Neonatal Jaundice Management

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Guideline to be followed by (target staff): Neonatal and Maternity Staff

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
- Milton Keynes University Hospitals NHS Foundation Trust. Prolonged Jaundice guideline. 2021
- Treating Neonatal Jaundice with Phototherapy and Exchange transfusion V4- Thames Valley & Wessex Neonatal Operational Delivery Network Guideline 2018

Are there any eCARE implications?

CQC Fundamental standards:

Regulation 9 – person centred care
Regulation 10 – dignity and respect
Regulation 11 – Need for consent
Regulation 12 – Safe care and treatment
Regulation 13 – Safeguarding service users from abuse and improper treatment
Regulation 14 – Meeting nutritional and hydration needs
Regulation 15 – Premises and equipment
Regulation 16 – Receiving and acting on complaints
Regulation 17 – Good governance
Regulation 18 – Staffing
Regulation 19 – Fit and proper

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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.

Guideline Statement

This guideline aims to ensure that jaundice is effectively identified and managed in both Maternity and Neonatal settings including community setting. 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 (separate guidelines for prolonged 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

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.

Significant jaundice: Jaundice is defined as significant once the unconjugated bilirubin is on or above the treatment threshold (identified by NICE Neonatal jaundice CG98).

Kernicterus: Neurological consequences 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. Also called Bilirubin encephalopathy and Bilirubin Induced Neurologic Dysfunction.

Physiological Jaundice: This is as a result of increased haemolysis (breakdown) of fetal haemoglobin (red blood cells), resulting in increased production of bilirubin. Occurs after first 24 hours of birth and is the most common cause of jaundice in neonates.

Pathological Jaundice: Jaundice that 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 if there is conjugated jaundice.

Prolonged Jaundice: Jaundice that persists after 14 days of age in term babies and 21 days in preterm babies (Refer to prolonged jaundice guideline).

Exchange Transfusion: 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.

1.0 Roles and Responsibilities

1.1 Senior Nursing & Midwifery Staff

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.

1.2 Medical Staff

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.

1.3 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.

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 Background and risk factors

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). 3

Physiological Jaundice: Most common cause of neonatal jaundice, occurring after 24 hours of birth.

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 gestation
2. Previous sibling with neonatal jaundice requiring phototherapy
3. Exclusively breast fed infant
4. Increased hemolysis: Maternal history of antibodies or O-type blood group
5. Polycythemia from placental transfusion (Delayed cord clamping or twin-twin transfusion recipient baby)
6. Blood extravasation: Bruising/ birth trauma/ cephalhaematoma/ internal haemorrhage
7. Dehydration/ decreased feeding
8. Entero-hepatic circulation of bilirubin: Delayed intestinal transit time/ passage of meconium
9. Sepsis: May interfere with normal liver processes and increase hemolysis

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.

Pathological 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:

1. Onset before 24 hours of age
2. Deep jaundice of trunk, hands and feet or rate of rise of bilirubin levels is greater than 8.5µMol/L/hr
3. Unwell baby with ANY of the following: pallor, poor feeding, vomiting, irritability, pyrexia, abdominal distension
4. Prolonged Jaundice: Beyond day 14 in term babies and day 21 in preterm babies
5. Failure to regain birth weight by 10 -14 days of age or subsequent poor weight gain on growth chart
6. Conjugated hyperbilirubinemia: Conjugated serum bilirubin fraction > 25µMol/L or presence of pale stools and/or dark urine

3.3 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.

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.

3.3.1 Visual inspection and history

The neonate should be examined in bright, natural light if possible. Examine the sclera, blanched 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 and look for risk factors that can exaggerate jaundice and need urgent treatment:

- Age in hours at onset of jaundice
- Gestational age <38 weeks
- Method and quality of feeding
- Breastfeeding assessment has been completed
- Any signs or symptoms suggestive of infection
- Any perinatal trauma e.g., cephalhaematoma, bruising
- Hypoxia / Hypercarbia / Acidosis / H/o asphyxia
- Stool and urine colour
- Mother's blood group and antibody status
- Ethnic background of both parents
- Family history of neonatal jaundice, especially in a sibling, requiring phototherapy

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 and needs to be escalated to the Paediatric team as soon as possible.

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 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.

3.3.2 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 greater than 250micromol/litre
    - Babies at or above treatment threshold
    - If baby is ≥35 weeks gestation, more than 24 hours old and bilirubin is below phototherapy treatment level but within 50 µMol/L of the treatment line:
    - No additional risk factors- recheck bilirubin within 24 hours
    - Additional risk factors present- recheck bilirubin within 18 hours

- 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 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 8)
  - Clinical features of acute bilirubin encephalopathy (kernicterus)
  - Prolonged jaundice (>2 weeks in term and >3 weeks in preterm)
  - Conjugated bilirubin >25 µmol/L

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.

3.3.3 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). 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 3.4 & 3.5

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 lifesaving.

3.4 Babies more than 24 hours old and jaundiced

3.4.1 Babies ≥38 weeks gestation midwifery management

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 8). 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 maternity 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 3.4.2 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 ≥35 weeks gestation, more than 24 hours old and bilirubin is below phototherapy treatment level but within 50 µMol/L of the treatment line:

- No additional risk factors- recheck bilirubin within 24 hours
- Additional risk factors present- recheck bilirubin within 18 hours

If the bilirubin level is more than 50 µMol/L below the treatment line, do not repeat the bilirubin level.

3.4.2 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 and will need 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

3.4.3 Pre-term babies ≥35 weeks gestation with jaundice at >24 hours old

This applies to babies without evidence of sepsis or haemolysis

History and investigations: as for well babies ≥ 38 weeks gestation (Section 3.4.2 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 3.4.2). Use the age appropriate treatment threshold graphs – see Appendix 8.

3.4.4 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.

In all babies with suspected or obvious jaundice in the first 24 hours of life, continue to measure the serum bilirubin level every 6 hours until the level is both:

- below the treatment threshold
- stable and/or falling. [NICE 2016]

This group of babies can be unwell with signs of sepsis or have evidence of haemolysis: early onset jaundice 8.5µMol/L/hr.

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

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

3.4.5 Haemolytic disease

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.

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. Intensive phototherapy needs to be started as soon as possible.

IVIG:

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.

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.

Dose of IVIG: 500mg/kg infused over 4 hours.
Out of hours: Contact site manager for IVIG access

Indications of exchange transfusion:

- 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 the rate of rise of bilirubin is ≥ 8.5 µMol/L/hr or a rapidly falling haemoglobin despite intensive phototherapy

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. See Section 3.6 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.

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.

3.5 Phototherapy

3.5.1 Practice guidelines

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.

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 Appendix 8).

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

During phototherapy:
• repeat serum bilirubin measurement 4–6 hours after initiating phototherapy
• repeat serum bilirubin measurement every 6–12 hours when the serum bilirubin level is stable or falling. [NICE 2016]

3.5.2 Communication with parents

Ensuring that parents understand what is planned for their baby and gaining informed consent is extremely important prior to commencing phototherapy. Please see Trust interpretation, translation guidance for supporting information on how to meet individual needs.
Interpretation, Translation and Accessing information to meet individual needs.pdf

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 and 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 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 most 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.

3.5.3 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.

3.5.4 Types of phototherapy and care under phototherapy

For types of phototherapy including equipment available and nursing care in babies requiring phototherapy including general care, care of eye, skin, temperature regulation and fluid balance refer to Guideline Treating Neonatal Jaundice with Phototherapy and Exchange transfusion- Thames Valley Guideline.

3.5.5 Intensive phototherapy

The NICE guidelines (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 within 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 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.

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 and/ or fontanelle
- Dry mucosa

3.5.6 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.

3.5.7 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 (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. 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.

3.5.8 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.

3.6 Exchange transfusion

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.

3.6.1 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.

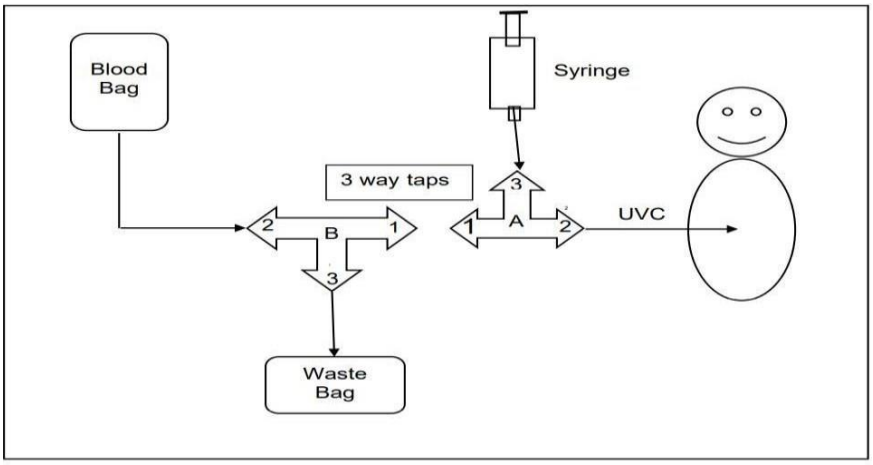
Care of the infant during exchange transfusion procedure:

- 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 90º 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 180o 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 90o 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

NB: 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 bradycardia, goes pale or appears in pain STOP the exchange.

After the 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 6-12 hours after stopping phototherapy.

4.0 Statement of evidence/references

References:

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- Unconjugated hyperbilirubinemia in the preterm infant (less than 35 weeks gestational age). Available from: https://www.uptodate.com/contents/unconjugated-hyperbilirubinemia-in-the-preterm-infant-less-than-35-weeks-gestational-age

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5.0 Governance

5.1 Document review history

Version number	Review date	Reviewed by	Changes made
5	May 2022	Zuzanna Gawlowski, Mary Plummer	Reviewed and Updated

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
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	HOM&PN	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
Janice Styles	Consultant Midwife	16/6/22	17/6/22	No comments	N/A
Leticia Thomas-Andrew	Labour Ward Co-ordinator	10/6/22	14/6/22	Comprehensive guideline well put together	N/A
Anja Johansen-Bibby	Consultant Obstetrician	10/6/22	14/6/22	For physiological jaundice should there be additional information about bottle fed	Yes
Mary Doige	Nursery Nurse	8/6/22	14/6/22	Various for nursery nurse role	Yes
Ghaly Hanna	Consultant Obstetrician	8/6/22	8/6/22	No comments	N/A

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 3 years	Paediatric CIG

5.4 Equality Impact Assessment

As part of its development, this Guideline and its impact on equality has been reviewed. The purpose of the assessment is to minimise and if possible remove any disproportionate impact on the grounds of race, gender, disability, age, sexual orientation, religion or belief, pregnancy and maternity, gender reassignment or marriage and civil partnership. No detriment was identified. Equality Impact assessments will show any future actions required to overcome any identified barriers or discriminatory practice.

Equality Impact Assessment			
Division	Women's Health	Department	Paediatrics
Person completing the EqIA	Zuzanna Gawlowski	Contact No.	-
Others involved:	-	Date of assessment:	05/2022
Existing policy/service	Yes	New policy/service	No

Will patients, carers, the public or staff be affected by the policy/service?	Yes
If staff, how many/which groups will be affected?	Nursing & medical staff

Protected characteristic	Any impact?	Comments
Age	NO	Positive impact as the policy aims to recognise diversity, promote inclusion and fair treatment for patients and staff
Disability	NO	
Gender reassignment	NO	
Marriage and civil partnership	NO	
Pregnancy and maternity	YES	
Race	NO	
Religion or belief	NO	
Sex	NO	
Sexual orientation	NO	

What consultation method(s) have you carried out?
Meetings, emails
How are the changes/amendments to the policies/services communicated?
Meetings, emails
What future actions need to be taken to overcome any barriers or discrimination?

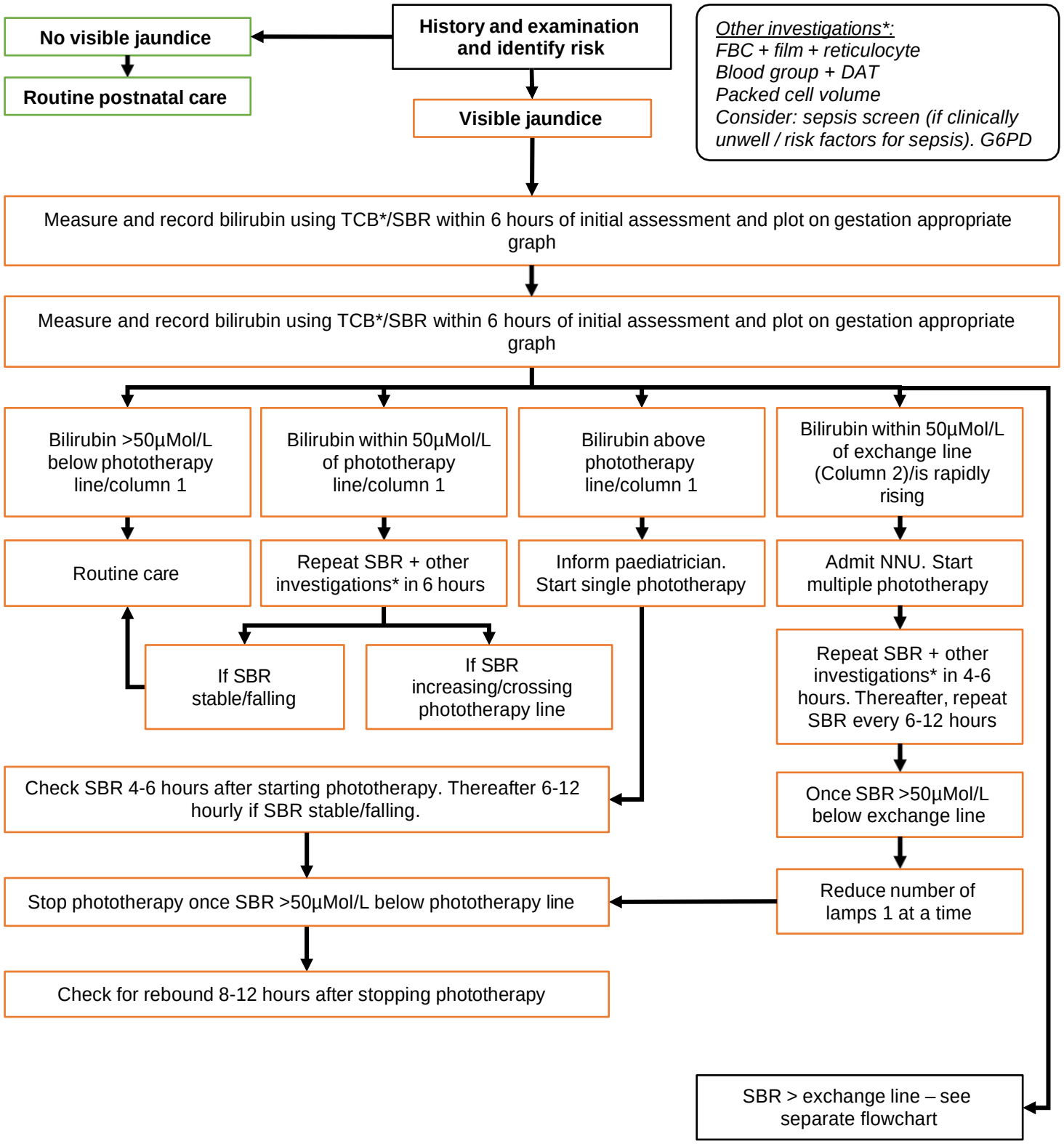
What?	Who will lead this?	Date of completion	Resources needed
N/A	N/A	N/A	N/A
Review date of EqIA	05/2025		

Appendix 1: NICE Guidance Threshold Treatment Table

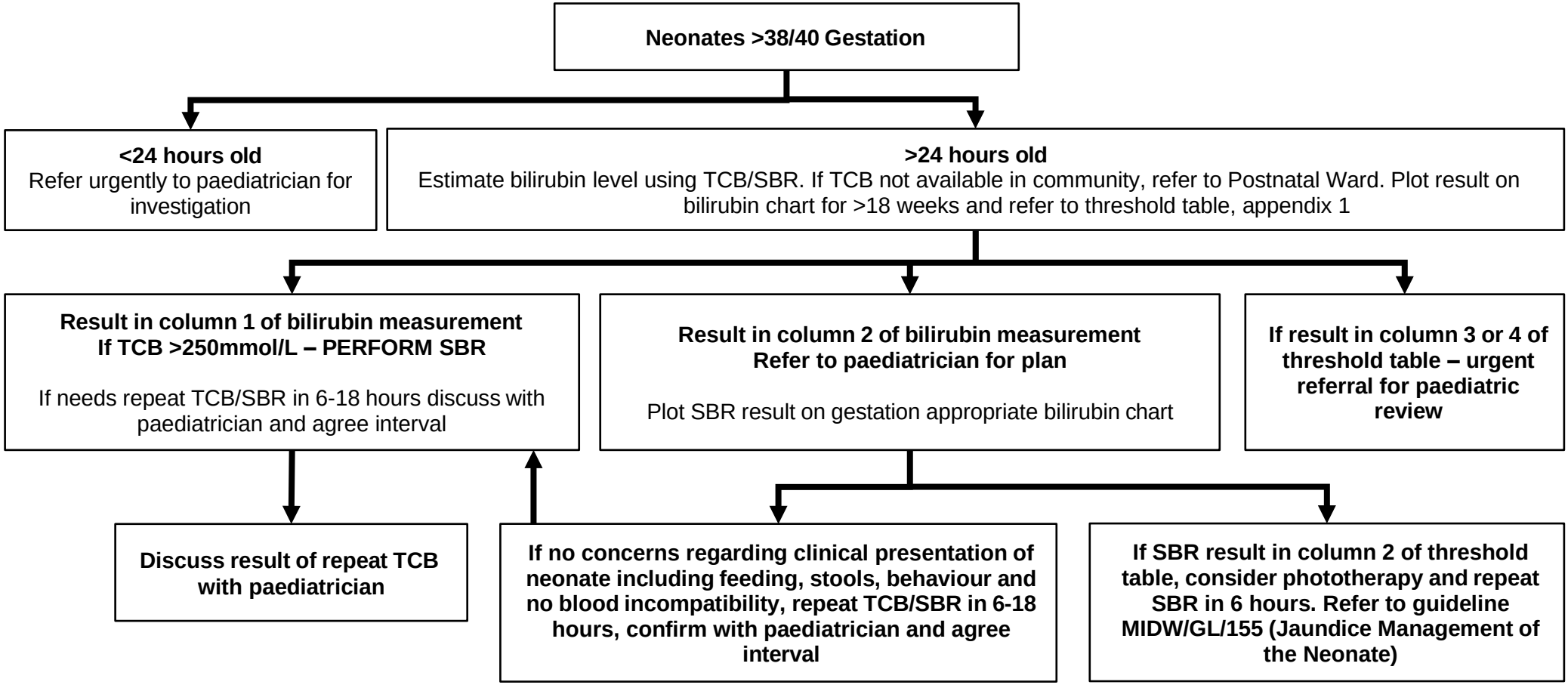
Table taken from NICE Clinical Guideline 98, Jaundice in newborn babies under 28 days, 2010; updated Oct 2016

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
		>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

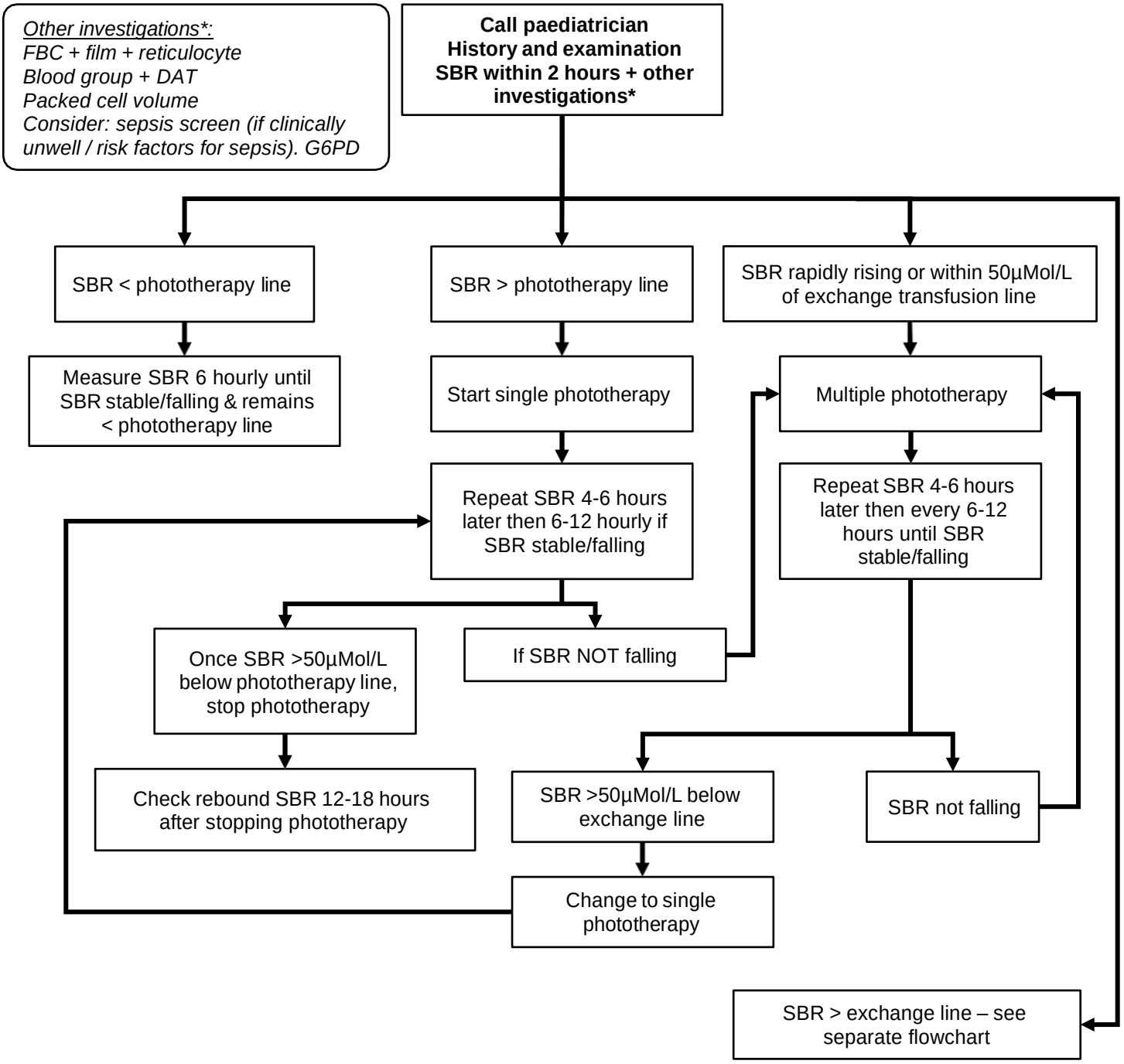


Appendix 3: Community Midwifery Flowchart for Jaundice >24 Hours Old

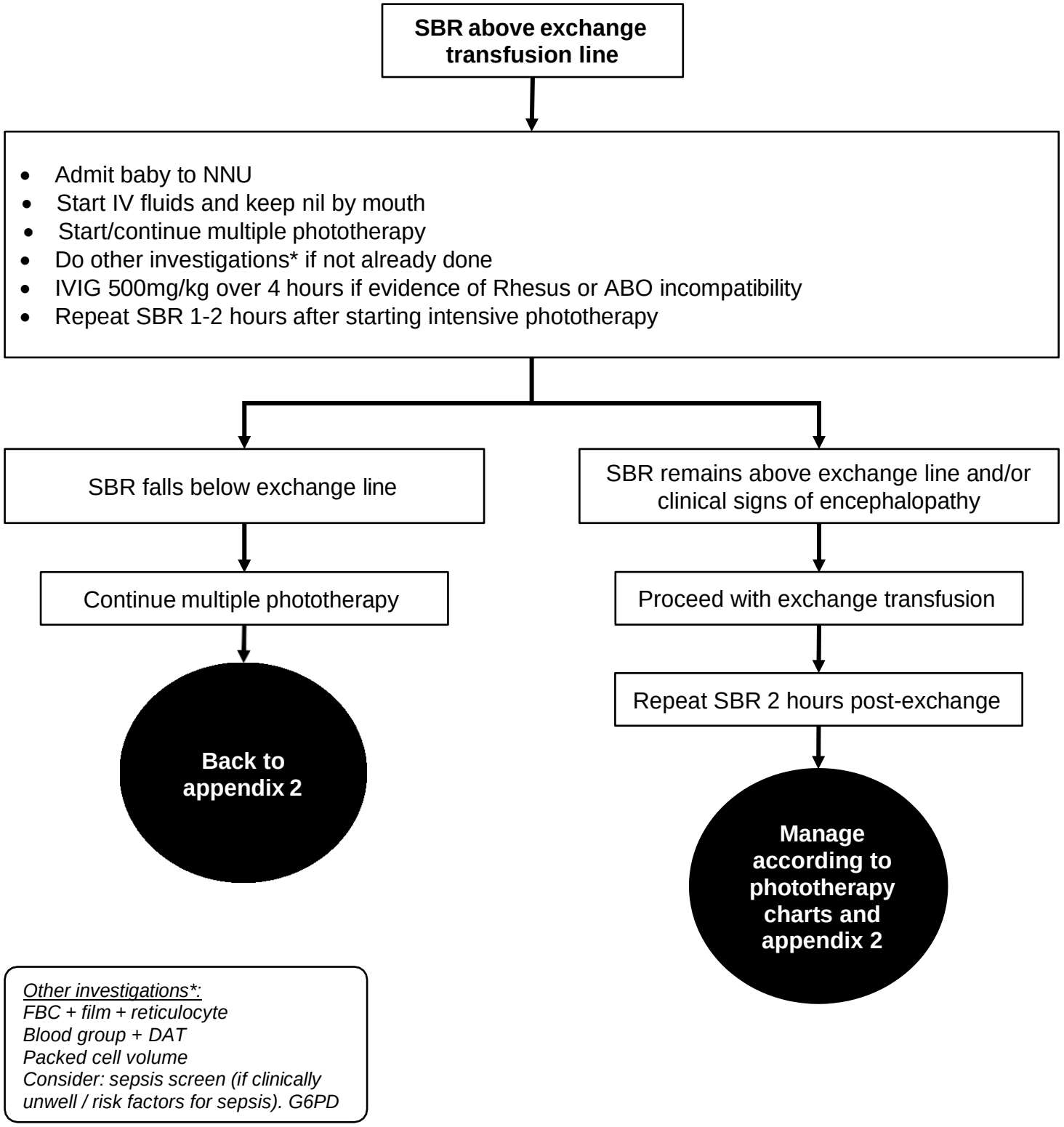


For MSWs or Midwives at the end of their shift Inform Community Midwife on long day shift, or late on call midwife at the weekend of the need to chase and action the result of the SBR you have taken.

Appendix 4: Flowchart for Jaundice <24 Hours of Age



Appendix 5: Flowchart for SBR Above Exchange Transfusion Line



Appendix 6: Exchange Transfusion Record

BABY LABEL

File in baby's notes when completed

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

- 180ml/kg =
- Number of aliquots Volume of each aliquot

Initial investigations

- Baby's blood group Direct anti-globulin test
- Mother's blood group

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

Take pre-exchange bloods from baby

Na		K		Ca		Glucose	
Hb		Plats		Bilirubin		pH	
PCV							

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

BABY LABEL

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

Blood gas plus SBR midway through exchange

Na		K		Ca		Glucose	
Hb		Plats		Bilirubin		pH	
PCV							

Take bloods from baby at end of exchange

Na		K		Ca		Glucose	
Hb		Plats		Bilirubin		pH	
PCV							

Further plan for ongoing phototherapy and timing of measurement of next bilirubin level

Inform parents that procedure has been completed

Catheters should be left in place until no further exchanges are required.

Appendix 7: Exchange Transfusion Log

BABY LABEL

Page One

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

BABY LABEL

Page Two

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)

Appendix 8: Treatment Threshold Graphs

Treatment threshold graph for babies with neonatal jaundice

NHS National Institute for Health and Clinical Excellence

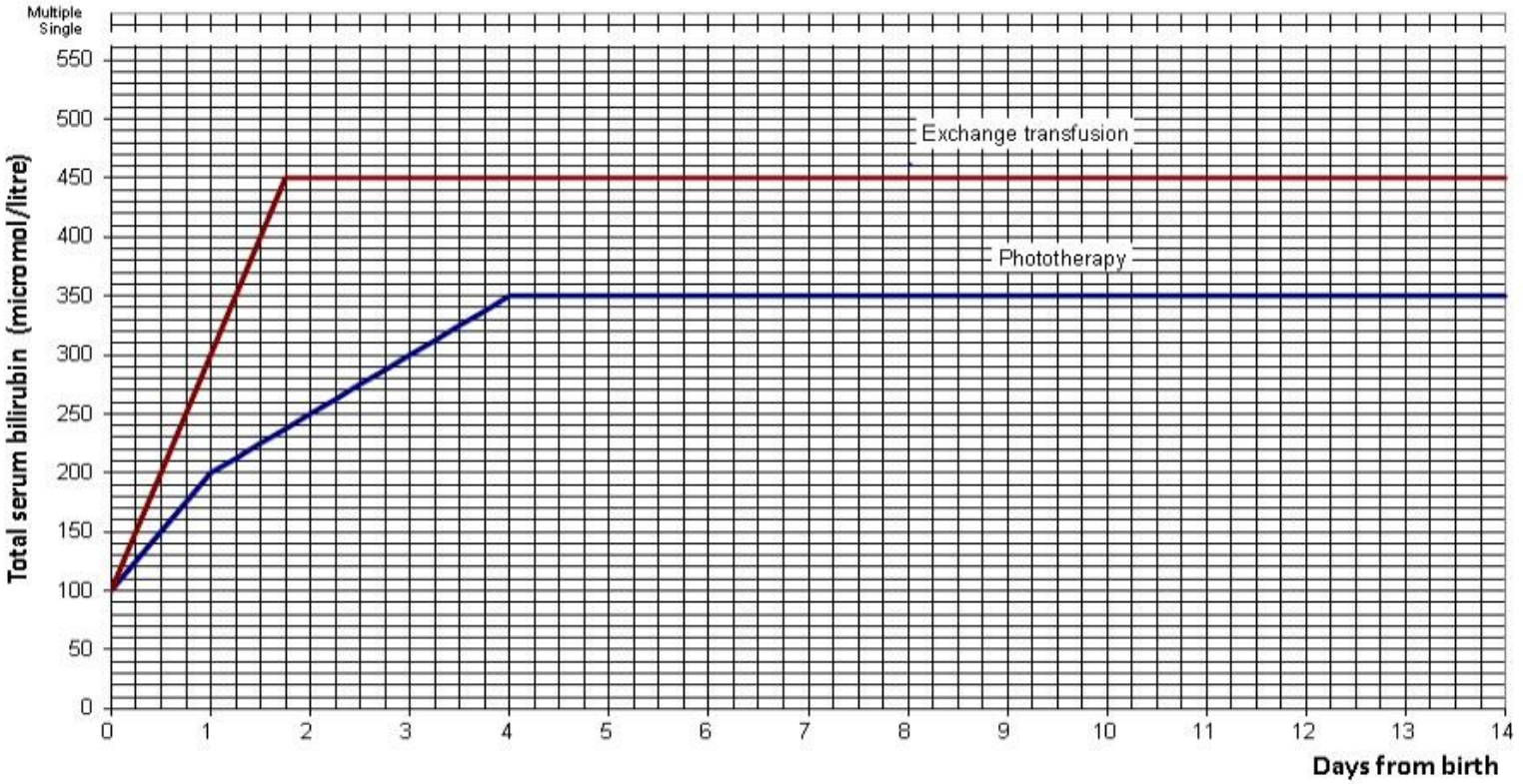
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

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

Click below and choose gestation

>=38 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

NHS National Institute for Health and ClinicalExcellence

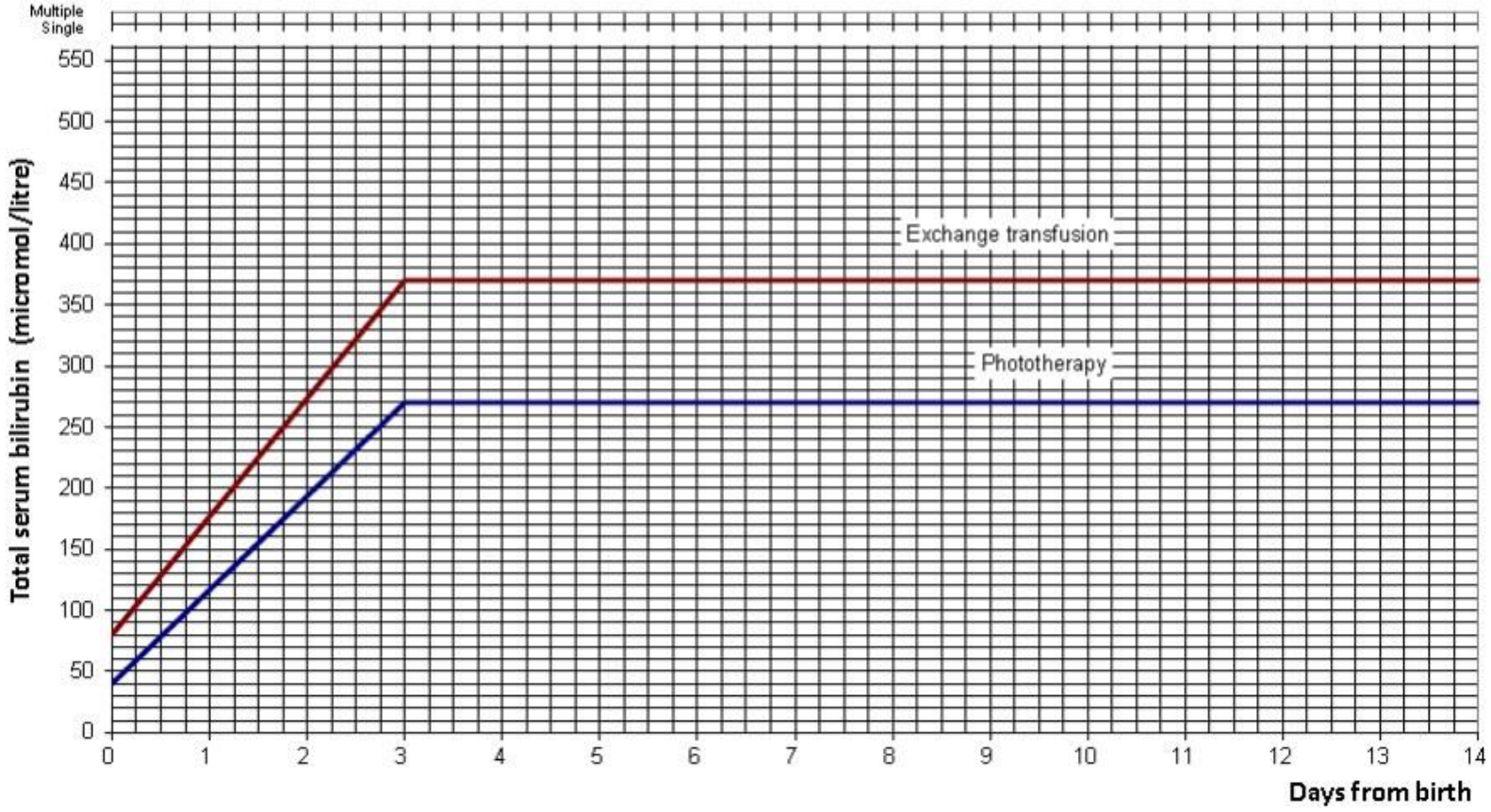
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

Click below and choose gestation

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

37 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

NHS National Institute for Health and ClinicalExcellence

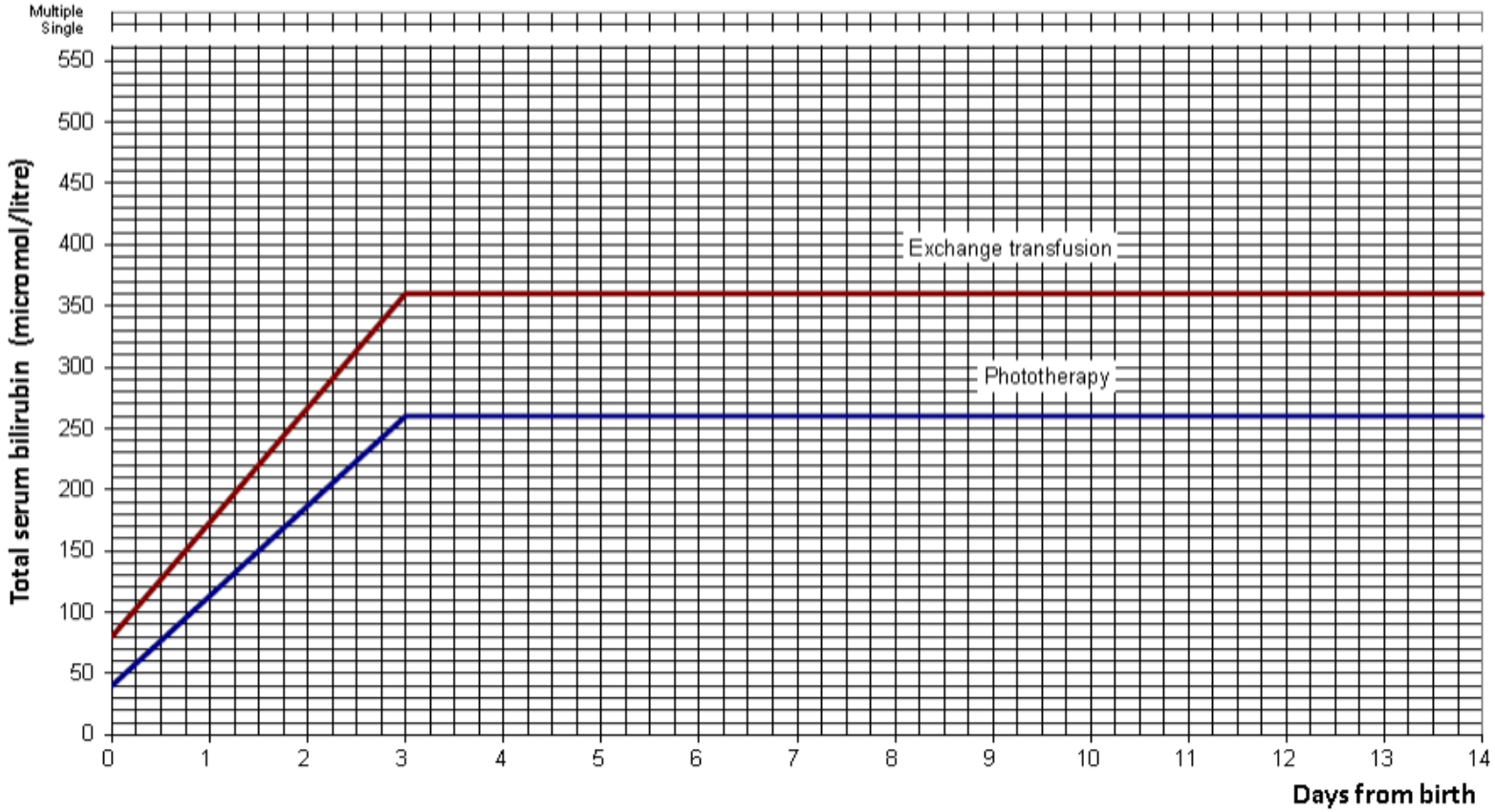
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

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

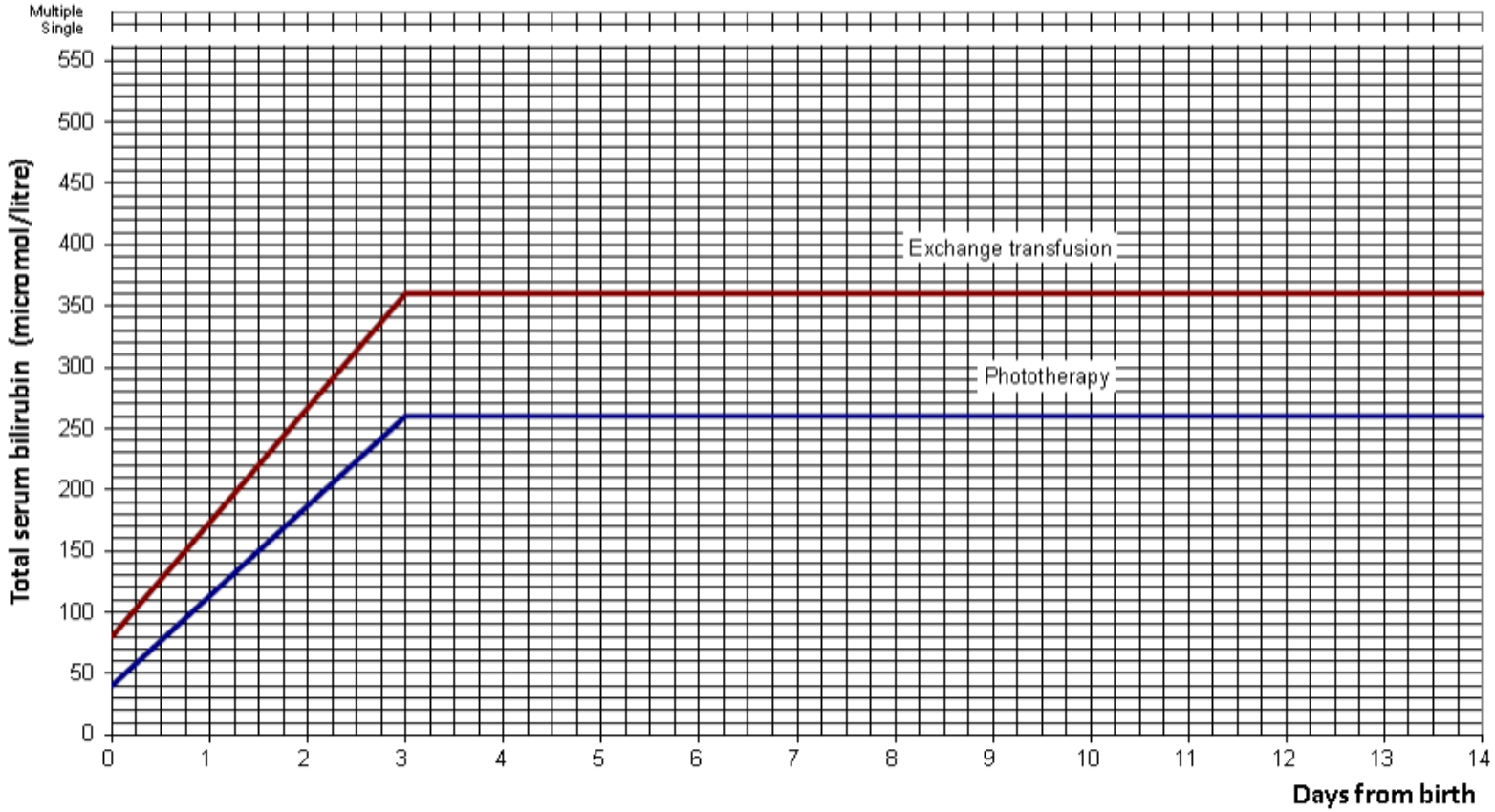
Baby's name _____ Date of birth _____

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

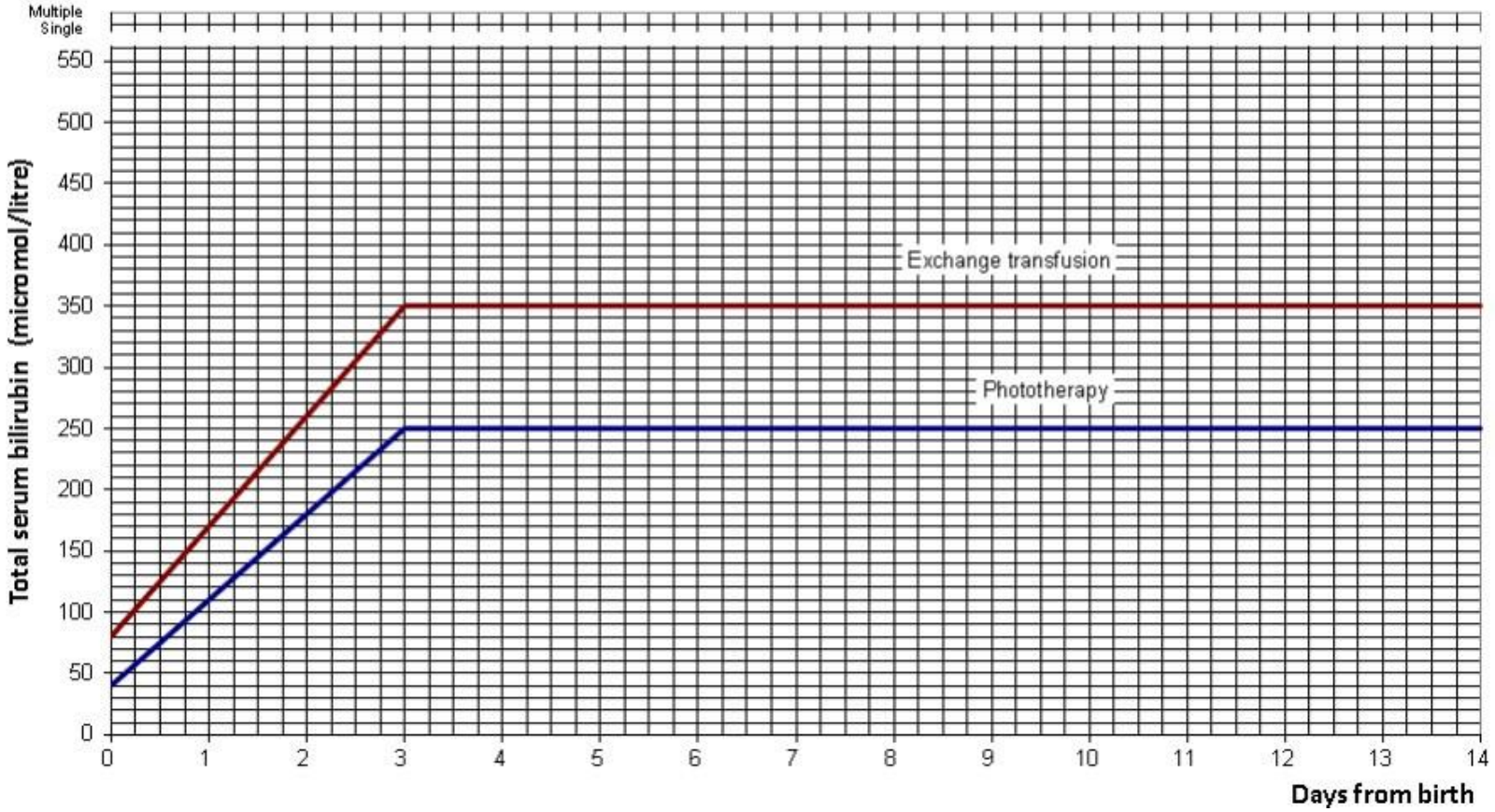
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

Click below and choose gestation

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

35 weeks gestation



NHS
Milton Keynes University Hospital
NHS Foundation Trust

Treatment threshold graph for babies with neonatal jaundice

NHS National Institute for Health and ClinicalExcellence

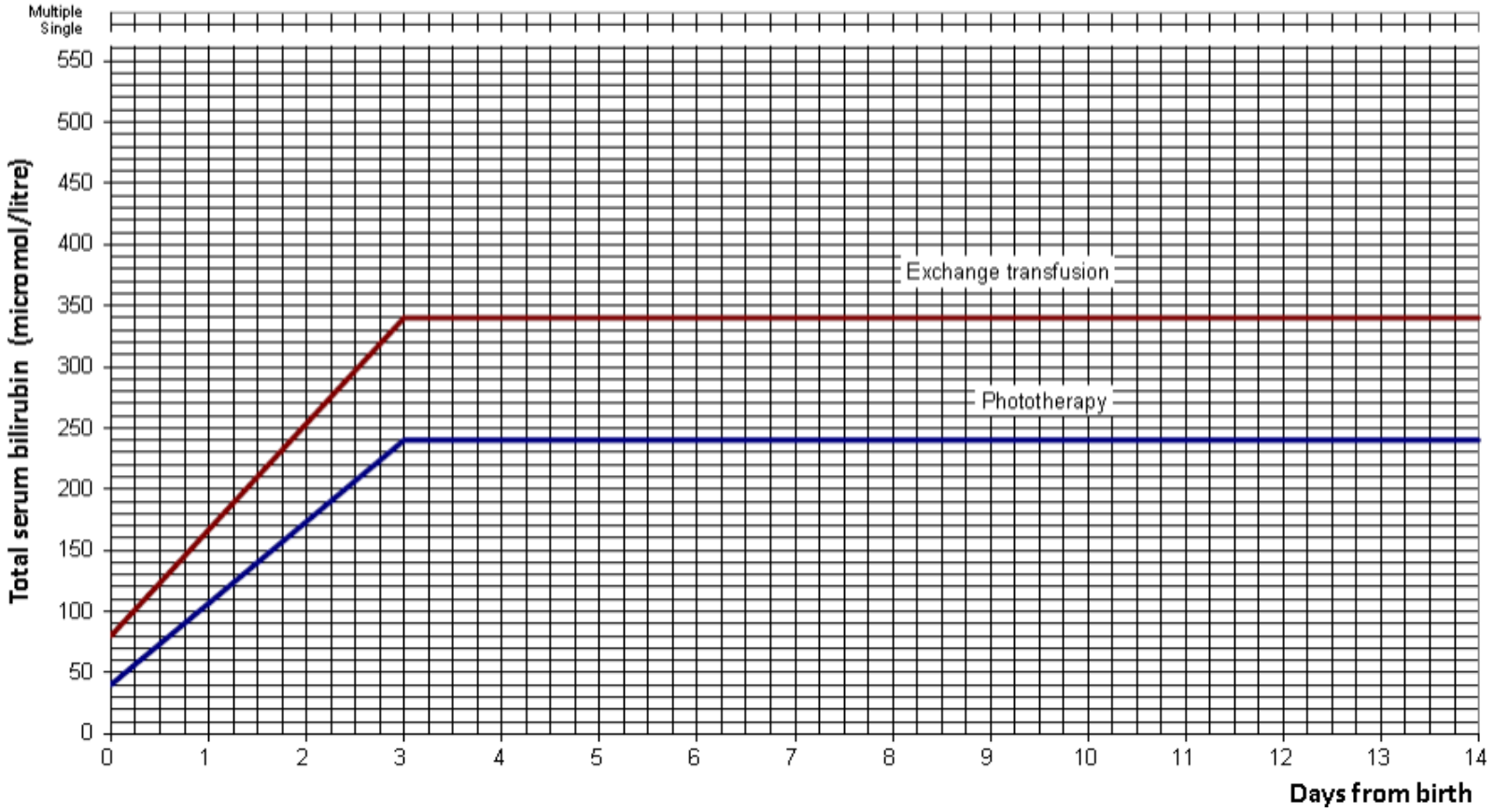
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

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

Click below and choose gestation

34 weeks gestation



NHS
Milton Keynes University Hospital
NHS Foundation Trust

Treatment threshold graph for babies with neonatal jaundice

NHS National Institute for Health and ClinicalExcellence

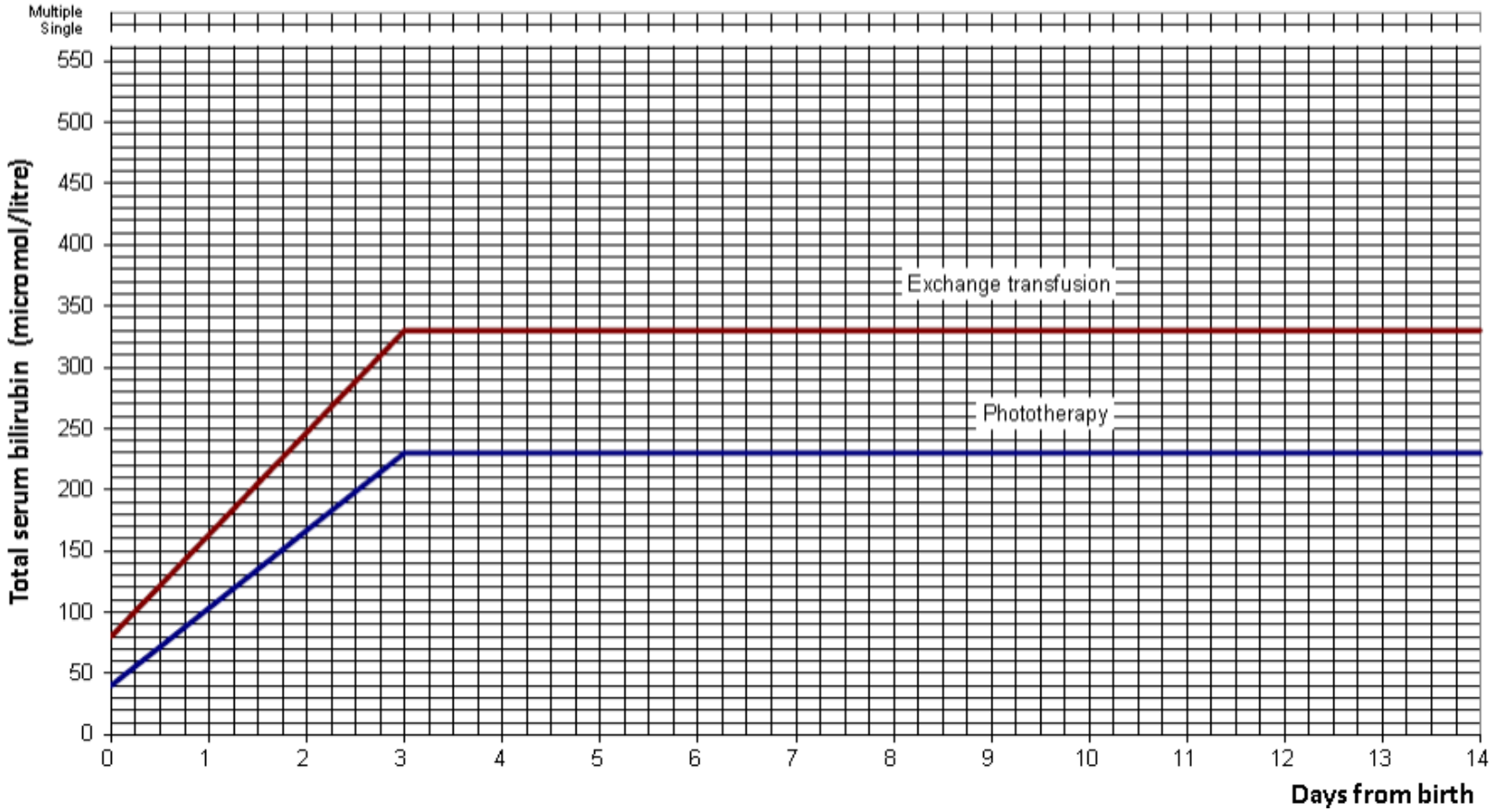
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

Click below and choose gestation

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 Clinical Excellence

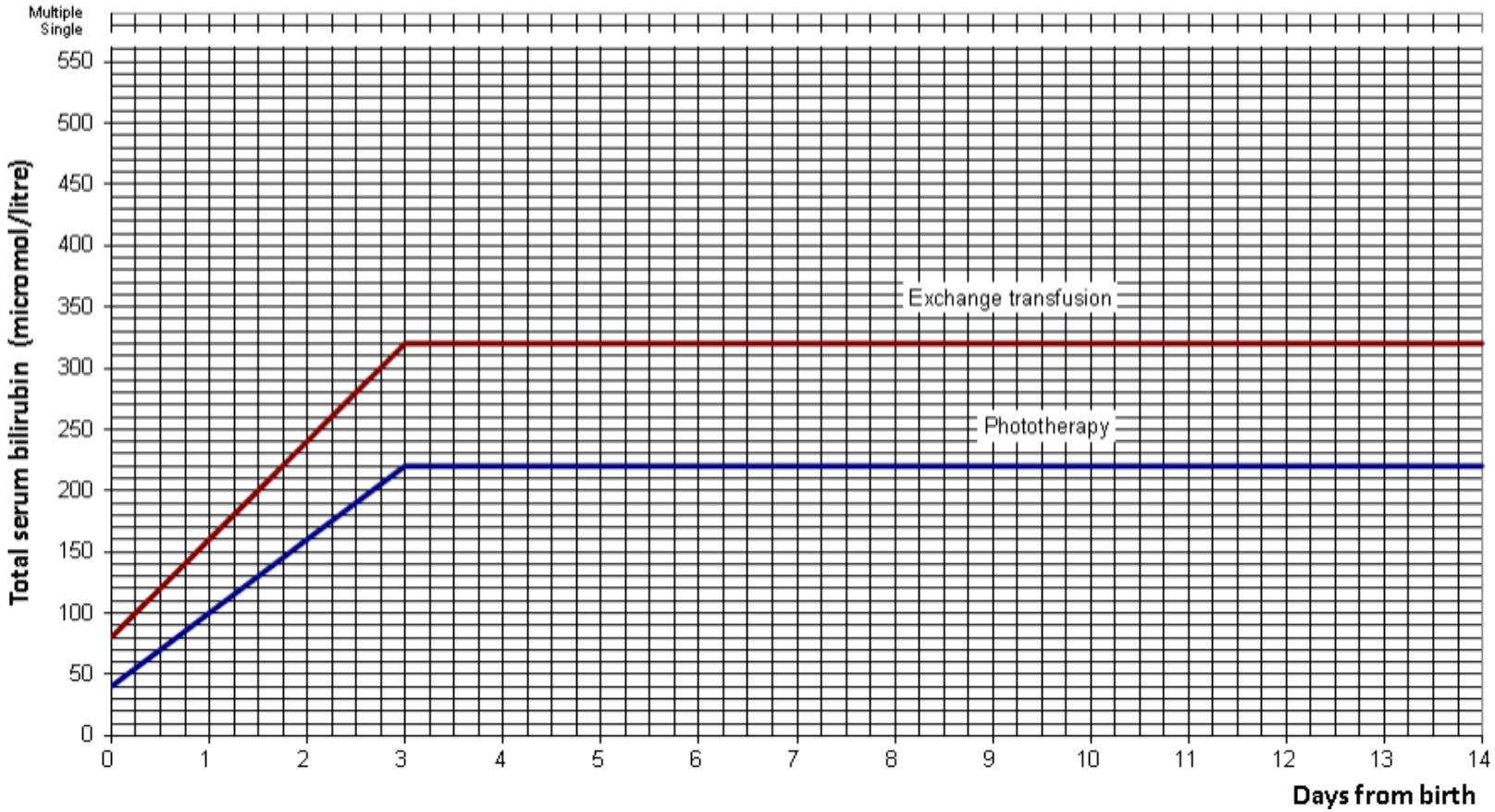
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

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

Click below and choose gestation

32 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

NHS National Institute for Health and Clinical Excellence

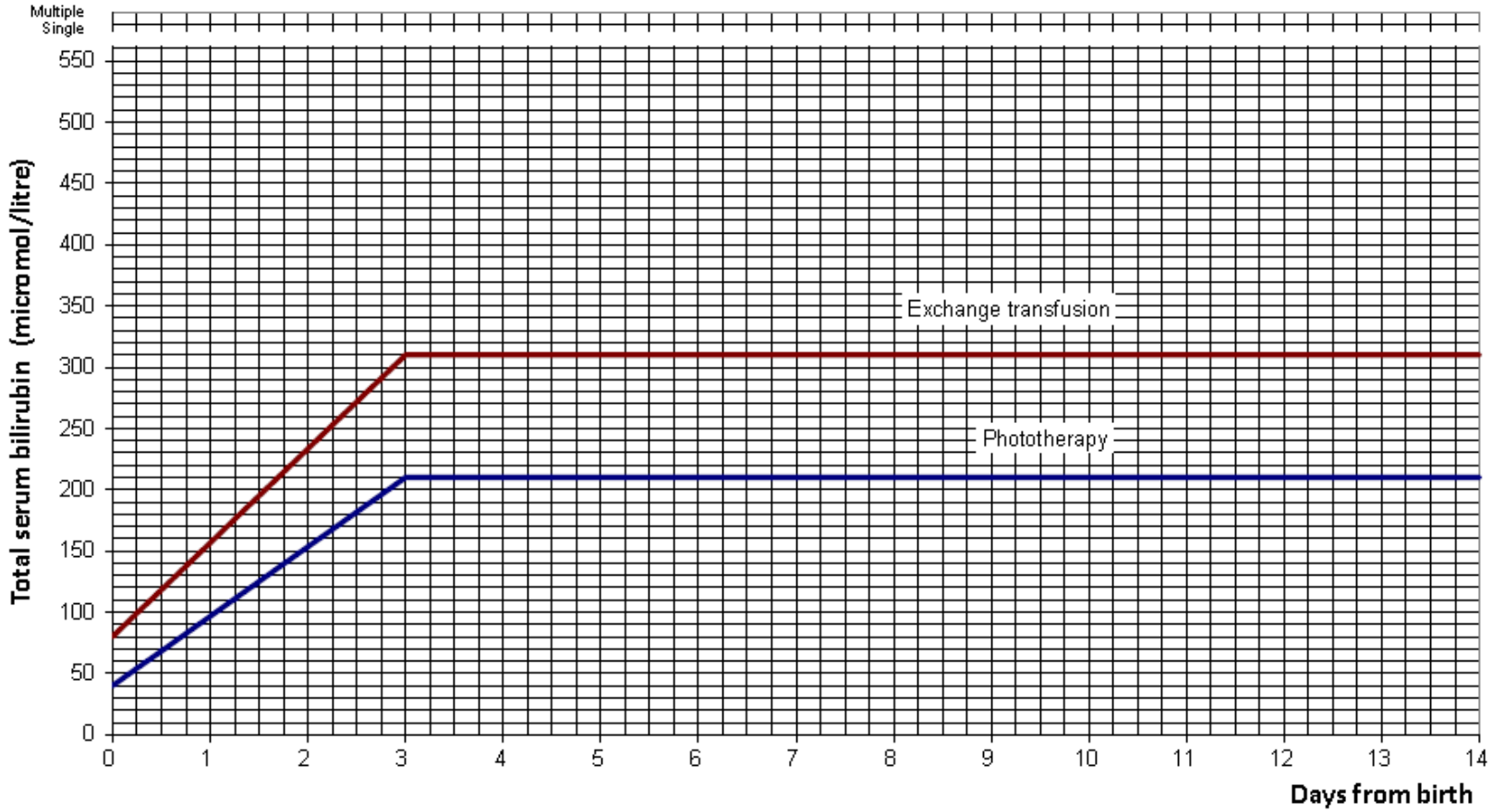
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

Click below and choose gestation

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

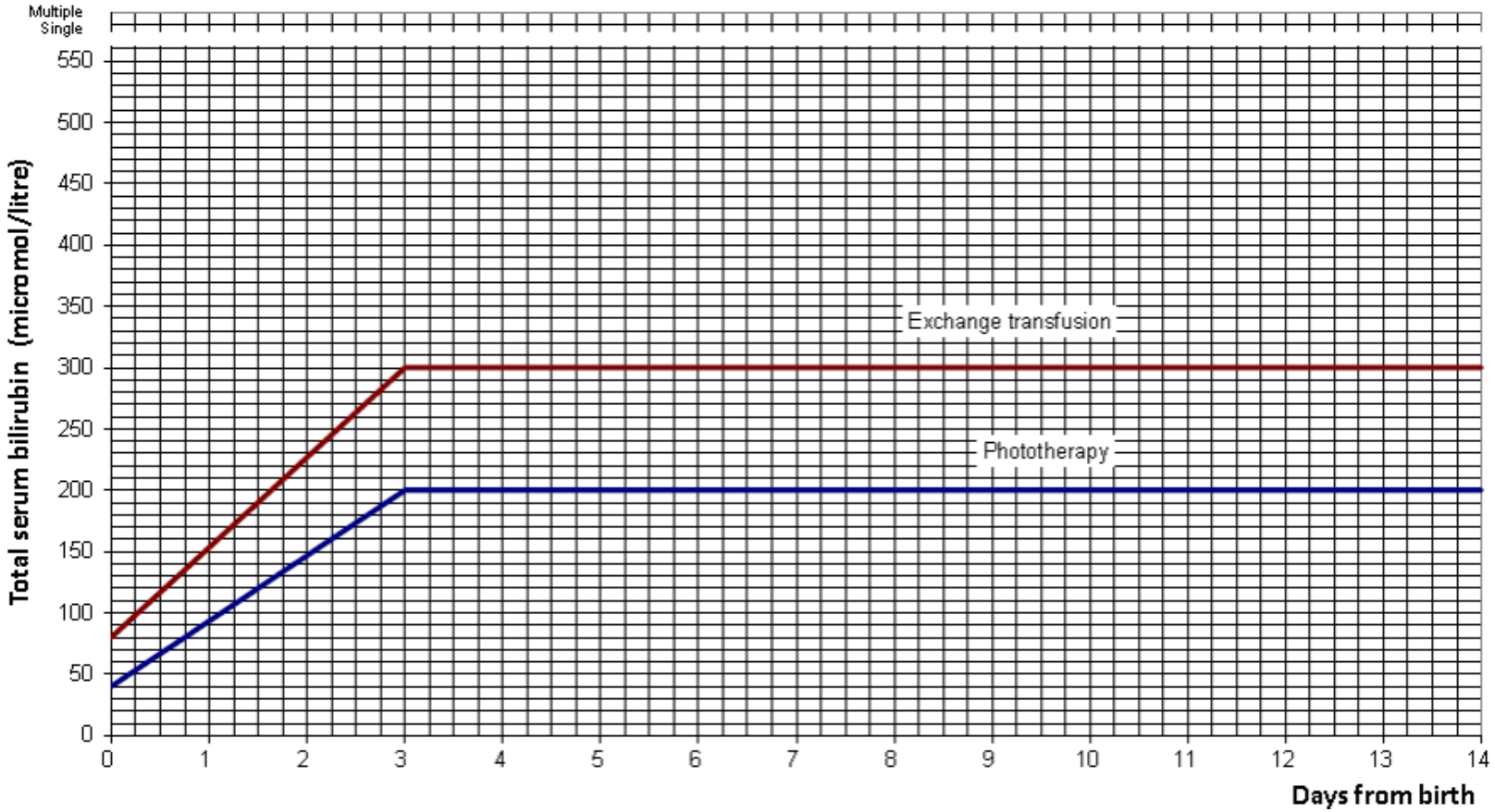
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

Click below and choose gestation

30 weeks gestation

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



Treatment threshold graph for babies with neonatal jaundice

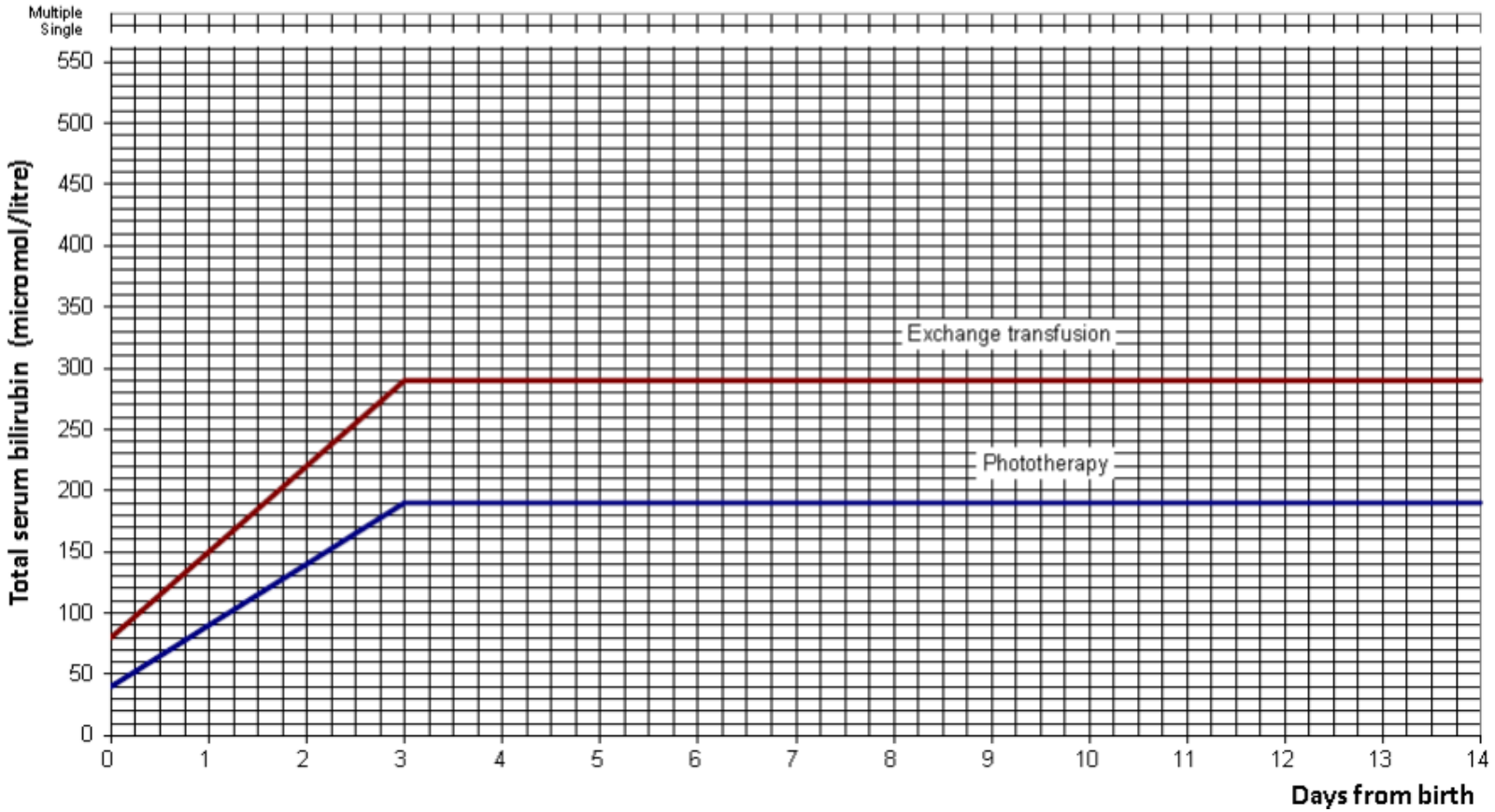
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

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

Click below and choose gestation

29 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

NHS National Institute for Health and Clinical Excellence

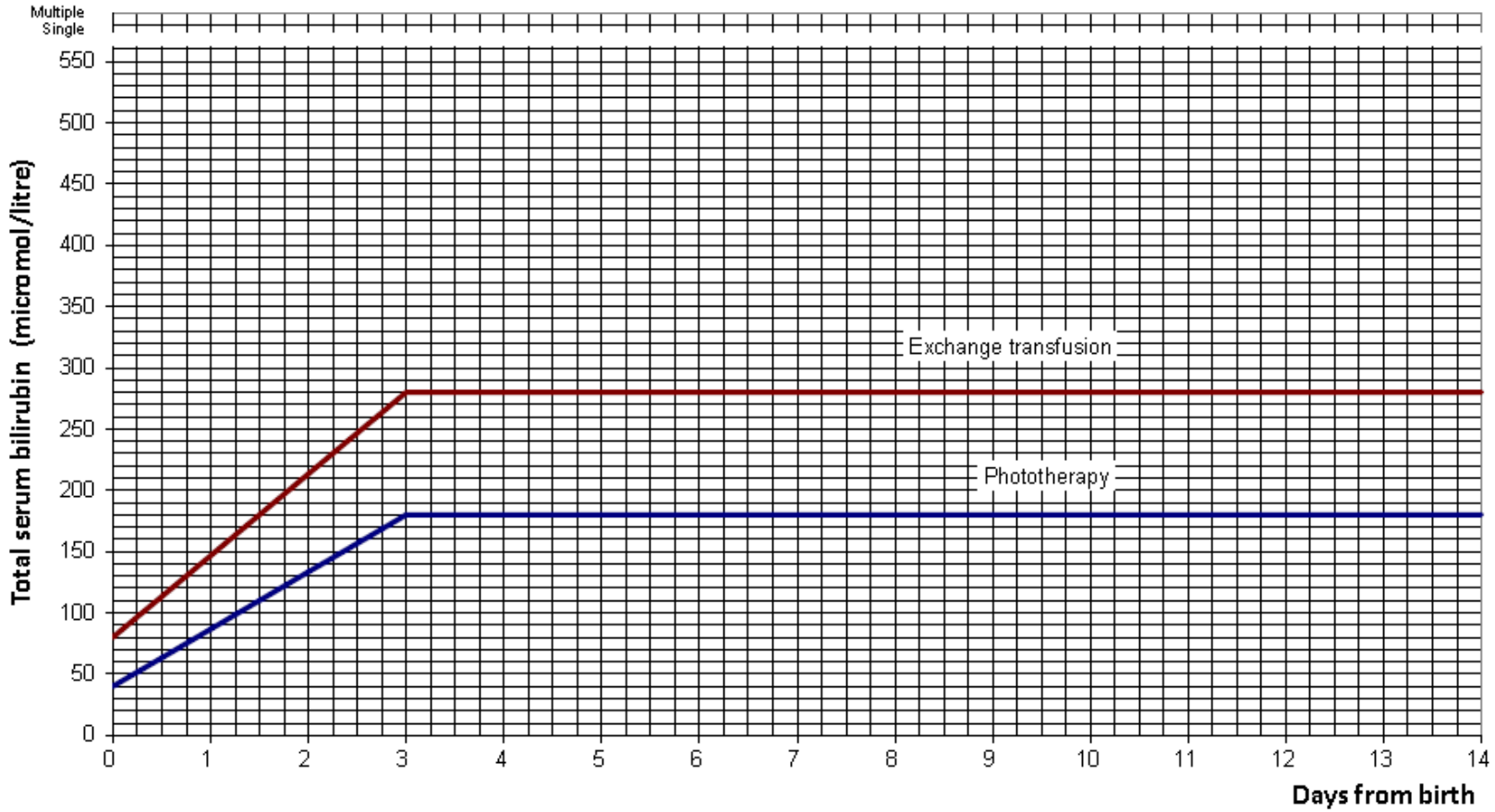
Baby's name _____ Date of birth _____

Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____

Click below and choose gestation

28 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

27 weeks gestation

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