Clinical Guideline:

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For use in: EoE Neonatal Units
Guidance specific to the care of neonatal patients.

Key Words: Exchange Transfusion, Jaundice, Neonatal Jaundice

Date of Ratification:

Review due:

Registration No: **NEO-ODN-2025-19**

Approved by:

Neonatal Clinical Oversight Group	
Clinical Lead Sajeev Job	*S.Job*

Ratified by ODN Board:

Date of meeting	

Audit Standards(MNSI, 2025):

- Evidence that repeat bilirubin is checked before exchange transfusion.
- Evidence of documented double check process for infusion line type and pump setup.
- Percentage of procedure packs audited containing the correct infusion line for blood.
- Evidence of named senior oversight during exchange transfusion.
- Evidence that staff have completed simulation training including equipment safety scenarios.
- Documentation completeness for aliquot volumes, timings, and physiological parameters.
- Evidence of escalation and review process where procedure progress deviated from expected norms.

- Incidents involving incorrect infusion line usage reported via local governance and MHRA.

CONTENTS

INTRODUCTION

1.1 Jaundice is common in the first few days of life, but significant hyperbilirubinaemia is associated with risks of brain damage, kernicterus and long-term disability. It is usually successfully managed with phototherapy and feeding support.

1.2 Exchange transfusion may be indicated in significant hyperbilirubinaemia secondary to acute haemolysis, by removing the affected red blood cells and circulating maternal antibodies to reduce red cell destruction. This involves the removal of patient blood in aliquots and replacement with donor blood.

**This guideline is aligned with:

The 2025 British Association of Perinatal Medicine Safety Alert on Exchange Transfusion[1] and incorporates recommendations from the MNSI bulletin[2].

The NICE Clinical Guideline CG98: Jaundice in newborn babies under 28 days and reflects updates from the 2023 surveillance review[3]**

2. PURPOSE

2.1 To help staff manage significant hyperbilirubinaemia safely and prevent complications of brain damage and kernicterus.

3. SCOPE

3.1 All health care professionals (permanent and temporary) working on NICU/SCBU within East of England Neonatal ODN

4. INDICATIONS

4.1 Measured serum bilirubin is on or above exchange transfusion line (https://www.nice.org.uk/guidance/cg98/resources) and not responding to intensive phototherapy

4.2 Risk factors that increase the risk of kernicterus:

- Rate of rise of bilirubin >8.5micromol/litre/hour
- Clinical features of acute bilirubin encephalopathy
- Evidence of acute haemolysis
- Acute anaemia at birth (Hb <100g/l)
- Cord bilirubin >80micromol/litre

5. PRENATAL MANAGEMENT

5.1 The need for exchange transfusion may be predicted antenatally, particularly if atypical antibodies are detected or there is known rhesus disease. In this instance, it is helpful to organise blood in advance, as it may be difficult to source for rare maternal antibodies.

5.2 These patients should be highlighted during the perinatal meeting and a joint plan made for each patient.

5.3 It is helpful to note that the **American Academy of Pediatrics (AAP)** provides guidance that includes bilirubin threshold graphs incorporating an **Escalation of Care Zone** for infants **with risk factors** for exchange transfusion. This approach aims to prompt earlier intervention to **reduce the likelihood of requiring an exchange transfusion.**[4]

This guidance is typically used alongside the **BiliTool™** and outlines escalation steps such as:

- Increasing the frequency of bilirubin monitoring (e.g. every 2 hours),
- Optimising intensive phototherapy (e.g. ensuring 360 degree light exposure where available),
- Commencing intravenous fluids
- Considering the administration of IVIG (see Section 6.3) if haemolysis is suspected,
- Prompt communication with the attending consultant and/or referral centre if transfer may be required.

Important note: The AAP guideline uses different exchange transfusion thresholds depending on risk status. While the Escalation of Care approach can support earlier recognition in high risk infants, the "low risk" threshold

charts used in the AAP/BiliTool™ may permit higher bilirubin levels than NICE CG98 allows. These must not be used in UK clinical practice.

Clinicians should use NICE CG98 bilirubin threshold charts exclusively when determining treatment and exchange transfusion decisions.

6. PREPARATION

6.1 Total serum bilirubin above exchange transfusion threshold is a medical emergency and it is essential that the consultant on-call is informed. The infant should be admitted to NICU/SBCU for the procedure.

6.2 Start intensive phototherapy and IV fluids (at one day ahead) as soon as possible. Consider the use of 360 phototherapy if available.

6.3 Consider the administration of IVIG.

Use should be considered when managing a baby with haemolytic disease of the newborn if there is delay in commencing an exchange transfusion due to the availability of blood. It can also be used as an adjunct to phototherapy to try and reduce the need for exchange transfusion.

Use IVIG 500mg/kg over 4 hours.

Parents and carers should be offered information on the following:

- Why IVIG is being considered
- Why IVIG may be needed to treat significant hyperbilirubinemia
- The possible adverse effects of IVIG
- When it will be possible for parents/carers to see the baby

The adverse effects are fever, allergic reaction (including anaphylaxis), hypoglycaemia, hypotension and fluid overload.

6.4 Inform parents of the procedure, gain consent and document the conversation.

Parents should be made aware of the following:

- The need to admit the baby to NICU/SCBU
- Why an exchange transfusion is being considered and how it will treat significant

hyperbilirubinaemia

- The duration of the procedure
- The risks of the procedure
- When it will be possible for parents to see the baby

The risks are air embolus, thrombosis, haemorrhage, hypotension, IVH (preterm infants), electrolyte derangement, arrhythmias, dilutional coagulopathy, necrotising enterocolitis, sepsis, hypothermia.

There is a 3 in 1000 risk of death.

Follow the trust policy if parents refuse to give consent for the transfusion. A child should be given such treatment as is immediately necessary for the preservation of life or prevention of serious harm or deterioration.

6.5 Calculate the required transfusion volume and contact Blood Bank to order the blood (CMV negative, irradiated, less than 5 days old). A group and save sample from the infant and mother will be required to crossmatch blood.

Unless otherwise indicated, a **double-volume exchange of 170ml/kg** should be used.

6.6 The procedure must be carried out by competent members of the neonatal team who has completed relevant procedural training[1,2].
A minimum of 3 staff are required for the procedure. A 1:1 nurse and doctor will be required throughout the procedure (2-3 hours), plus one other healthcare professional. Staff should be bleep-free[1,2]. Consider delegation and reallocation of the workload.

6.7 Gather your equipment – please see section 7.1

Ensure appropriate continuous monitoring in place – including ECG, temperature probe, blood pressure and oxygen saturation monitoring.

Document baseline observations on the Neonatal Exchange Blood Transfusion Record

6.8 Keep the infant nil by mouth throughout the procedure

6.9 Obtain access – you will need either:

- UAC and UVC (optimum)
- Peripheral cannula and UAC
- Peripheral cannula and 2 x peripheral arterial line
- UVC only
- **Note: arterial lines should only be used for the withdrawal of blood, NOT the infusion of donor blood**

6.10 Baseline bloods (including group and save, full blood count, clotting, urea &

electrolytes, bone profile and split bilirubin), blood glucose and blood gas should be taken prior to the procedure.

Obtain a pre-transfusion blood spot for neonatal screening and consider the need to take diagnostic samples for storage.

6.11 **Phototherapy should continue throughout the procedure.**

6.12 Determine the transfusion rate and total transfusion time. You will be taking aliquots of a set size over 5-minute intervals. (Aliquot = volume of blood to be removed)

WEIGHT	ALIQUOT SIZE	INFUSION SPEED
<1500g	5ml	1ml/min (60ml/hr)
1500g-2499g	10ml	2ml/min (120ml/hr)
2500g-3499g	15ml	3ml/min (180ml/hr)
>3500g	20ml	4ml/min (240ml/hr)

Divide your calculated total required volume (170ml x birth weight) by your ml/min to obtain total transfusion time.

Example: For a 3.5kg term infant undergoing double volume exchange transfusion.

3.5 x 170 = 595ml (TOTAL REQUIRED VOLUME)

595ml divided by 4ml/min = 148.75 minutes (TOTAL TRANSFUSION TIME)

595ml divided by 20ml aliquots = 29.75 separate aliquots

6.13 Please see Appendix 2 for reference flow chart

6.14 During an exchange transfusion DO NOT:

- Stop continuous phototherapy
- Perform a single volume exchange
- Use albumin priming
- Routinely administer IV calcium

7. THE PROCEDURE

7.1 Equipment required:

- Appropriate means of thermoregulation for the infant
- Observation monitoring equipment, including ECG, temperature probe, blood pressure and oxygen saturation monitoring

- Blood sugar monitoring
- Sterile plastic sheet to place under sterile drape
- IV infusion pump (Allaris Signature)
- 10% dextrose
- Selection of disposable sterile Luer lock syringes and needles
- 3-way tap x 2
- Chlorhexidine
- Red cell infusion set (CE/UKCA/UKNI-marked set[5]) with appropriate filters (170–200 micron)- double-checked by two members of staff before use[1,2].
- Blood warmer (if infusion is given continuously, not suitable for "push-pull" method
- Drainage bag and extension sets
- Urine bag or cotton balls to monitor urine output
- Oral sucrose/pacifier
- Personal protective equipment for sterile procedure
- Sharps bin
- Blood bottles, including clotting (green), EDTA (red), serum gel (brown) and fluoride (yellow) - as per section 6.10 and 8.4
- Neonatal resuscitation equipment
- Timing device for infusion and withdrawal of aliquots

7.2 Ensure that equipment is set up using aseptic technique and all lines are primed appropriately. In line with BAPM safety standard please ensure the giving set used for red cell infusion contains a suitable in-line filter (170–200 micron[5]) for blood products[1,2]. This should be verified by a double check process[1,2]. Please also note albumin priming is not recommended.

7.3 <u>Infusion of donor red cells at a constant rate, with simultaneous withdrawal of aliquots of blood from the infant</u>

Donor blood is infused at a constant rate through a venous line – see section 6.12 for

calculation of infusion rate.

Simultaneously, aliquots of blood are withdrawn from the infant through an arterial line over 5 minutes – as calculated in section 6.12.

Safety Point: The volume limit should be set on the pump for each quantity of blood being given. This limit should only be increased after verbal confirmation between nurses and doctor that the corresponding aliquot volume has been successfully removed.

If the procedure is halted for any reason or the arterial line stops sampling, it is essential that the infusion of donor blood is stopped immediately to prevent hypervolaemia.

Please see diagram in Appendix 1.

7.4 <u>One person push-pull technique via single vascular access</u>

The UVC is connected to the red cell giving set via 2 separate 3-way taps (to ensure a closed system). On the 3-way tap nearest the infant, a 50ml syringe is attached. On the 3-way tap furthest from the infant, a drainage bag is attached.

Standard cycle over 5 minutes:

- An aliquot of blood is withdrawn from the infant (as calculated in section 6.12)
- The 3-way tap is turned off to the infant, and on to the waste
- Blood is pushed into the waste bag
- The 3-way tap is turned off to the waste, and on to the donor blood
- The same size aliquot of blood is withdrawn from the bag
- The 3-way tap is turned off the donor blood, and on to the infant
- The aliquot of blood is delivered to the infant

The procedure always starts with the withdrawal of blood to ensure the infant's circulation is not overloaded.

Please see diagram in Appendix 1.

8. MONITORING & COMPLICATIONS

8.1 During the procedure:

- Continuous monitoring of HR and rhythm, oxygen saturations, respiratory rate

and temperature. Note: any deviation from baseline may indicate an adverse reaction.

- A staff member should be responsible for accurate recording of blood input and withdrawal, and record observations with each cycle of the procedure.

- Blood gas and blood glucose (including ionised calcium, potassium and lactate) should be measured half hourly during the procedure.

- Bloods, including full blood count, clotting, urea & electrolytes, bone profile and split bilirubin, should be taken halfway through the procedure.

8.2 Closely observe the infant, watching for cyanosis, distress, pallor, vomiting or abdominal distension

8.3 If there is any physiological deterioration during the procedure, such as bradycardia, arrhythmia, hypothermia, signs of hypocalcaemia, hyperkalaemia, or acidosis the procedure should be paused in line with the BAPM safety alert and prompt escalation made to the supervising clinician and the correct underlying issue should be explored before deciding to continue the exchange.

<u>Complications</u>

Cardiac arrest – Consider air embolism, cold blood, hypovolaemia or hypo/hyperkalaemia. Manage according to NLS algorithm and correct above issues if present.

Convulsions – Stop exchange transfusion. Manage seizure. Check pH, glucose, calcium and magnesium.

Hypothermia – Confirm placement of temperature probe. Confirm blood warmer is at 37c. Slow the exchange.

Hyperglycaemia – Donor blood is preserved in dextrose. Blood glucose levels can be elevated during the procedure and generally resolve without intervention.

Hypoglycaemia – May occur during, or shortly after, the exchange. Follow local hypoglycaemia guidelines. Repeat blood glucose within 15 minutes and continue to monitor closely.

Hyperkalaemia – Lower risk with red cells less than 5 days old. Stop exchange if potassium >7.0. Peaked T waves, wide QRS or ventricular ectopics may be seen on ECG monitoring. Manage as per local hyperkalaemia guidelines. The exchange can be restarted if potassium is <6.0.

Hypocalcaemia – Rare with new preservative anticoagulants. If ionised calcium <0.8, then flush catheter dead space with normal saline and give urgent IV correction (1-2ml/kg calcium gluconate 10% via central line over 10 minutes). Prolonged QT may be seen on ECG monitoring.

Metabolic Acidosis – Mild metabolic acidosis is common and may not require treatment. If base excess drops below -10, then flush catheter dead space with normal saline and give a half bicarbonate correction ([body weight x base excess x 0.3]/2 = mmol of sodium bicarbonate 4.2%). If acidosis persists or worsens, consider stopped exchange.

Thrombocytopenia – Donor blood is platelet depleted, so the platelet count will tend to fall. This rarely needs intervention. If platelets are <50, consider stopping exchange and arranging platelet transfusion via a peripheral line.

Air Embolus – Preventable by careful set-up and priming of lines. Observe lines for presence of air during the exchange and ensure 3-way taps are closed with filling or expelling contents of the syringe.

Anaemia/Polycythaemia – Gently agitate donor blood at frequent intervals to prevent separation of red cells and plasma.

8.4 After the procedure:

- Measure the serum split bilirubin, electrolytes, bone profile, full blood count and clotting profile within 2 hours
- Monitor blood glucose hourly for 4 hours, and closely thereafter
- Keep nil by mouth for 24 hours after the procedure
- Continue intensive phototherapy initially, and then manage according to bilirubin result and NICE treatment threshold graphs
- Maintain central access until confident that no further exchanges are required

8.5 The infant should receive irradiated blood for any transfusions 6 months post-exchange to eliminate the risk of graft vs host disease

9. REFERENCES

9.1 [1] British Association of Perinatal Medicine (BAPM). *Safety Alert: Lookalike IV Administration Giving Sets*. London: BAPM; June 2023. Available at: https://www.bapm.org/articles/safety-alert-lookalike-iv-administration-giving-sets

9.2 [2] **Maternity and Newborn Safety Investigations (MNSI).** *Safety Spotlight: Neonatal Exchange Blood Transfusion*. Safety observations and learning from an exchange transfusion incident highlighting risks such as pump-line mismatch and hypovolaemia. 24 July 2025. Available via MNSI publications.pslhub.orgmnsi.org.uk

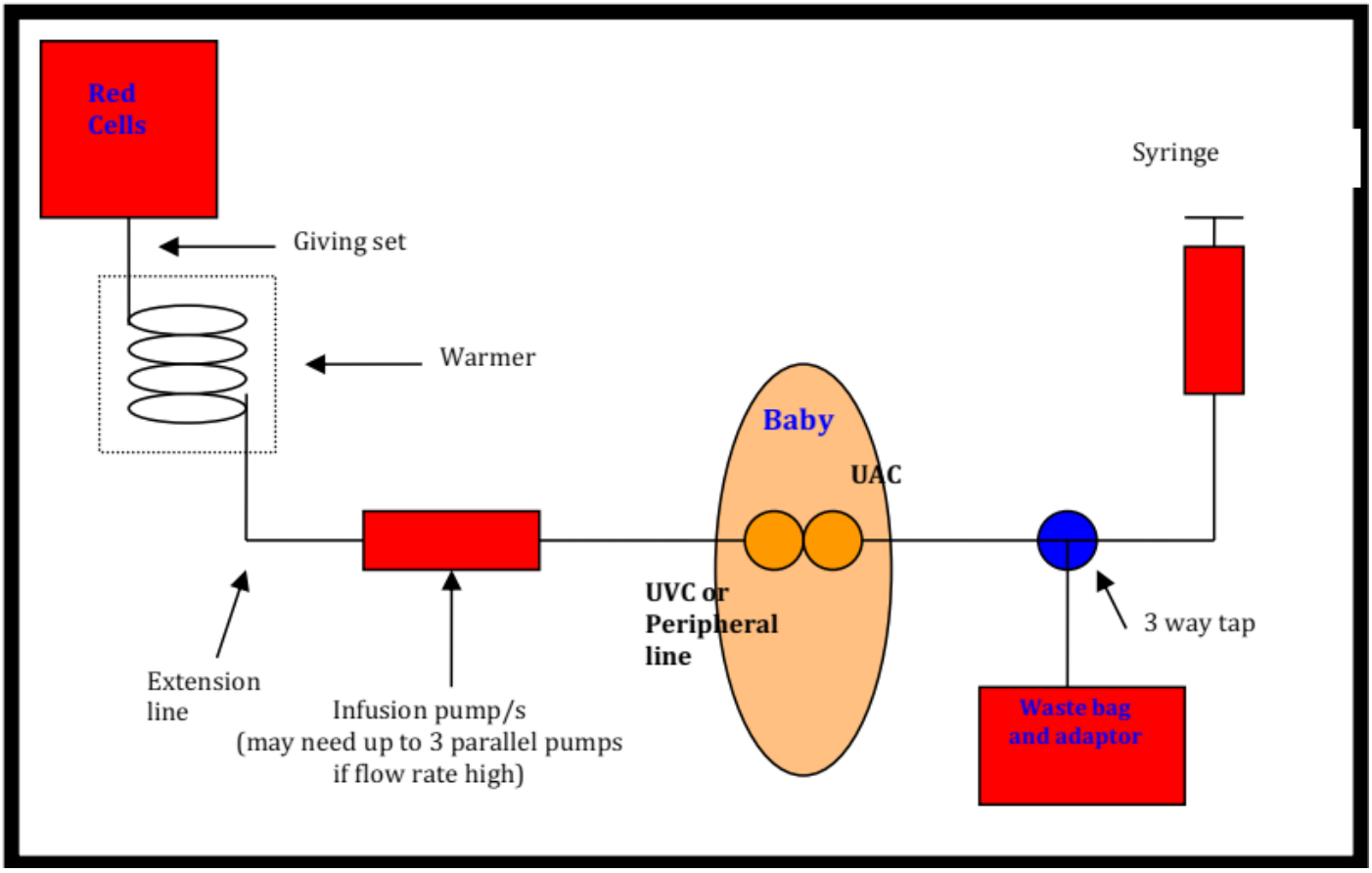
9.3 [3] NICE. *Jaundice in newborn babies under 28 days: Clinical guideline [CG98]*. London: National Institute for Health and Care Excellence; 2010 (updated June 2020, surveillance reviewed 2023). Available at: https://www.nice.org.uk/guidance/cg98

9.4 [4] American Academy of Pediatrics Subcommittee on Hyperbilirubinemia. *Clinical Practice Guideline: Management of Hyperbilirubinemia in the Newborn Infant 35 or More Weeks of Gestation*. Pediatrics. 2022;150(3):e2022058859. DOI: 10.1542/peds.2022-058859

9.5 [5]*Joint United Kingdom Blood Transfusion and Tissue Transplantation Services Professional Advisory Committee (JPAC). Guidelines for the Blood Transfusion Services in the United Kingdom ("Red Book" — Change Notification 03-2024 update).* London: JPAC/NHSBT; 2024. Available from transfusionguidelines.org.

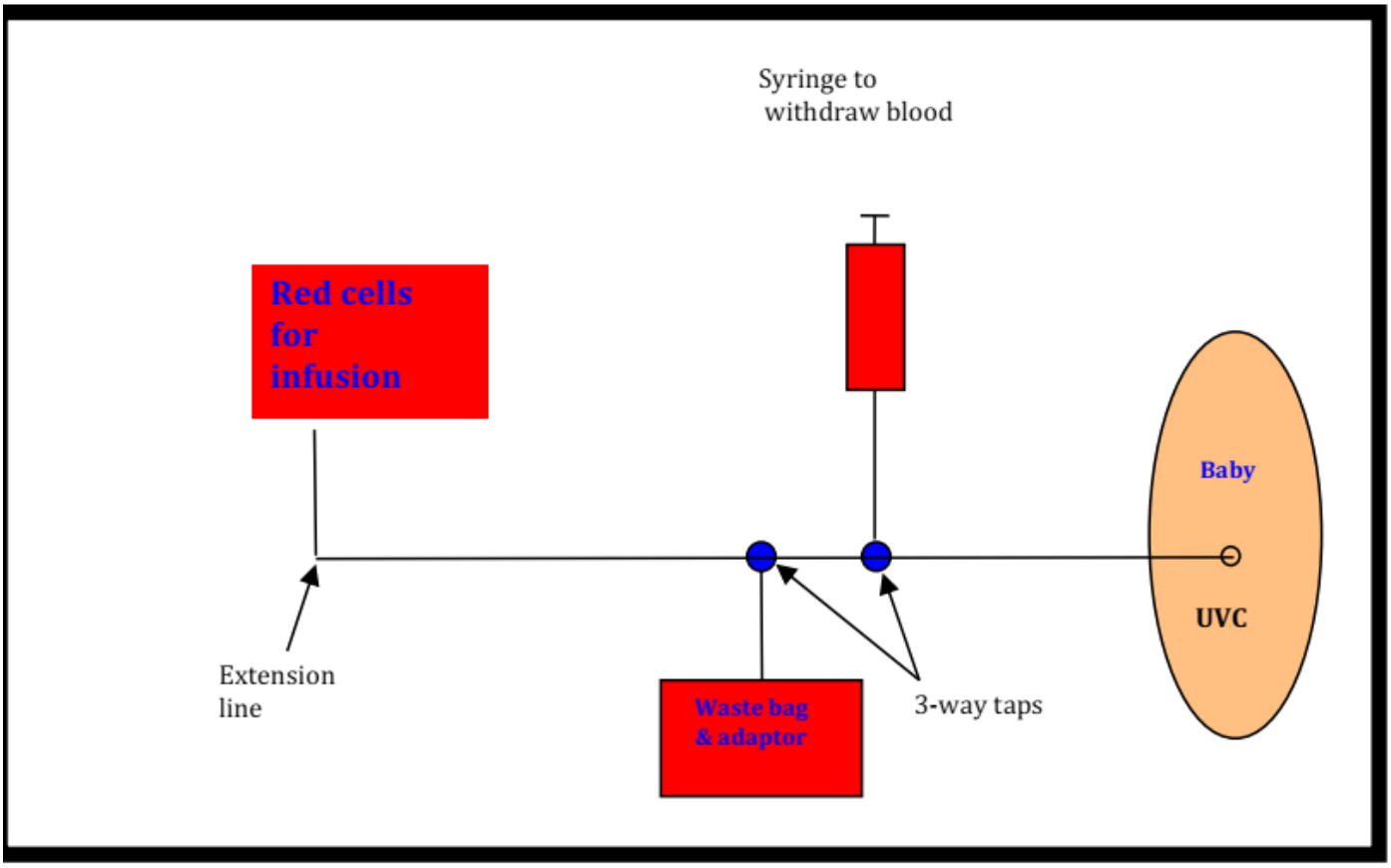
• APPENDIX A: EQUIPMENT AND SET-UP

Infusion of donor red cells at a constant rate, with simultaneous withdrawal of aliquots of blood from the infant



One person push-pull technique via single vascular access

• APPENDIX B: SUMMARY FLOW CHART



• APPENDIX C: NEONATAL EXCHANGE TRANSFUSION RECORD

Name			
Date of Birth			
Hospital Number			
Gestation		**Total Volume of Transfusion (ml/kg)**	
Blood Group		**Total Required Volume (ml)**	
DAT		**Aliquot Size / Infusion Speed**	
Mothers Name		**Aliquot Frequency**	
Mothers Hospital Number		**Time for Transfusion (min)**	

Aliquot Number	Time	IN		OUT		Total Balance (In-Out)	Blood Taken?	HR	RR	Temp	BP	SpO2
		Aliquot ml	Total ml	Aliquot ml	Total ml							
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East of England Neonatal ODN
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Exceptional Circumstances Form

Form to be completed in the **exceptional** circumstances that the Trust is not able to follow ODN approved guidelines.

Details of person completing the form:	
Title:	Organisation:
First name:	Email contact address:
Surname:	Telephone contact number:
Title of document to be excepted from:	
Rationale why Trust is unable to adhere to the document:	
Signature of speciality Clinical Lead: Date:	Signature of Trust Nursing / Medical Director: Date:
Hard Copy Received by ODN (date and sign):	Date acknowledgement receipt sent out:

Please email form to: kelly.hart5@nhs.net requesting receipt.

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