg approximately twice the baby's blood volume. This 'double volume exchange' will remove ~ 90% of the initial red cells and 50% of the available intravascular bilirubin.
- Blood will be CMV negative and <5 days old. Blood group O Rh negative (or same-group as baby Rh negative) for Rhesus (D/d) disease or group O rhesus specific for ABO incompatibility.
- Samples of babies and mother's blood should be sent for cross-match.
- Irradiated and leuco-depleted blood is used for all neonatal exchange transfusions.

Preparation of blood

- The exchange blood is pre-prepared to have a PCV of 0.5 – 0.6 and a pH of ~7.0. This will not contribute to acidosis in the infant. Acidosis is more likely to be the result of underlying hypovolaemia, sepsis or hypoxia. 'Correction' of pH to physiological levels by the addition of buffer solution is not required
- There is no need to check electrolyte values on the exchange blood.
- As ambient temperature in the nursery is warm there is no need to connect exchange blood through blood warmer.

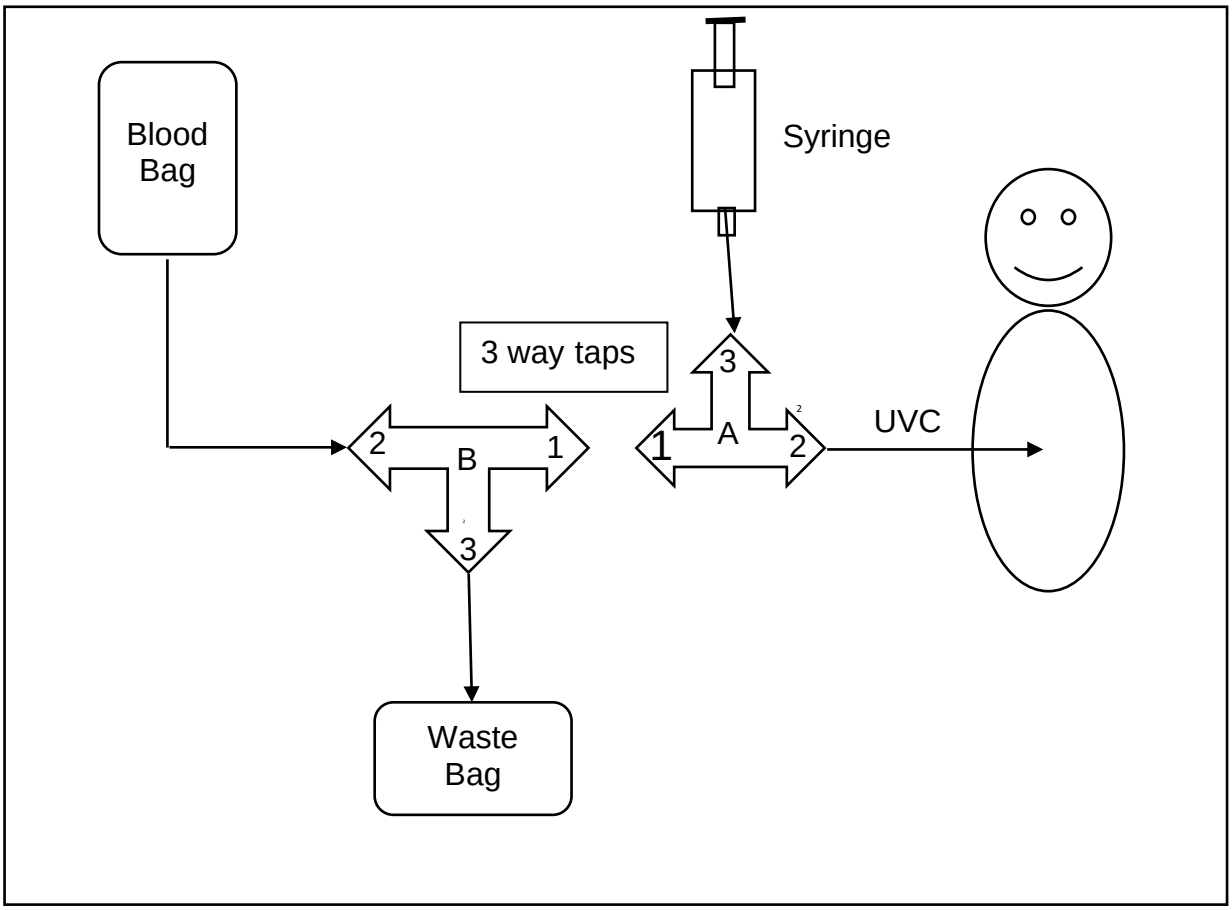
Care of the infant during exchange transfusion procedure

- The baby should be kept warm either in an incubator or under suitable radiant heat.
- Continuous ECG monitoring is essential.
- Resuscitation equipment should be on hand
- Two members of staff must be present throughout the procedure.
- Phototherapy should be continued throughout procedure.

Standard approach

- The standard approach is to use a pull-push procedure via an umbilical catheter.
- Prime the UVC catheter with saline and attach this to the three-way tap **A** at position 2. Leave an empty syringe attached via the three-way tap supplied in pack rotated to the 'locked position' (3), as disconnection may result in an avoidable fatality from air embolism or exsanguination.
- Insert UVC into umbilical vein ideally up to IVC / atrium junction.
- Using a second syringe, take pre-exchange blood for bilirubin, haemoglobin and further cross match, electrolytes, calcium and glucose. Viral serology & bacterial culture should be taken if indicated.
- Connect primed line containing the 'new' exchange blood to position 2 on the second three way tap **B** and the waste disposal line to position 3.
- Connect the two 3-way taps (A and B) together at point 1 on each tap as shown below.

Exchange transfusion: Single Catheter approach



Procedure

- Blood is exchanged in aliquots: 20ml >3kg,10ml 2-3 kg, 5ml <2kg.
- Blood is withdrawn over 1 minute and injected over 2 minutes. Total time ~ 2hours.
- The procedure is carried out by rotating the arm of the stopcock in a clockwise direction through a series of 90^{o} turns.

Step 1
Arm of stopcock A (white lever on three way tap) in position 1
The syringe is now linked to umbilical venous catheter
Withdraw aliquot of blood from the baby into the syringe
Turn stopcock through 180^{o} clockwise to position 2 on Tap A.

Step 2
Arm of both stopcocks (A and B) in position 2
The syringe is now connected to the extension tube connected to the 'removed blood' container (waste bag).
Expel removed blood
Turn stopcock B through 90^{o} clockwise to position 3.

Step 3
Arm of stopcock connected to new blood now in position 3
Leave arm of stopcock A connected to syringe in position 2
This aligns the syringe with the new blood
Draw aliquot of new blood into syringe
Turn stopcock A through 180º back to position 1

Step 4
Arm of stopcock back to position 1
The syringe is now in alignment with the catheter
Inject new blood into baby
Return to step 1

Note: If you pause for any reason, leave the catheter full of new blood, which is anti-coagulated, or heparinised saline, not the baby's blood which will clot.

Alternative method

- If an infusion pump is available which provides continuous display of infused volume this may be used to deliver exchanged blood over a predefined period (usually 2 hours).
- The volume delivered is matched with measured aliquots withdrawn via a umbilical lines or peripheral arterial catheter.

During the procedure

- Record all required information on the 'Exchange Transfusion Record' – see Appendix 6.
- Each aliquot of blood removed and replaced should be recorded on the 'Exchange Log' – See Appendix 7.
- Pulse rate, temperature, should be recorded every 5 minutes and BM stix hourly.
- Remember to agitate the donor pack at intervals to prevent settling
- Biochemistry, ionised calcium, lab glucose and pH should be measured on the gas machine mid-way through the exchange.
- Lab and gas machine biochemistry, calcium, glucose, pH and lab FBC should be recorded on completion of exchange

If the baby develops a bradycardia, goes pale or appears in pain STOP the exchange.

After procedure

- Inform parents that procedure has been completed.
- Catheters should be left in place until no further exchanges are required.
- Once the exchange transfusion is complete, intensive phototherapy should be continued and the bilirubin repeated every 6-12 hours with haemoglobin repeated as appropriate. Occasionally a second exchange transfusion may be required. Phototherapy can be discontinued or stepped down if bilirubin is 50 µMol/L below treatment threshold. The bilirubin should be repeated again 6-12 hours after stopping phototherapy.

3.9 Prolonged Neonatal Jaundice

Prolonged jaundice is a relatively common problem seen in the neonatal period. This is defined as jaundice in babies more than 2 weeks of age, if they are term (37 weeks and above) or more than 3 weeks of age, if preterm. Although, in the vast majority of cases, this is due to a benign and self-limiting cause such as Breast-milk jaundice, it is vital to assess and investigate this thoroughly to identify serious and time-critical conditions such as Extra-Hepatic Biliary Atresia, Galactosaemia, Alpha-1 Anti-Trypsin Deficiency, Hypothyroidism, Hypopituitarism, ensuing liver failure etc. so that management is instituted early. Prolonged jaundice due to breast milk jaundice will resolve by itself in time and is NOT a contra-indication to breastfeeding.

3.9.1 Care Pathway for Babies with Prolonged Jaundice

It is the referrer's responsibility to ensure that the baby does not have any other urgent medical needs and if any, they should follow the usual pathway for urgent referral to the hospital/GP.

3.9.2 For babies in the Community (See Appendix 8 for Flow Chart)

Babies referred with this condition will be seen in the weekly Prolonged Jaundice Clinic, which will be held on Wednesday or Thursday afternoons in the Milton Mouse Unit Paediatric Day Care Unit. The clinic will be run jointly by the Paediatric Registrar and Sister in charge of Paediatric Day Care Unit (PDCU), under the supervision of the PAU Consultant.

Referrals usually come from GPs, Health Visitors, outreach nursing teams (Paediatric and Neonatal) and, rarely, directly from parents and midwives. Referrals are made to the PDCU Scheduler during working hours Monday – Friday. Appointments will be offered at the next clinic, usually within 1 week. Parents will be given an appointment date and time over the phone and followed up with a letter. If the baby is already older than 4 weeks and there is a suspicion of obstructive jaundice as suggested by history of pale stools and dark urine, the appointment needs to be expedited and the baby brought to PAU as soon as possible for evaluation.

Assessments will last roughly 45 minutes to 1 hour. Baby will be seen initially by the allocated Paediatric Registrar using the Assessment Proforma (Appendix 9). Then, blood and urine tests will be carried out by PDCU nursing staff. If nursing staff are not successful, the PAU SHO or Registrar will complete the tests. There will usually be 4 slots (13h30, 14h00, 14h30 and 15h00), but this can be extended to 6 slots (15h30 and 16h00) depending on waiting list, so that all babies are seen within 2 weeks of referral.

Follow-up:
The results of the investigations will be chased by the Paediatric Registrar the following day, who will feedback to the parents and write the discharge summary using the Amalga Discharge summary application. Outstanding results are noted down in the PAU "Results to Chase" workbook for the PAU team to chase. If the baby has conjugated hyperbilirubinaemia or any other abnormal results, this has to be discussed with the PAU consultant. The baby should be brought back within 1 or 2 days to complete the "Conjugated Jaundice" Investigations (Appendix 10). This can be done in Milton Mouse Unit (by PDCU nursing staff) or, if there is no space available, then in the PAU (by PAU SHO). These results should be chased urgently and discussed with the PAU consultant and the Paediatric Liver Unit at King's College Hospital. If referral to King's College is recommended, this should be faxed urgently.

Named Clinician:
There is a named Paediatric Consultant for Prolonged Jaundice under whom all the investigations are requested. The named consultant will undertake to chase all outstanding results and inform parents and GP. However, in the event that the baby underwent a prolonged jaundice screen at the behest of another Paediatric Consultant whist an inpatient on the Neonatal Unit or Ward 5, then that consultant will be the named consultant for that particular baby.

3.9.3 For babies admitted on the Neonatal Unit or Ward (see Appendix 9 for Flow Chart)

The attending team are responsible for completing the assessment, investigations and to arrange follow-up. Appendix 8 includes history, examination and investigations when seeing these babies in PDCU / PAU.

Important points to note in the history and examination are as follows:

- Method and quality of feeding
- Baby's current weight and any evidence of weight loss / poor weight gain.
- Colour of stool – beware of pale stools
- Colour of urine – beware dark urine
- Ethnic background of parents
- Any family history of jaundice.

3.10 Conjugated hyperbilirubinaemia

Conjugated hyperbilirubinaemia occurs when the conjugated fraction is greater than 15% of the total bilirubin or absolute value is ≥ 25 µMol/L. This may be due to total parenteral nutrition cholestasis or sepsis for those babies who have been on the Neonatal Unit, particularly preterm babies. There are also various underlying causes e.g. biliary atresia, choledochal cyst, alpha-1-antitrypsin deficiency and galactosaemia that need to be considered and diagnosed quickly in order that treatment may be started as soon as possible in order to achieve the best possible outcome. Any delay in initiating treatment could have a significantly negative impact on outcome, especially in the case of biliary atresia where surgery needs to have taken place before Day 56 of life in order to maximise the chance of successful outcome. Furthermore, the problem of bleeding due to Vitamin K deficiency secondary to liver impairment/failure could be avoided.

It is important to take a good history and, specifically, to ask about the colour of the stool and urine. Dark urine and pale stool are indicative of obstructive jaundice.

Investigations to be performed: See Appendix 10.

If there is co-existent hypoglycaemia with conjugated hyperbilirubinaemia, cortisol level should be considered as this could be indicative of panhypopituitarism. Discuss urgently with endocrine team for further investigations and management if the endocrine results are abnormal

Other metabolic conditions may also need to be considered such as very long chain fatty acid disorders, bile acid synthesis defects etc.

Early referral to a tertiary paediatric hepatology unit (King's College Hospital in London) is important if the jaundice is not improving.

Nutrition is of the utmost importance in this group of babies.

Consider starting the following regime of drugs for these babies:

DRUG	DOSE
Dalivit	0.6ml orally once daily
Vitamin E (alpha-tocopherol acetate suspension)	50mg orally once daily
Vitamin K	1mg orally once a week
Ursodeoxycholic acid	10mg/kg/dose orally three times a day

4.0 Statement of evidence/references

Statement of evidence:

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5.0 Governance

5.1 Document review history

Version number	Review date	Reviewed by	Changes made
3	08/2017	Paediatrics/Maternity	Reviewed and updated
4	10/2018	Paediatrics/Maternity	Amended following an incident around exchange transfusion on NNU

5.2 Consultation History

Stakeholders Name/Board	Area of Expertise	Date Sent	Date Received	Comments	Endorsed Yes/No
Denise Campbell	Quality Lead Paediatrics	29/8/2017	4/9/2017 and 20/9/2017	Made amendments. Happy with the Guideline. Received comments from parents and these have been noted.	Yes
Karen Rice	Lead Nurse NNU		5/9/2017	Comments made	Yes
Julie Cooper	Head of Midwifery		20/8/2017	Review the Guideline with the consultant – no further comments to be made	Yes
Dr Rohith Shetty	Consultant		12/9/2017	Comments made	Yes
Kate Swailes	Matron, Children Services		20/9/2017	No further comments	Yes
Angela Weatherley	Midwife		12/2017		Yes
Parents			2/10/2017	Comments made	Yes
Ros McFadden	Infant Feeding Lead Midwife		09/2017		Yes
Julie Cooper	Head of Women's and Children's Health	11/09/2018	21/09/2018	Comments received	Yes
Ed Neale	Divisional Director	11/09/2018	12/09/2018	Approve – no comments	
Premila Thampi	Consultant	11/09/2018	12/09/2018	No comments	
Catherine Pitchford	Midwife	11/09/2018	12/09/2018	Comments acknowledged	
Jayne Plant	Library	11/09/2018	25/09/2018	Comments received	Yes

5.3 Audit and monitoring

Audit/Monitoring Criteria	Tool	Audit Lead	Frequency of Audit	Responsible Committee/Board
Audit compliance with the Guideline		Neonatal benchmarking group representative	Every three years	Paediatric CIG

5.4 Equality Impact Assessment

This document has been assessed using the Trust's Equality Impact Assessment Screening Tool. No detailed action plan is required. Any ad-hoc incident which highlights a potential problem will be addressed by the monitoring committee.

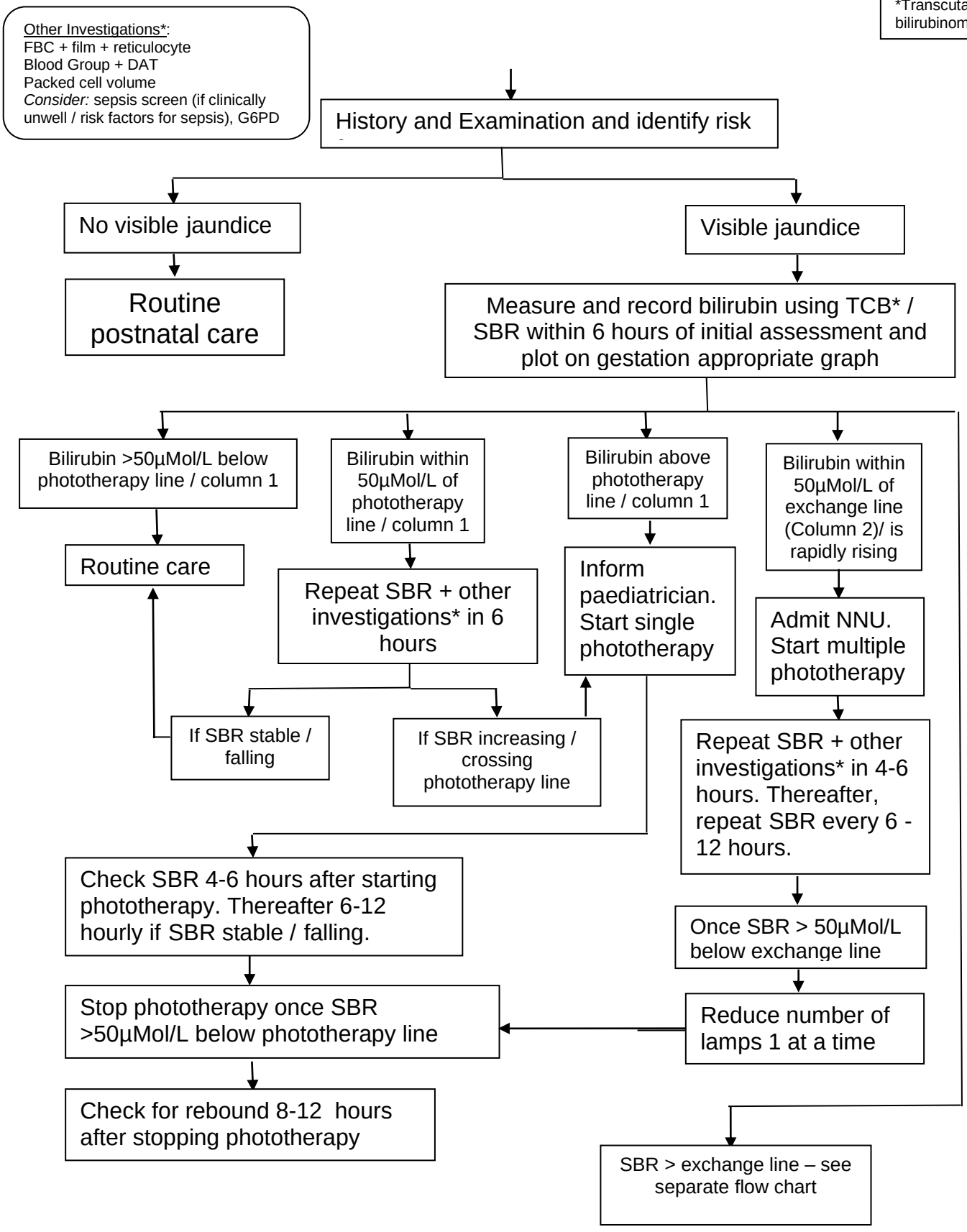
Impact	Age	Disability	Sex (gender)	Gender Reassignment	Race	Religion or Belief	Sexual orientation	Marital Status	Pregnancy & Maternity
Do different groups have different needs, experiences, issues and priorities in relation to the proposed policy?	N	N	N	N	N	N	N	N	N
Is there potential for or evidence that the proposed policy will not promote equality of opportunity for all and promote good relations between different groups?	N	N	N	N	N	N	N	N	N
Is there potential for or evidence that the proposed policy will affect different population groups differently (including possibly discriminating against certain groups)?	N	N	N	N	N	N	N	N	N
Is there public concern (including media, academic, voluntary or sector specific interest) in potential discrimination against a particular population group or groups?	N	N	N	N	N	N	N	N	N

Appendix 1: NICE Guidance Threshold Treatment Table

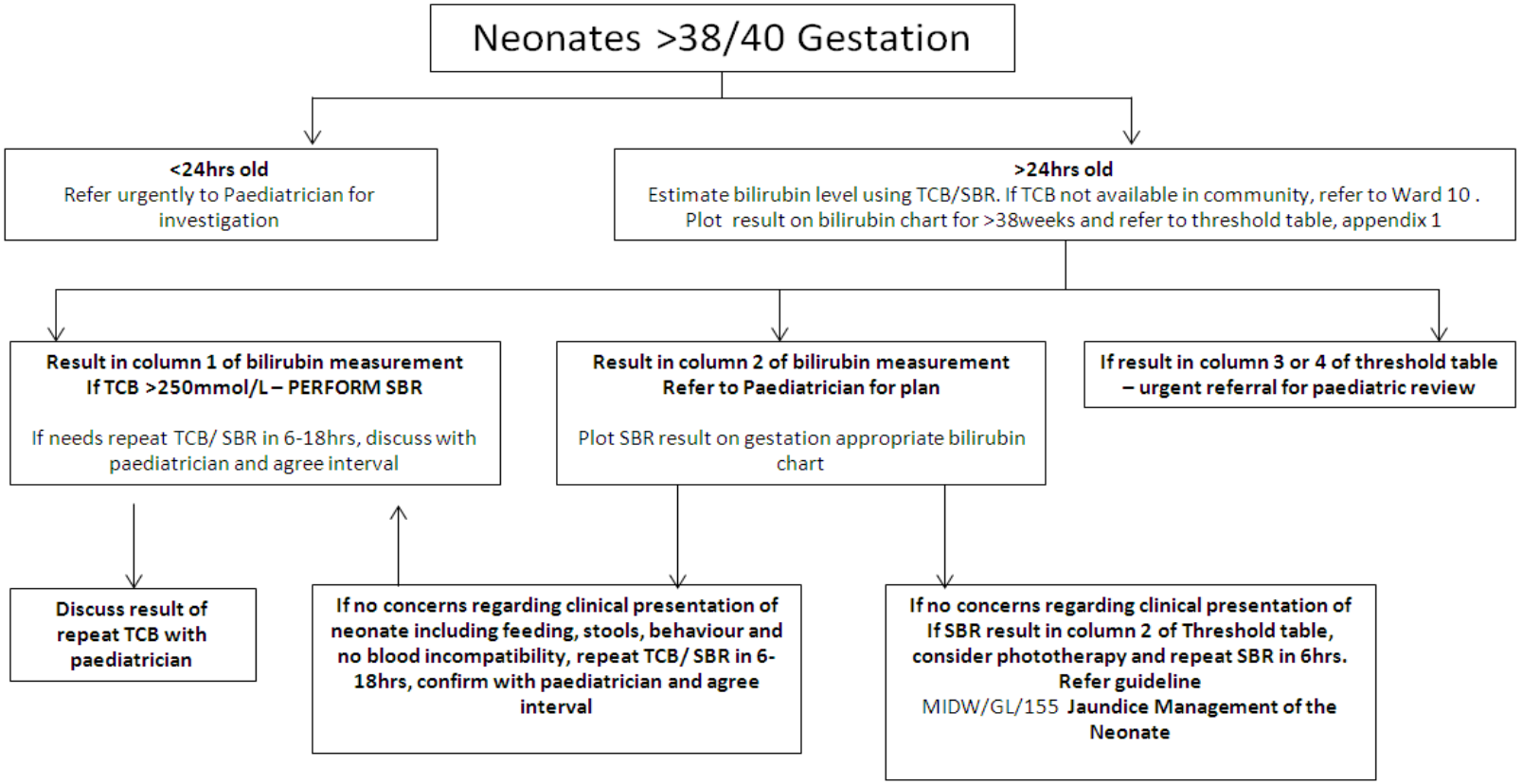
Table taken from NICE Clinical Guideline 98, Jaundice in newborn babies under 28 days, 2010; updated 2016.

Age in Hours	**Bilirubin Measurement (micromol/litre)**	
0	>100	>100
6	>125	>150
12	>150	>200
18	>175	>250
24	>200	>300
30	>212	>350
36	>225	>400
42	>237	>450
48	>250	>450
54	>262	>450
60	>275	>450
66	>287	>450
72	>300	>450
78	>312	>450
84	>325	>450
90	>337	>450
96+	>350	>450
Action	**Start Phototherapy**	**Perform exchange transfusion unless the bilirubin level falls below threshold while the treatment is being prepared**

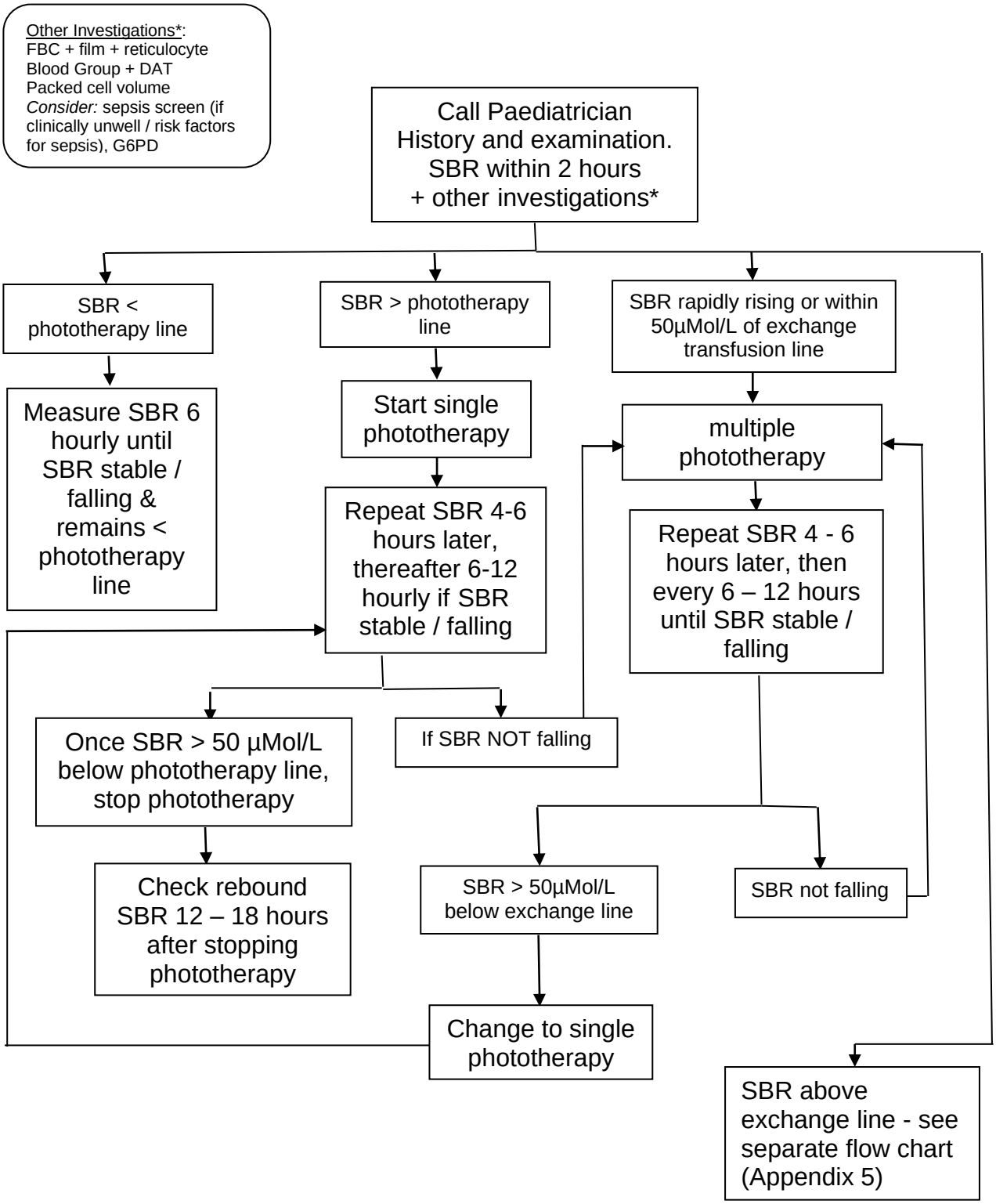
Appendix 2: Flowchart for Jaundice >24 hours of age



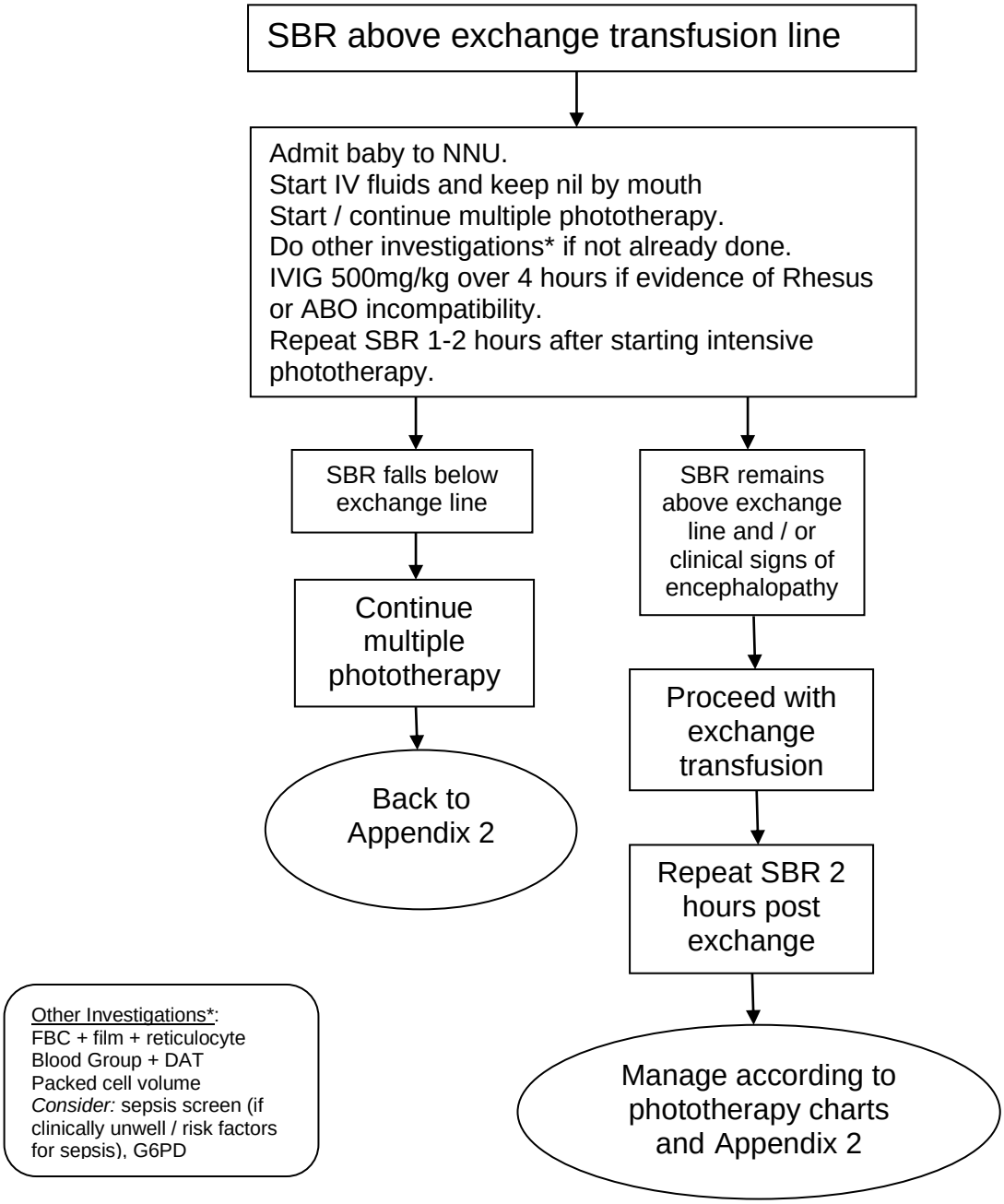
Appendix 3: Community Midwifery Flowchart for Jaundice >24 hours old



Appendix 4: Flowchart for Jaundice < 24 hours of age



Appendix 5: Flowchart for SBR above exchange transfusion line



Appendix 6: Exchange Transfusion Record

PATIENT LABEL

File in baby's notes when completed

1. Calculate volume of exchange, volume and number of aliquots

- 180 mls / kg =

- Number of aliquots

Volume of each aliquot

2. Initial investigations

- Baby's blood group
- Mother's blood group

Direct anti-globulin test

3. Preparing baby in anticipation of need for exchange transfusion

- Site umbilical venous catheter (or peripheral arterial line) for exchange procedure (check position of UVC on X-ray)
- Site second peripheral cannula
- Two members of staff available throughout procedure (may last 2-3 hours)
- Ensure resuscitation equipment is to hand
- Continuous ECG monitoring
- Continue phototherapy during exchange

4. Take pre-exchange bloods from baby

Na K Ca glucose

Hb plats bilirubin pH

PCV

Baby label

5. Commence exchange transfusion

- Record each aliquot removed and replaced on exchange log
- Pulse rate, temperature recorded every 5 minutes, blood sugar every 30 minutes
- Agitate the donor pack at intervals to prevent settling
- Electrolytes, ionised calcium, glucose, Hb, PCV and pH plus bilirubin should be measured at midway and end of exchange (gas machine values acceptable)
- Check FBC and platelets at end of exchange

If baby develops a bradycardia, goes pale or appears on pain – <u>STOP exchange</u>

6. Take bloods from baby midway through exchange

Na ☐ K ☐ Ca ☐ glucose ☐

Hb ☐ bilirubin ☐ pH ☐

PCV ☐

7. Take bloods from baby at end of exchange

Na ☐ K ☐ Ca ☐ glucose ☐

Hb ☐ plats ☐ bilirubin ☐ pH ☐

PCV ☐

8. Inform parents that procedure has been completed
Catheters should be left in place until no further exchanges are required.

9. Consider plan for ongoing phototherapy and timing of measurement of next bilirubin level.

Appendix 7: Exchange Transfusion Log

Page one

Baby label

If you need to pause for any reason, leave the catheter full of exchange 'new' blood which is anticoagulated not the baby's blood which will clot

No.	Time	Blood removed		Blood infused		Pulse rate and Temperature every 5 mins	Blood sugar every 30 mins	Comments
		Aliquot out	Total out	Aliquot in	Total in			
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

- Midway point reached: check electrolytes, calcium, glucose, Hb, PCV and pH plus bilirubin (gas machine values acceptable)
- End point reached: check electrolytes, calcium, glucose, Hb, PCV and pH plus bilirubin (gas machine values plus samples to lab)

EXCHANGE TRANSFUSION LOG: Page two

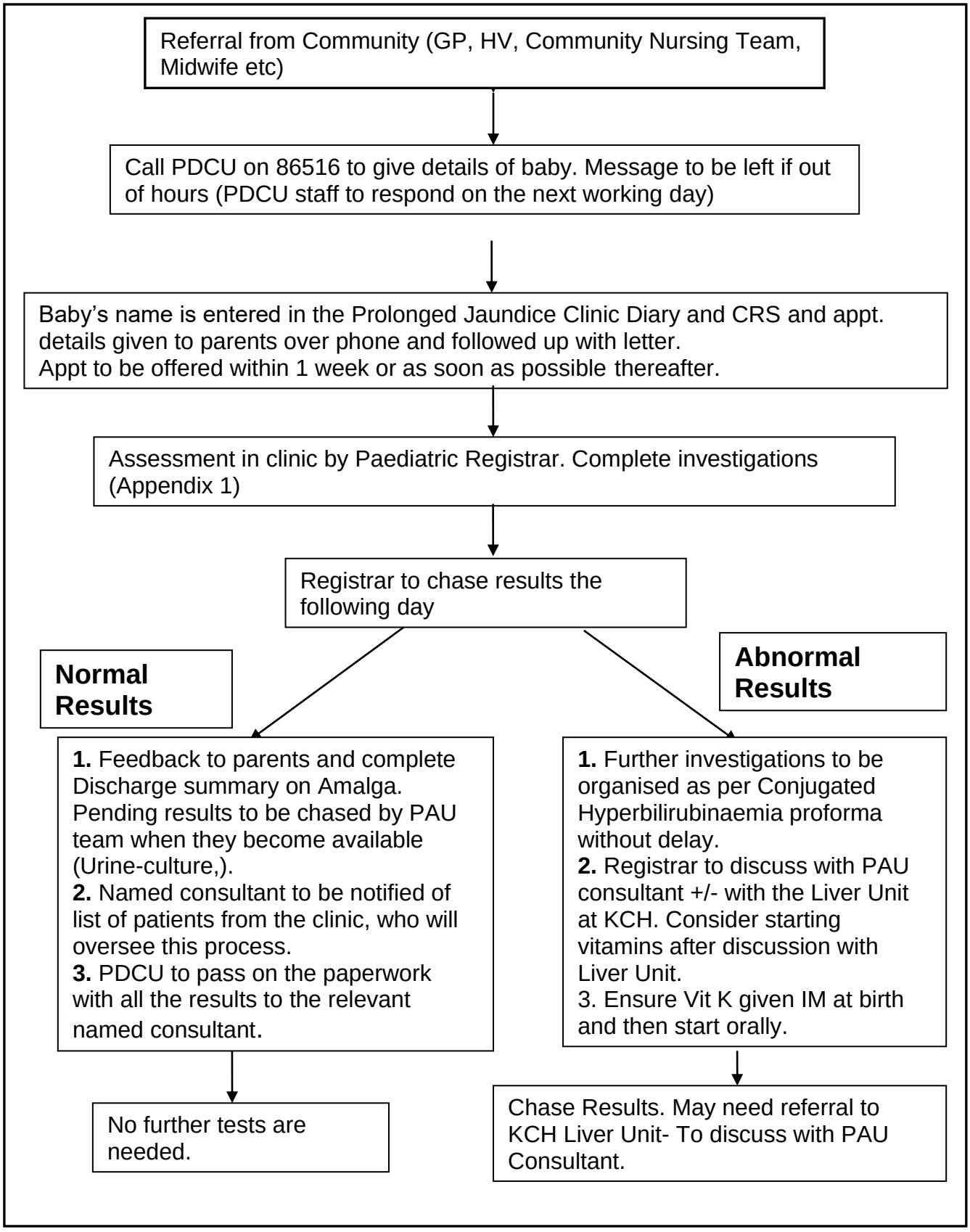
Baby label

If you need to pause for any reason, leave the catheter full of exchange 'new' blood which is anticoagulated not the baby's blood which will clot

No.	Time	Blood removed		Blood infused		Pulse rate and Temperature every 5 mins	Blood sugar every 30 mins	Comments
		Aliquot out	Total out	Aliquot in	Total in			

- Midway point reached: check electrolytes, calcium, glucose, Hb, PCV and pH plus bilirubin (gas machine values acceptable)
- End point reached: check electrolytes, calcium, glucose, Hb, PCV and pH plus bilirubin (gas machine values plus samples to lab)

Appendix 8: Flow chart for Prolonged Jaundice Clinic



Appendix 9: Prolonged Jaundice Assessment Proforma

Prolonged Jaundice Assessment Proforma:

Addressograph Label

Date: Time: Seen By:

Referred by:

Parents' contact details:

History:

Feeding History:

Method Feeding: Birth weight: Current weight:
Colour of stool
Family History and pregnancy and delivery details:

Examination:

PATIENT LABEL

Investigations:

Test	Specimen	Place a tick here once the sample is sent
FBC Blood film and Reticulocyte Count	EDTA 0.7 ml	
Group and Direct Antiglobulin Test (DAT)	EDTA 0.7 ml	
LFT with Split Bilirubin	Lithium Heparin (Orange) 1ml	
BM (Ideally pre-feed)	Bedside with glucometer	
Urine dipstix and M,C&S (Clean Catch sample)	Universal sterile container	
Ensure Newborn Blood Spot Screen done (Day 5-7)		
Review stool colour		

Result Summary:

Plan:

Discharge Letter to GP and HV sent: ☐ **(check when completed)**

Parents informed by: _____ **(sign, name and date)**

Appendix 10: Investigations for conjugated hyperbilirubinaemia

Disorder	Investigation	Specimen	Date sent	Result	Sign and result chased date
Liver Dysfunction	LFTs including AST, ALT, ALP, GGT, Protein Ferritin	Lithium Heparin (orange 1.3mls)			
Risk of coagulopathy	Clotting profile	1.8mls light blue citrate bottle			
Hepatitis	Hepatitis B and C serology	White clotted bottle 1.3mls			
Galactosaemia	Gal-1-PUT activity Urine reducing substances (if not sent already)	Lith hep orange 1.3-2mls send away in the morning not Friday White universal container			
Endocrine disorders	TFT (if not already sent) Random Cortisol	White clotted bottle 1.3mls White clotted bottle 1.3mls			
Cystic Fibrosis	Sweat Test	Arranged separately			
Sepsis	Urine Culture (if not already sent)	Universal container			
Alpha1 anti-Trypsin Deficiency	A1AT level and phenotype	White or gold gel serum sample			
Metabolic Disorders	Plasma amino acids Urine Organic acids Ammonia Lactate Blood gas	Orange 1.3ml lithium heparin Universal container Orange lithium heparin Yellow fluoride Capillary tube			
Congenital Infections	Toxoplasma, Rubella, CMV, Herpes, EBV	White clotted bottle			
Biliary Atresia	USS- Liver				

Appendix 11:Treatment Threshold Graphs

Treatment threshold graph for babies with neonatal jaundice

NHS National Institute for Health and ClinicalExcellence

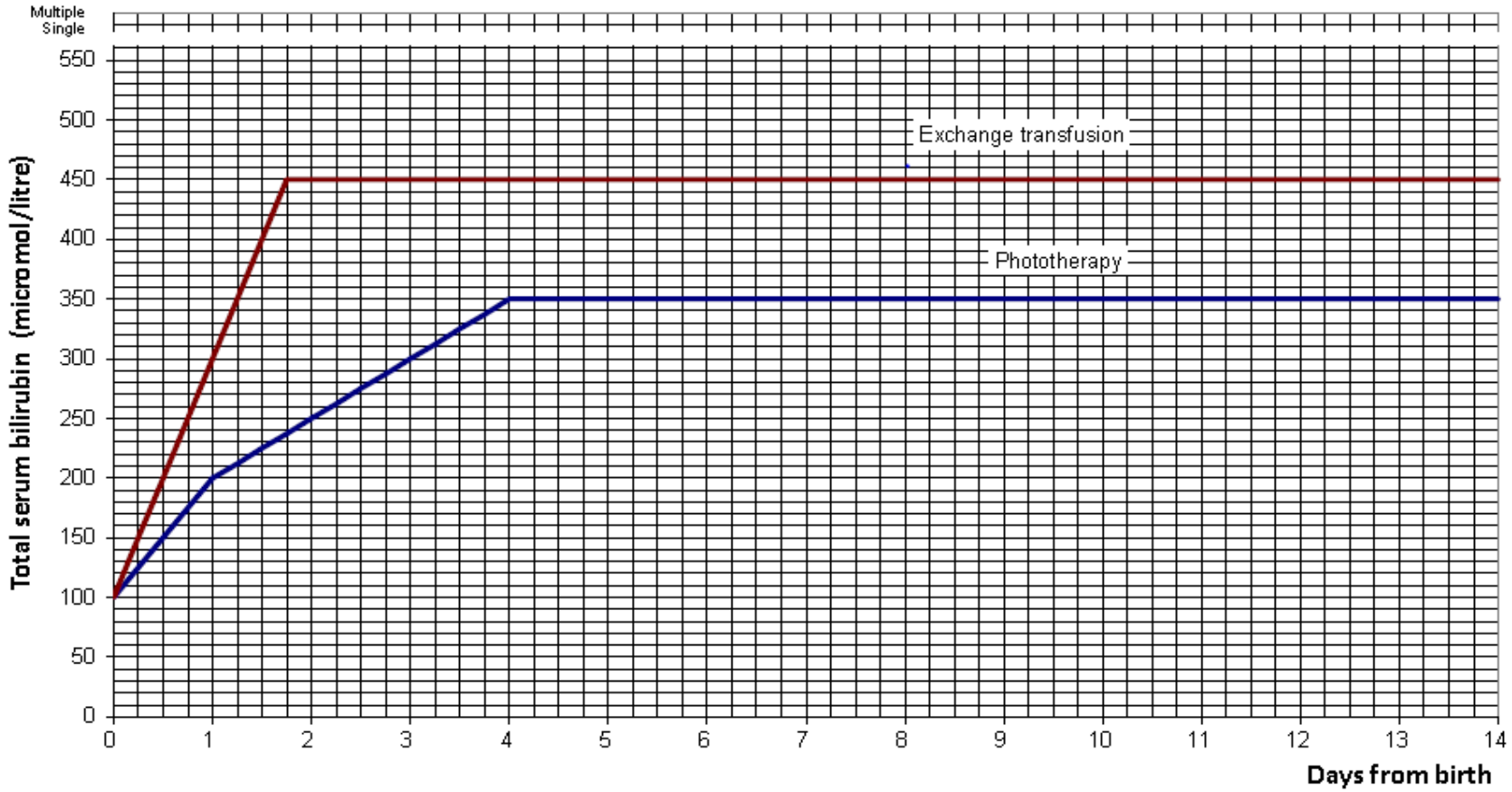
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

Click below and choose gestation

>=38 weeks gestation

Shade for phototherapy Baby's blood group _____ Mother's blood group _____



Treatment threshold graph for babies with neonatal jaundice

NHS National Institute for Health and ClinicalExcellence

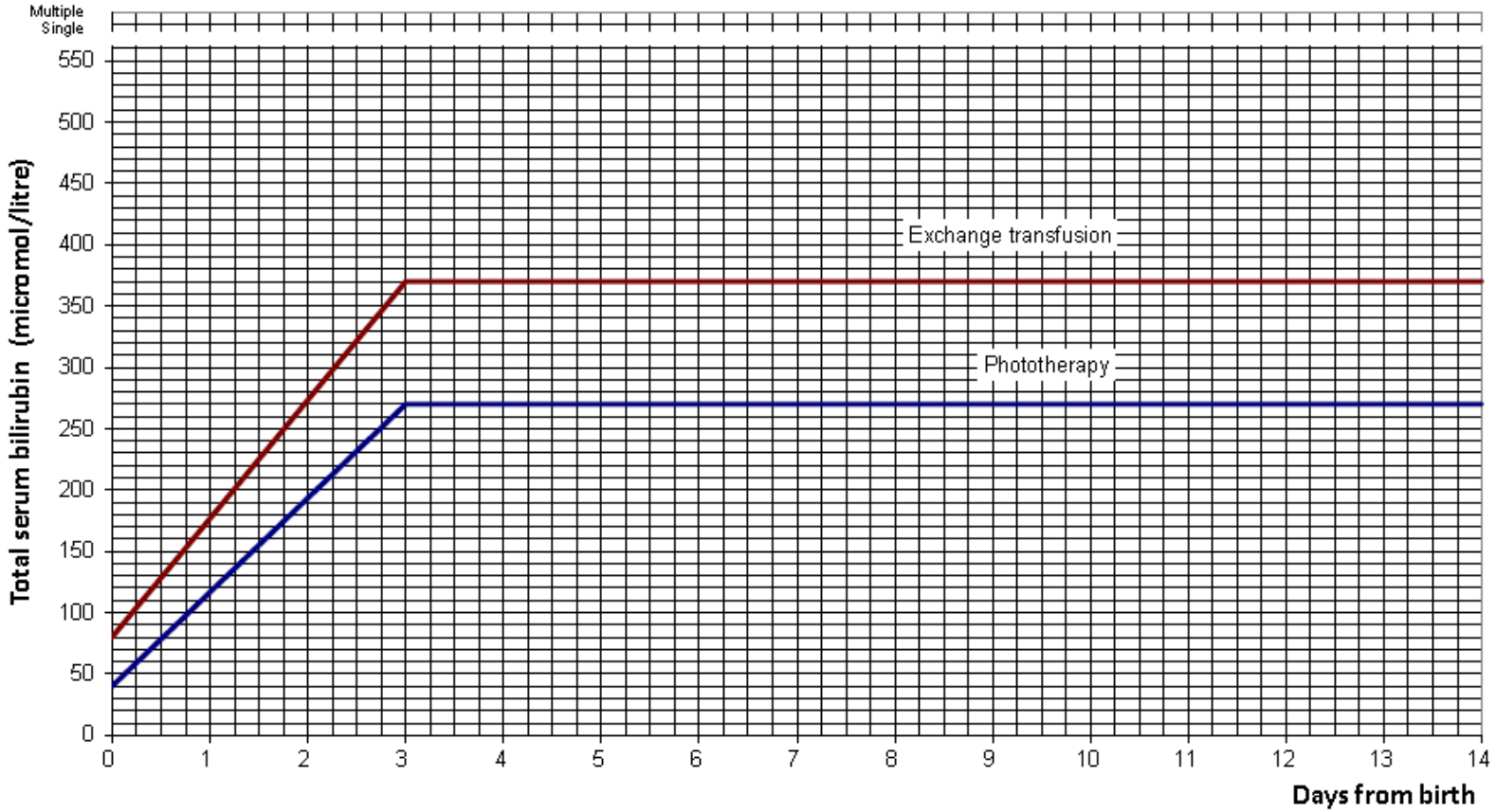
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

Shade for phototherapy Baby's blood group _____ Mother's blood group _____

Click below and choose gestation

37 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

NHS National Institute for Health and Clinical Excellence

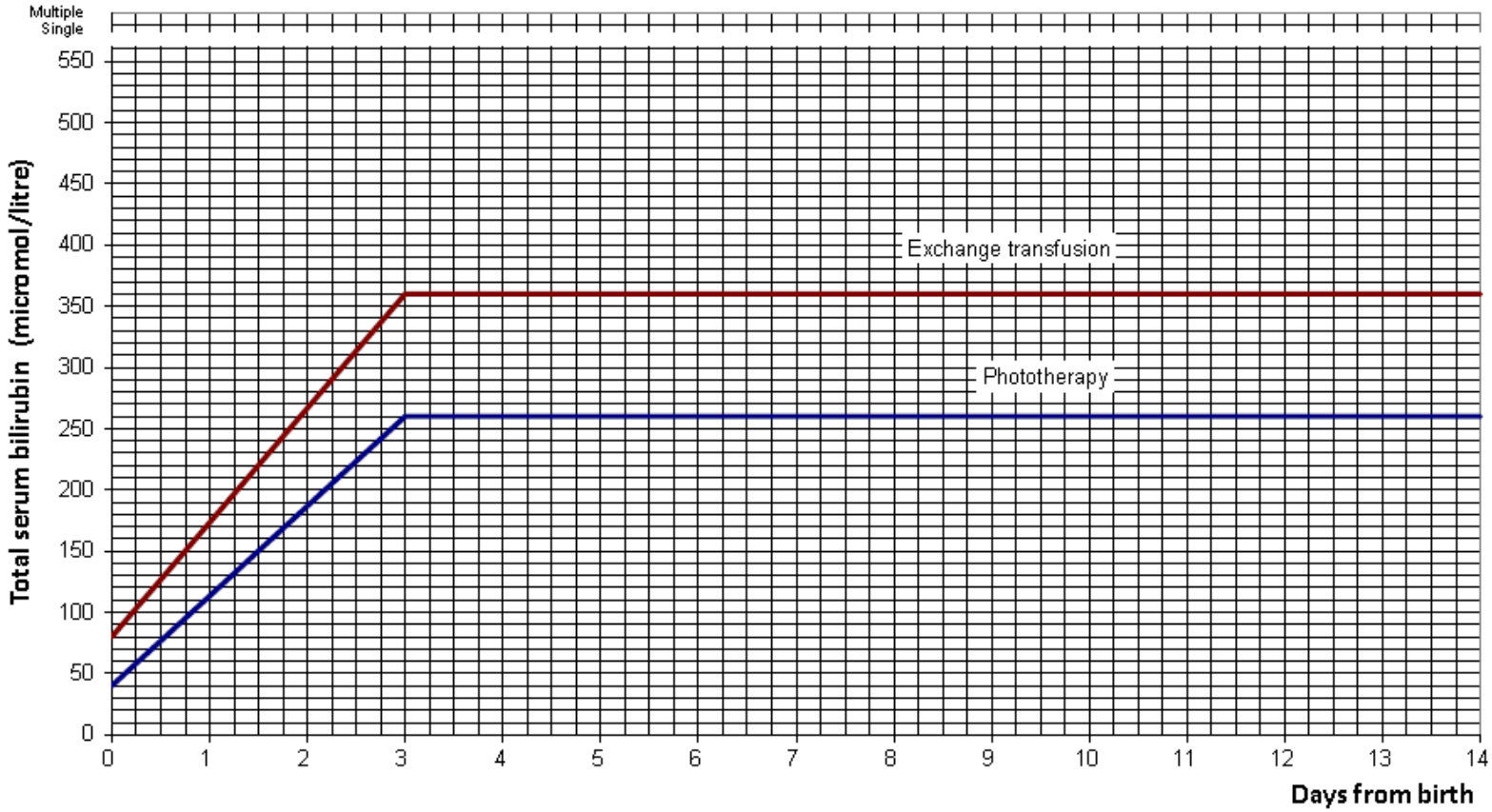
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

Shade for phototherapy Baby's blood group _____ Mother's blood group _____

Click below and choose gestation

36 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

NHS National Institute for Health and ClinicalExcellence

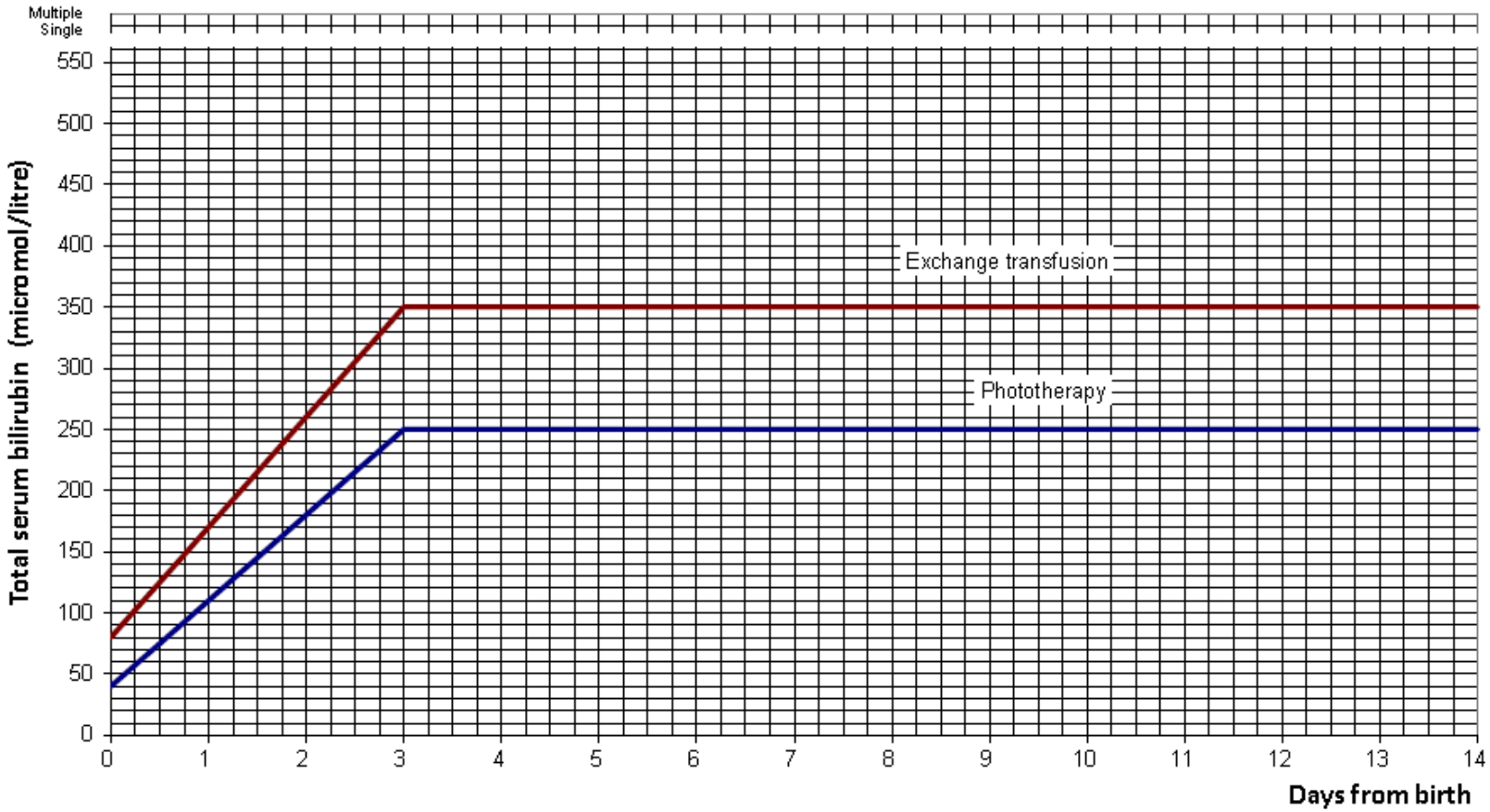
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

Click below and choose gestation

35 weeks gestation

Shade for phototherapy Baby's blood group _____ Mother's blood group _____



Treatment threshold graph for babies with neonatal jaundice

NHS National Institute for Health and ClinicalExcellence

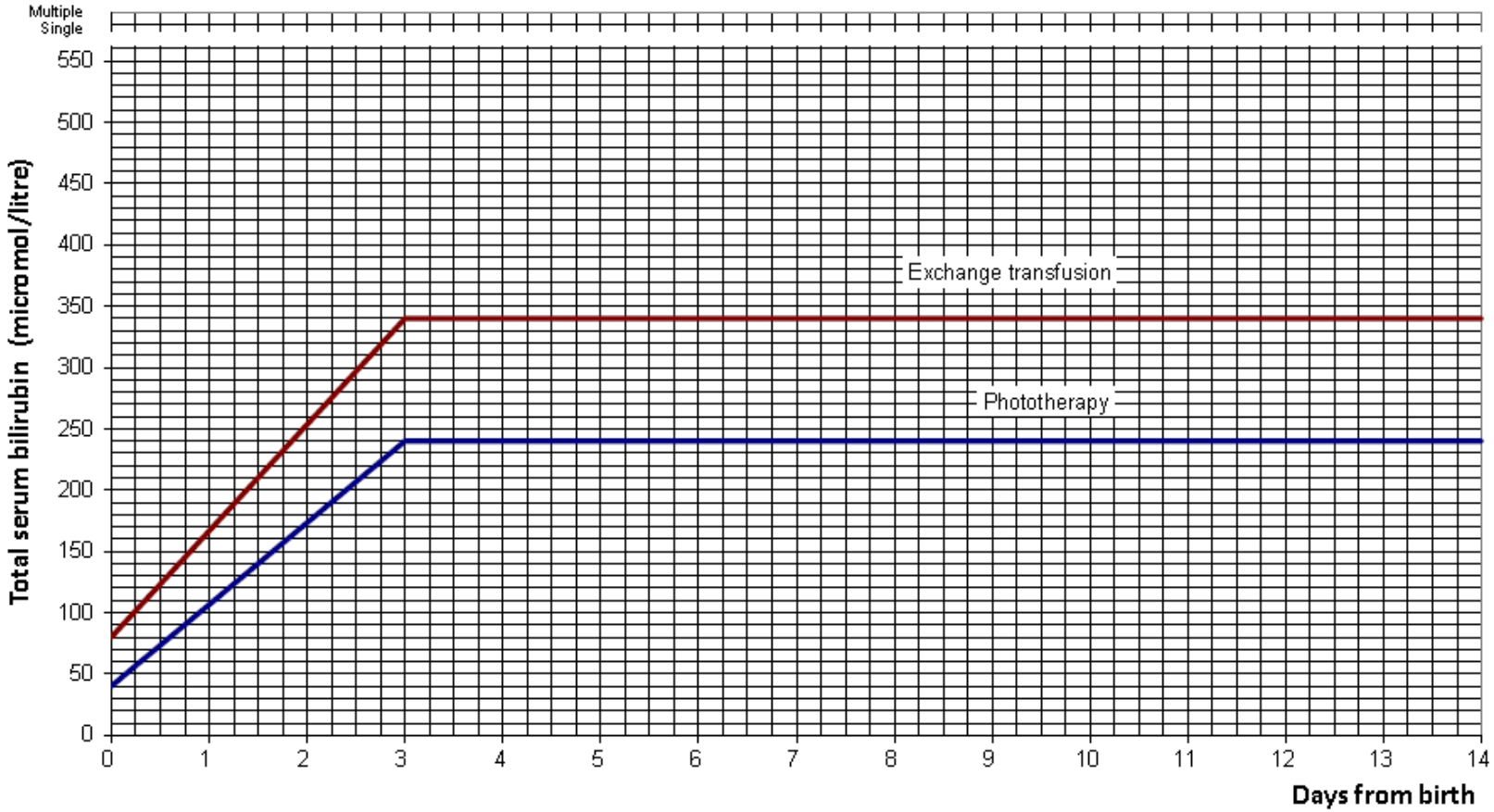
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

Click below and choose gestation

Shade for phototherapy Baby's blood group _____ Mother's blood group _____

34 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

NHS National Institute for Health and Clinical Excellence

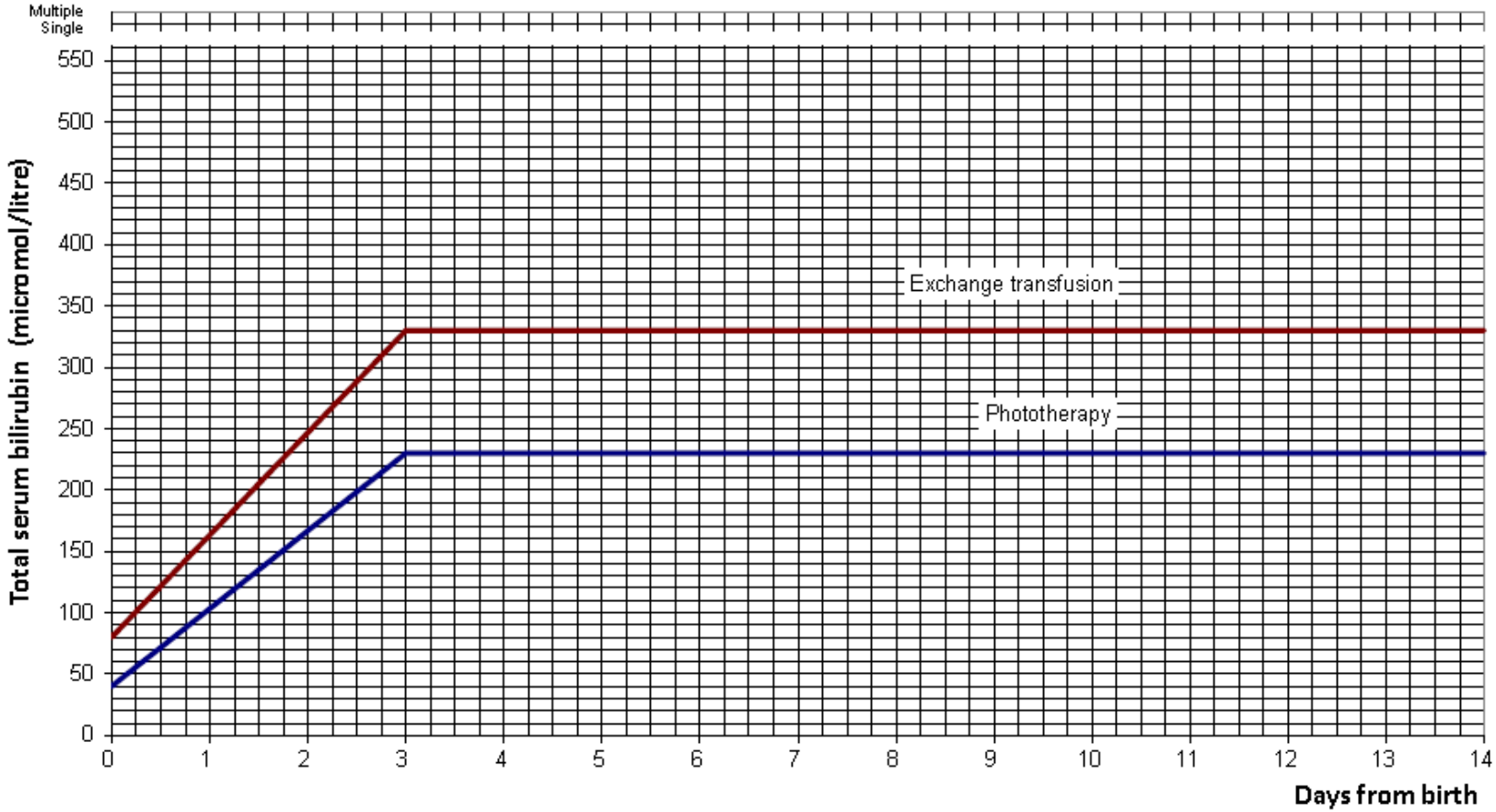
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

Click below and choose gestation

33 weeks gestation

Shade for phototherapy Baby's blood group _____ Mother's blood group _____



Treatment threshold graph for babies with neonatal jaundice

NHS National Institute for Health and ClinicalExcellence

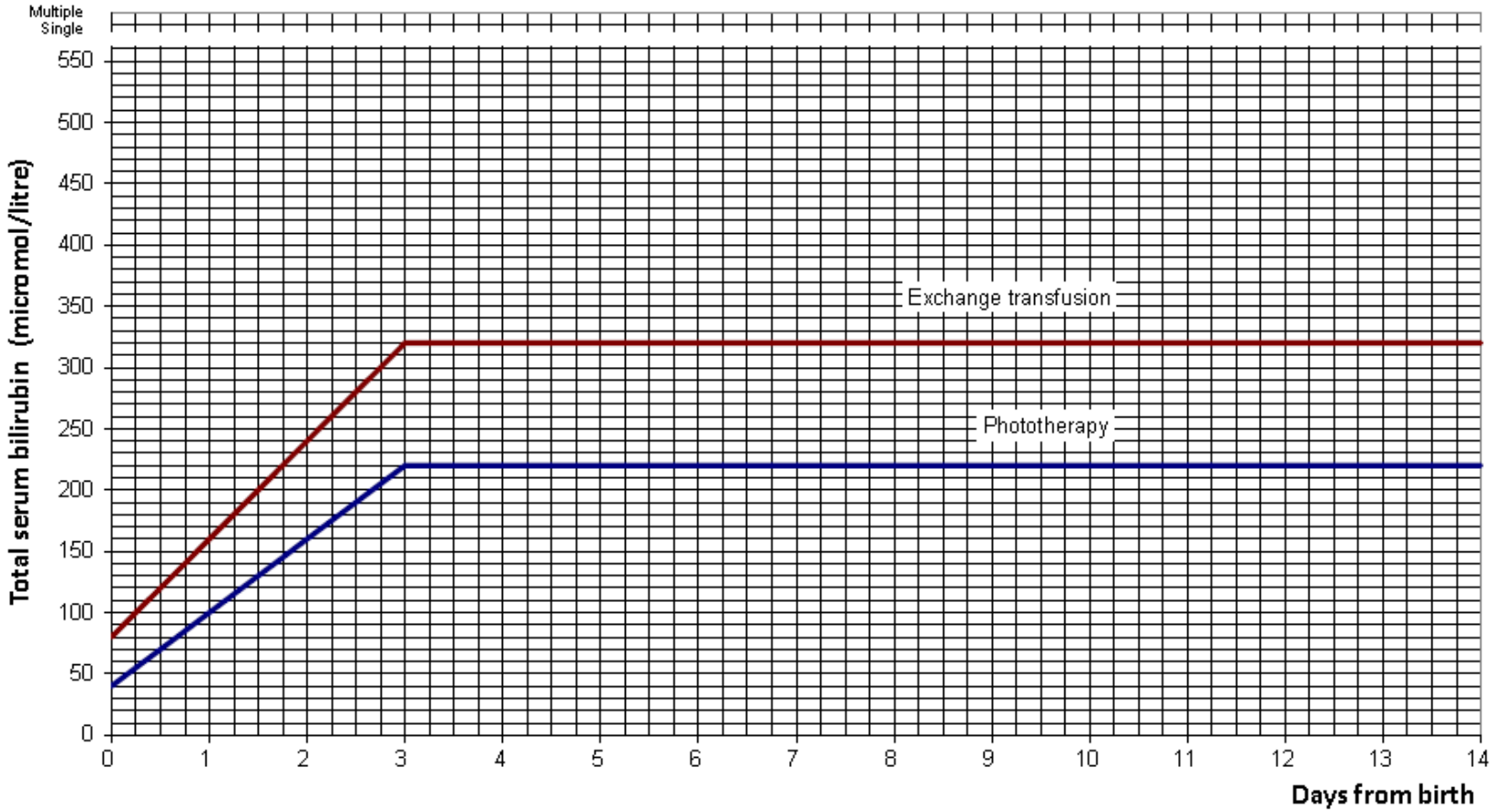
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

Click below and choose gestation

32 weeks gestation

Shade for phototherapy Baby's blood group _____ Mother's blood group _____



Treatment threshold graph for babies with neonatal jaundice

NHS National Institute for Health and ClinicalExcellence

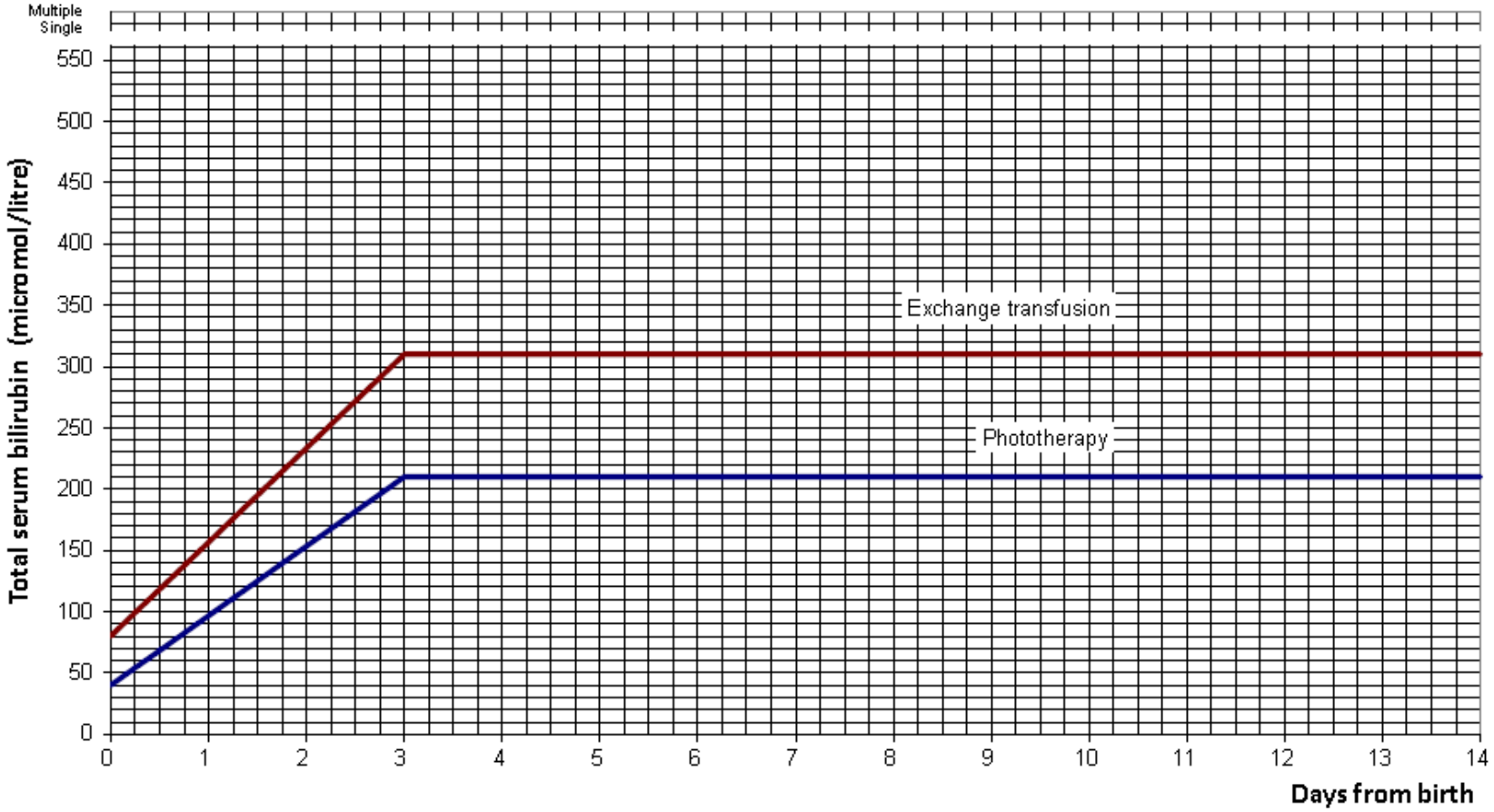
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

Click below and choose gestation

Shade for phototherapy Baby's blood group _____ Mother's blood group _____

31 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

NHS National Institute for Health and ClinicalExcellence

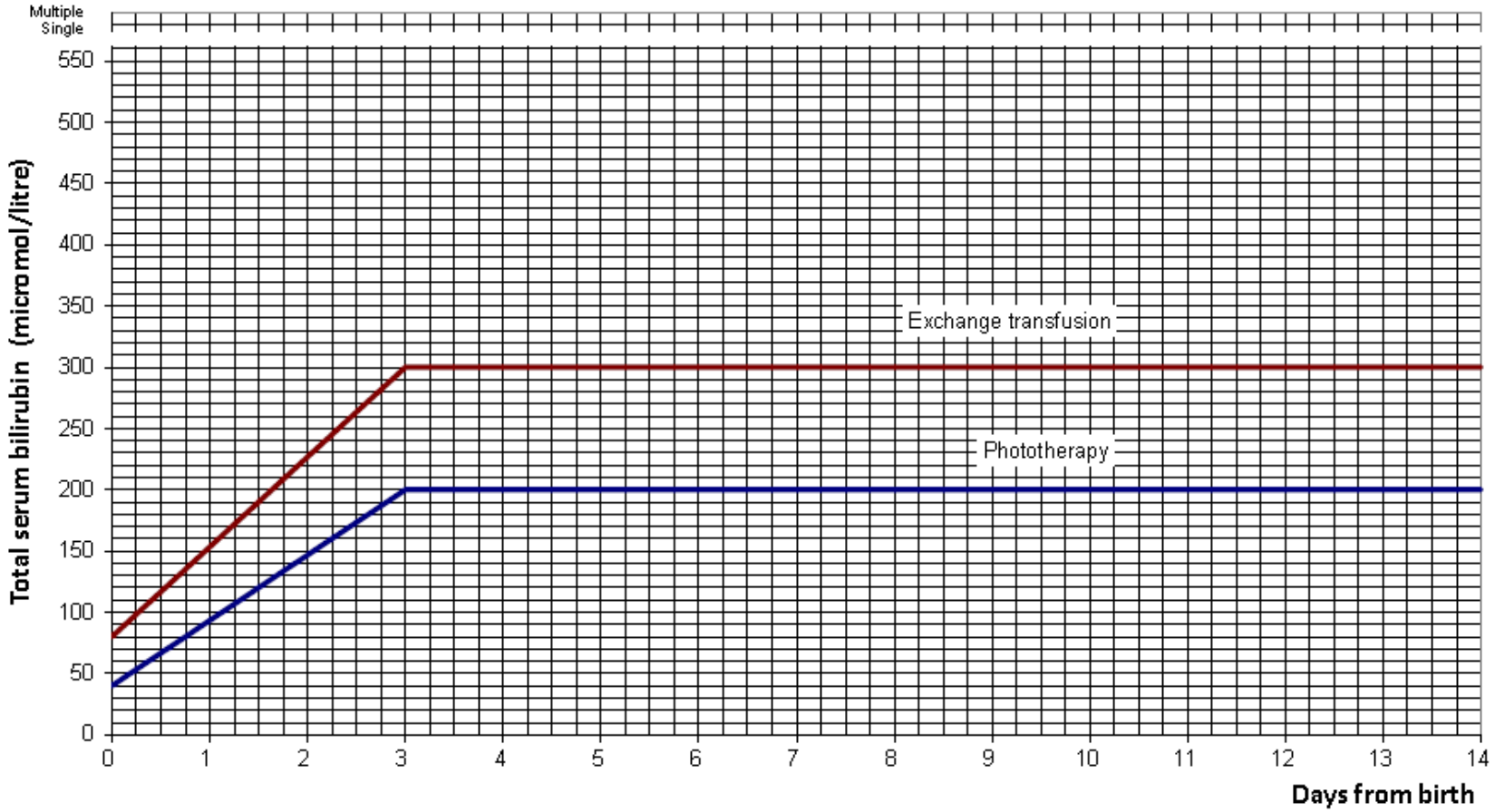
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

Click below and choose gestation

Shade for phototherapy Baby's blood group _____ Mother's blood group _____

30 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

NHS National Institute for Health and ClinicalExcellence

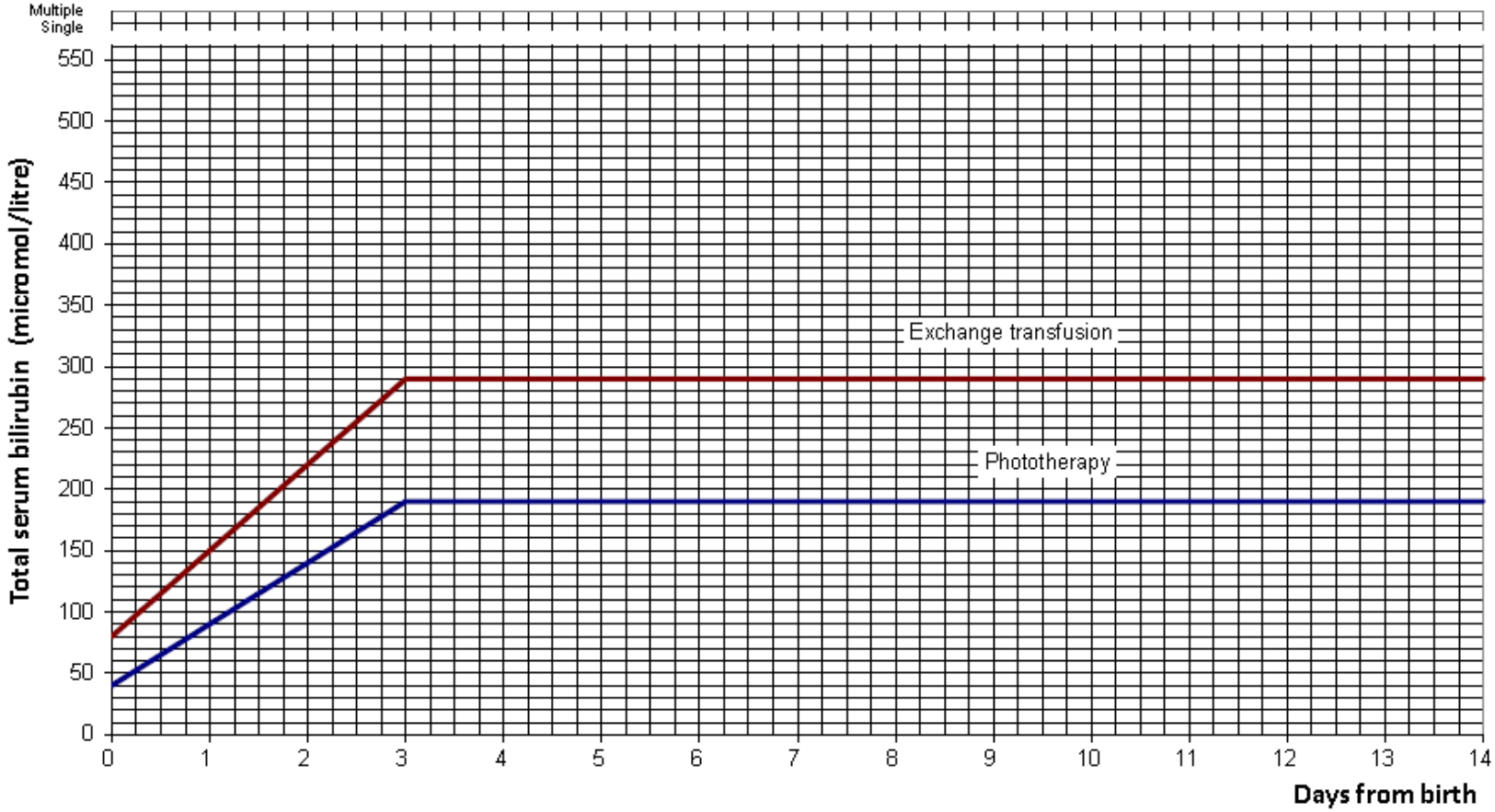
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

Click below and choose gestation

29 weeks gestation

Shade for phototherapy Baby's blood group _____ Mother's blood group _____



Treatment threshold graph for babies with neonatal jaundice

NHS National Institute for Health and ClinicalExcellence

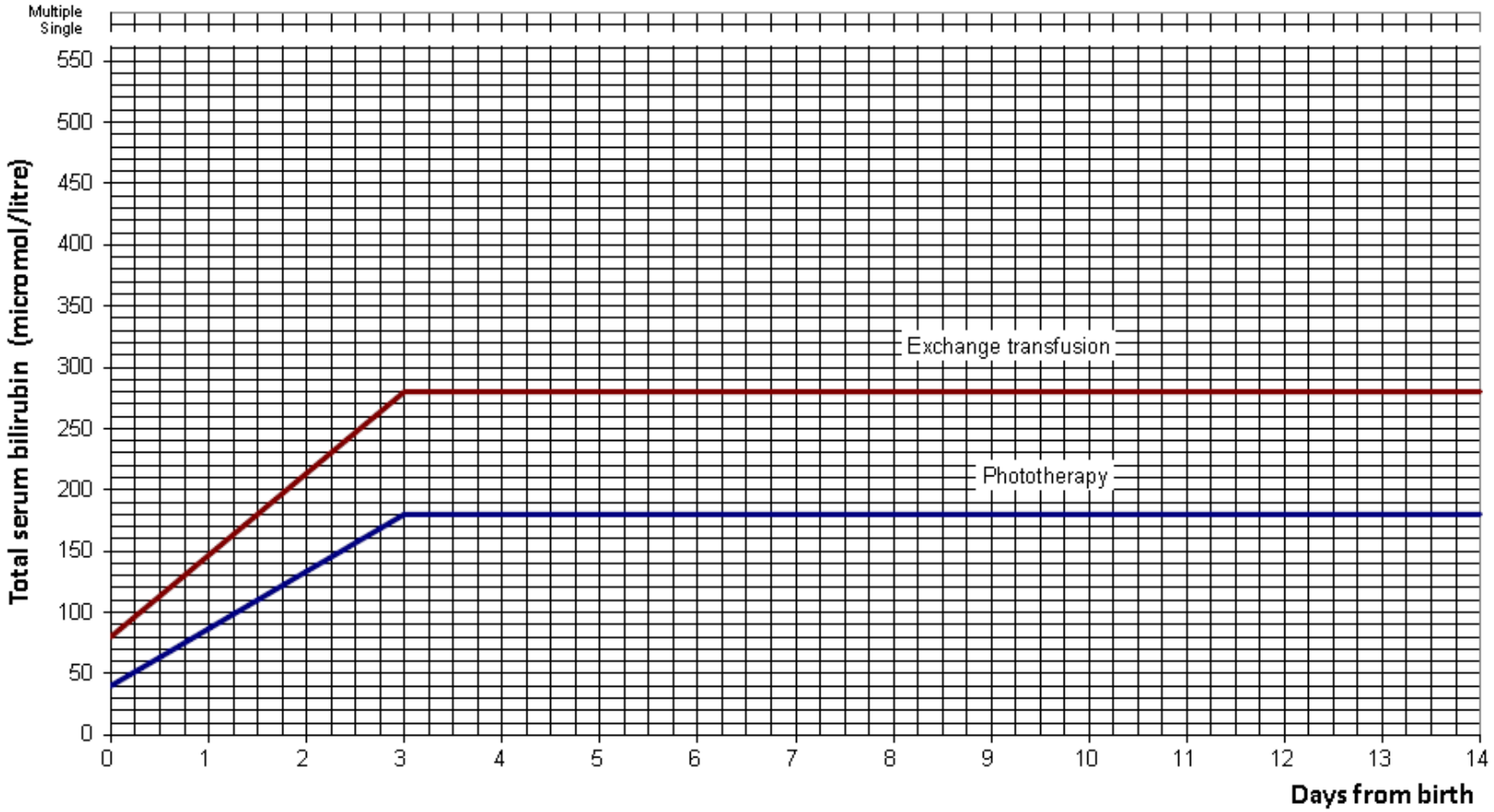
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

Shade for phototherapy Baby's blood group _____ Mother's blood group _____

Click below and choose gestation

28 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

NHS National Institute for Health and ClinicalExcellence

Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

Click below and choose gestation

27 weeks gestation

Shade for phototherapy Baby's blood group _____ Mother's blood group _____