

## Home Oxygen Therapy- NICU Full Clinical Neonatal Guideline

Reference no.: NIC NE 08/ May 22/v003

*This guideline has been developed from the British Thoracic Society's Guidelines for home oxygen in children<sup>1</sup>. This document is not extensively referenced; an exhaustive list of references can be found in the British Thoracic Society Guideline document.*

### 1 Introduction

Preterm infants who develop chronic lung disease (CLD) may continue to require supplemental oxygen when they are otherwise ready for discharge. Home Oxygen Therapy allows these babies to be discharged home safely.

This is a form of **long-term oxygen therapy** (LTOT) which is defined as the provision of oxygen for continuous use at home for patients with chronic hypoxaemia in order to maintain target oxygen saturations. As infants are rarely housebound and must be facilitated to go outside and lead a normal family life, LTOT is almost always accompanied by **portable oxygen therapy** which is the provision of oxygen that can be wheeled on a trolley or pram, worn in a backpack or carried.

### 2 Aim and Purpose

To guide the

- Identification of infants requiring home oxygen therapy
- Assessment for need of home oxygen therapy on the neonatal unit
- Setting up of home oxygen therapy in the home
- Discharge planning
- Management of home oxygen therapy after discharge from the neonatal unit.

### 3 Definitions and Keywords

CLD	-	Chronic Lung Disease
ECG	-	Electrocardiogram
ECHO	-	Echocardiogram
EMHORT	-	East Midlands Home Oxygen Risk Tool
HOOF	-	Home Oxygen Order Form
IHORM	-	Initial Home Oxygen Mitigation Form
LTOT	-	Long-term Oxygen Therapy
RSV	-	Respiratory Syncytial Virus
Sleep study	-	Overnight pulse oximetry study

## 4 Main body of Guidelines

### 4.1 Indications for LTOT

Home oxygen therapy can be used (when the infant is otherwise ready for hospital discharge) for infants with:

- Neonatal Chronic lung disease
- Other oxygen-dependent neonatal lung conditions including interstitial lung disease
- Pulmonary hypertension
- Palliative care (for symptomatic relief)

In some conditions such as chronic hypoventilation or neurological conditions, home oxygen may be required but it must be given only if the infant is optimally ventilated and, if required, additional ventilatory support has been provided.

### 4.2 Home oxygen therapy for neonatal chronic lung disease

CLD is the most common indication for use of home oxygen therapy among infants discharged from neonatal units.

#### 4.2.1 Benefits

The pathophysiological effects of chronic hypoxia support the use of supplementary oxygen in infants CLD:

- To improve survival: decrease risk of acute life threatening events and sudden unexplained deaths in infancy
- To reduce or prevent pulmonary hypertension
- To improve growth and neurodevelopment

The home environment is the optimal environment for the medically stable infant and early discharge from the neonatal unit with proper home follow-up is not only less costly but also safe and beneficial for the family. It reduces the risks of nosocomial infections and gives families the opportunity to settle into family life and gain control of the infant's care sooner.

#### 4.2.2 Challenges and potential disadvantages

Home oxygen is a potential hazard in the home environment particularly in the vicinity of cigarette smoking, gas cookers, open flames or generated sparks.

- Families must be made aware of the potential hazards of home oxygen
- Smoking must be strongly discouraged.

Discharge of a preterm infant on home oxygen could be an additional psychosocial burden on families. This may be the stress of caring for an unwell child in general but could be aggravated by the additional burden of home oxygen. However, studies show that parents feel that the benefit of having their child at home outweighs their anxiety and the increased anxiety levels after hospital discharge decreases as they see their child's oxygen dependency resolving<sup>2</sup>.

- Appropriate assessment of the family and living conditions must be performed and the parents consulted before planning discharge on home oxygen
- Optimal support must be provided to families who have an infant with home oxygen therapy in place.

### **4.3 Normal oxygen saturation levels in healthy infants < 1 year**

- The median baseline oxygen saturation in healthy term infants during the first year of life is 97-98%.
- In only 5% of healthy infants is the oxygen saturation < 90% for > 4% of the time.

#### **4.3.1 Consequences of chronic low oxygen saturation in infants**

In infants with neonatal CLD

- Hypoxaemia causes pulmonary hypertension and oxygen saturation levels > 94-95% appear to reduce it.
- Hypoxia may have adverse effects on cognition and behaviour at oxygen saturation levels of ≤ 85%. Effects of less severe hypoxia are not well described.
- Oxygen saturation < 90% is associated with an increased risk of apparent life-threatening events while level of ≥ 93% is not.
- Oxygen saturations < 92% may be associated with suboptimal growth.
- Oxygen saturation of ≤ 90% impairs sleep quality but > 93% does not.

## **5 Assessment of inpatient infants for discharge on home oxygen**

Infants with neonatal CLD (defined, for the purposes of this guideline, as infants requiring supplemental oxygen at a corrected age of 36 weeks gestation who are at least 28 days old) or any other condition requiring LTOT (as given in Section 4.1) should be assessed for discharge on home oxygen.

### **5.1 Assessment of suitability for home oxygen therapy**

- Corrected gestational age of ≥ 36 weeks
- Weight ≥ 1800 gm
- Clinically stable and otherwise ready for discharge home
- The parental and home environment should be assessed and deemed to be suitable for discharge on home oxygen, particularly in consideration of the challenges given in Section 4.2.2.
- A multidisciplinary discharge planning meeting must be held prior to discharge.

### **5.2 Target oxygen saturations**

Pulse oximetry should be used for assessment; there is no need for arterial blood sampling or regular assessment of carbon dioxide levels.

Assessment should be performed by measuring the oxygen saturations over a period of at least 6 – 12 hours and should include all levels of activity e.g. during sleep and wake periods, plus during feeding.

**Supplemental oxygen should be given to maintain oxygen saturation levels of ≥ 93%.**

#### **5.2.1 Preparing the infant for assessment of supplemental oxygen requirement**

After the infant is assessed and considered suitable for home oxygen therapy, the lower limit of the oxygen saturation monitor should be set at 94% and the upper limit switched off. The supplemental oxygen levels should be adjusted until the infant is stable and free of

desaturations to below 94%. This level of supplemental oxygen (usually  $\leq 0.5$  L/min) should then be used consistently until the overnight pulse oximetry study is performed.

### **5.2.2 Overnight pulse oximetry study (sleep study)**

Infants who require  $\geq 0.1$  L/min of supplemental oxygen

- Sleep study should be performed in the level of oxygen the infant is stable at. This level should be maintained constantly during the study.
- If the infant has passed a sleep study, but for some reason discharge has been delayed, a repeat sleep study should be performed prior to discharge at the same oxygen flow rate.

Infants who require  $< 0.1$  L/min of supplemental oxygen

- The infant should have a trial in air, as appropriate, to assess whether they require supplemental oxygen. If they are unsuccessful with this trial in air supplemental oxygen should be restarted and a sleep study completed in the amount required.
- If the infant has outgrown the oxygen requirement a sleep study should be done in air to ensure that the target saturations are met. If these are not met then it would be good practice liaise with the Neonatal Consultant and to repeat the sleep study in oxygen.

### **5.2.3 Interpreting results of the sleep study**

The results of the sleep study should be discussed with the attending Consultant Neonatologist and if required, with the infant's named Consultant Neonatologist and/or the service lead for management of infants on home oxygen therapy.

The level of oxygen is appropriate for the infant if:

- The oxygen saturation level does not fall below 90% for  $\geq 5\%$  of the recording period.
- The mean oxygen saturation levels during the recording period is  $> 93\%$ .

If the infant's recording meets the above criteria, the same level of oxygen should be continued.

If the infant's recording does not meet the above criteria, a higher level of supplemental oxygen should be prescribed, and the sleep study repeated at this higher level until the suitable level is determined.

### **5.2.4 Air challenge**

An air challenge (ability of the infant to remain adequately oxygenated while breathing in air) should be considered prior to discharge to ensure that the infant could remain safe during accidental short-term disconnection from their supplemental oxygen supply.

To be considered safe, the infant should be able to maintain oxygen saturation levels of  $> 80\%$  for at least 30 minutes while breathing in air.

### **5.2.5 Additional investigations: assessment of the right heart to exclude pulmonary hypertension**

- ECG. Once the ECG has been reviewed and confirmed as satisfactory, should the infant be discharged.
- Echocardiogram, if indicated by the ECG or if clinically required. The ECHO, if possible to be completed as an inpatient prior to discharge. If this isn't possible this needs to be arranged as an outpatient appointment.

## 6 Preparation for discharge

- Oxygen requirement must be stable (usually at  $\leq 0.5\text{L}/\text{min}$ ) with mean oxygen saturation level  $\geq 93\%$ , without frequent desaturation. The level should not fall  $< 90\%$  for more than 5% of the artefact-free period.
- The infant should be otherwise ready for discharge such as medically stable with satisfactory weight gain.
- There is no evidence on whether the routine use of a saturation monitor at home is of benefit or harm, and, therefore, it is not currently recommended. Once a sleep study has been passed on the Neonatal Unit continuous saturation monitoring should be discontinued, for a minimum of 48 hours prior to discharge. Parents should be encouraged to room in pre-discharge, without oxygen saturation monitoring, to aid with their confidence and knowledge.
- Infants going home on oxygen should not be continuous oxygen saturation monitoring at home routinely. This should only be used if pre-decided with consultant approval in cases with complex needs e.g., heart disease.
- Standard childhood immunisations must be up to date and additional immunisations should be arranged – influenza immunisations (via the GP) and RSV must be arranged at appropriate times of the year.
- Home conditions should be satisfactory. Parents must have listed telephone numbers and contact details for advice and emergency help in case of equipment breakdown.
- Parents should be given relevant advice such as smoking cessation, precautions for travel with cylinder and information for home insurers.
- Appropriate support must be in place:
  - Meeting with neonatal home oxygen care team and individual hand-held care plan for the infants
  - Communications with the GP to ensure uneventful transition
  - Arrangements for how to access Children's Emergency Department

### 6.2 Referrals

- Community Children's Nurses. Appropriate referrals to Community Children's Nurses should be made as required. This must be done via telephone or online and a copy of the neonatal discharge summary and other details of the referral should be emailed to the relevant team.
- Any other relevant agency that maybe involved with the infant at home e.g Dietician, Physiotherapy.
- A Speech and Language Therapy referral must be completed when a sleep study is undertaken whilst on the neonatal unit.

### 6.3 Multi-Disciplinary Discharge Planning

A multidisciplinary discharge planning meeting should be arranged to facilitate the discharge, ideally 5 days prior to discharge to facilitate safe and smooth transition into the community and avoid unnecessary hospitalisations<sup>1</sup>.

The date and venue arranged for meeting and the invitations to meeting should be sent out ideally 7 days prior to meeting.

The named Consultant will chair this meeting which will include the following members of multidisciplinary team:

- The parents/carers of infant, the date set is set to suit the family.
- The child's named neonatal consultant
- Medical team in the neonatal unit to ensure attendance by senior doctor if Neonatal Consultant isn't available
- Health Visitor
- Community Children's Nurses
- Neonatal Outreach Team member
- Low dependency staff involved with Discharge planning of infant
- Physiotherapist if involved
- Dietician, if involved
- Speech and language Therapist, if involved
- Play services from Children's Hospital, if involved
- Social Care if involved

#### **6.4 Development of discharge plan at meeting.**

##### **Discharge planning meeting:**

Each attendee at the meeting is given the opportunity to give their report about the infant and plans and their roles for infant post discharge as applicable. Medical staff may leave the meeting after they have given their report.

This plan should be discussed with parents/ carers and other professionals at the meeting. It should also include:

- The plan for multidisciplinary follow-up to ensure a safe smooth transition into the community and to avoid unnecessary hospitalisations<sup>1</sup>.
- Date of discharge to be provisionally set
- Resuscitation training to be arranged
- Training programme to be set up for family to ensure confidence of family in the use of equipment used for administration of Home oxygen.
- Date for home installation agreed by family to facilitate ordering of oxygen.
- Family has all contact numbers listed and information for:
  1. Neonatal Outreach Team
  2. Health Visitors and GP
  3. Oxygen supplier and Medequip
  4. Emergency numbers- 999
- Recognise when an infant is ill and what to do

- If possible a date should be set for a hand over meeting between the Neonatal Outreach Team, health visitor and community children's nursing team approximately 4 weeks post discharge.

## 6.5 Discharge

The infant will usually be ready for discharge home when;

- The oxygen requirement is stable with a mean SpO<sub>2</sub> of >93% and without frequent episodes of desaturations or apnoea and this has been confirmed by an overnight pulse oximetry study. This usually corresponds with an oxygen flow <0.5lpm. Only under exceptional circumstances and after discussion with the Neonatal Consultant will an infant be discharged in a higher flow rate.
- There are no other clinical conditions precluding the discharge and the infant is medically stable with no episodes of apnoea or frequent desaturations for at least 2 weeks.
  - A satisfactory ECG has been performed and reviewed by a Neonatal consultant.
- All training for family to ensure confidence with their baby at home in oxygen is completed and parents can demonstrate the use of the equipment as per the Parent teaching protocol for Home oxygen leaflet. This leaflet should be given to parents as a resource for home and it should be documented that this has been completed in the medical and nursing notes.
- Newborn Basic Life Support and recognising the signs of respiratory compromise training has been undertaken with parents.
- Oxygen is installed at home and the family are aware of how to use equipment at home.

## 7 Ordering and provision of oxygen

- a. The ordering of home oxygen ordering should be undertaken by the Neonatal Outreach Team/ Consultant involved with discharge as prescribed by the paediatric / neonatal specialists via the appropriate oxygen supplier.
- b. While low flow oxygen cylinders are easier to handle, they empty more quickly. Parent choice and household environment should be considered prior to ordering.
- c. Portable equipment should be available for all infants as part of the provision of home oxygen.
- d. Nasal cannulae are preferable for infants for flows of <2LPM

### 7.1 Ordering of oxygen installation

A pre-discharge visit should be undertaken by the Neonatal Outreach Team, timescale to be arranged with the Neonatal Outreach Team, to complete the EMHORT, IHORM, HOOF and Pre-Discharge Home Visit checklist.

- Patient agreement for sharing information as part of oxygen supply at home service to be discussed and signed by parents/carer. Please ensure that the parents/carers have a copy and a copy is filed in medical notes (EMHORT and IHORM).
- Order oxygen from supplier using Home oxygen order form (HOOF). The order should be completed via the relevant oxygen portal/ emailed to air products as per instructions on form.
- Please ensure that a copy of the HOOF is filed in the medical records.

## **8 Care following discharge**

### **8.1 Consultation and reviews**

- The Neonatal Outreach Team or Community Children's Nurses should visit the home on the day of discharge to complete an oxygen check, to ensure correct administration of oxygen by the family and that they are confident in this. Infants going home with oxygen should, therefore, be discharged before midday to facilitate this.
- The infant should have an overnight sleep study, within 48 hours of discharge. To facilitate this, all discharges on home oxygen should occur on Monday-Thursday after ensuring that the Neonatal Outreach Team are available to conduct the study.
- Further regular visits or telephone consultations should be arranged as per individual requirements and suitability.
- All infants discharged on home oxygen will have regular neonatal follow up with their named Consultant Neonatologist.
- Infants who are in home oxygen between October and March will be reviewed and receive RSV.
- Neonatal Outreach follow up is at the discretion of the Neonatal Outreach Team until the family and their infant are well settled in the home environment and neonatal needs are met. These should include sustained growth and development of the infant with the family feeling confident in coping with their infant at home. Planned hand over of the infant to the Children's Community Nursing team and health visitor should be undertaken, usually at around 4 weeks post discharge.

### **8.2 Assessment of oxygen requirement at home<sup>3</sup>**

- Infants with home oxygen should have a sleep study completed within 48 hours of discharge, and monitoring should include various activity states<sup>3</sup>.
- Further sleep studies should be performed at 3-4 week intervals in a reduced flow rate of oxygen. If successful, the infant should be continued at the lower flow rate. If not successful, sleep study should be repeated at the lower rate after 3-4 weeks again.
- Once the infant is stable for 3-4 weeks in 0.1 L/min of oxygen, trial in air should be commenced. If the assessment is unsuccessful at any stage, the infants should be put back to the previous regimen of oxygen supplementation and repeat attempted after a suitable period.
- Infants with CLD will continue to be followed up until they no longer require oxygen by Respiratory Specialist Paediatrician and the relevant Children's Community Nursing team.

### **8.3 Specialist referral**

If the infant continues to require supplemental oxygen at 1 year of corrected gestational age, a specialist referral to Paediatric Respiratory team at the Derby Children's Hospital should be considered.



Additional assessment for co-existing conditions such as cystic fibrosis should be considered and a repeat assessment for pulmonary hypertension (ECG, Echocardiogram) should be performed.

### 1. Documentation Controls

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<b>Training and Dissemination:</b> All training will be provided to the neonatal outreach team, KITE team and neonatal staff.				
<b>Development of Guideline:</b> Gemma Manning (Neonatal Outreach Sister and Shalini Ojha (NICU consultant)				
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<b>Contact for Review</b>			Gemma Manning (Neonatal Outreach Sister and Shalini Ojha (NICU consultant)	



## Appendix 2

## Home Oxygen Pathway

**Affix patient identification label inbox below or complete details**

Surname	Hospital No	Neonatal Consultant
Forename	Date of Birth	
Address	NHS No	Provisional date of discharge
	Sex	
Postcode	Male / Female	

Pathway	Due	Initial, date & time
Set alarm limits on saturation monitor to 88% lower and 97% higher to gauge correct amount of oxygen needed. Attempt to wean oxygen.	36 weeks corrected gestation	
If baby is in oxygen at 36 weeks corrected gestational age, refer to Neonatal Outreach Team who will discuss home oxygen with the family and provide written information.	At 36 weeks corrected gestation	
Oxygen dependant babies to have saturation monitoring only and stop cardiac monitoring if condition allows. If available change onto a Nellcor monitor.	At 36 weeks gestation	
If by 38 weeks the baby still has an oxygen requirement. They will need sleep studies to establish oxygen levels needed	At 38 weeks gestation	
Once sleep studies have been passed and oxygen requirement have been agreed by medical staff, further oxygen saturation monitoring should be stopped. The baby should be kept in the agreed amount of oxygen without oxygen saturation monitoring for at least 48h prior to discharge home.	Once a sleep study has been passed	
Neonatal Outreach Team will gain consent from family for home installation and order home oxygen from relevant oxygen provider.	1 week prior to discharge	
Neonatal Outreach Team will organise a home visit and complete parent education training of home oxygen.	In the week prior to discharge	
Ensure ECG and Echo have been performed as per guideline.	In the week prior to discharge	
Neonatal staff to complete a referral to the relevant Children's Community Nursing Team.	In the week prior to discharge	
Arrange discharge planning meeting, send invites to all appropriate members of the multidisciplinary team e.g. Health Visitors, physiotherapist, SALT, Dietician, GP, Children's Community Nurses, Portage worker.	In the week prior to discharge	

Arrange RSV vaccination if appropriate ( <b>refer to RSV guideline</b> ref NIC)	Before discharge	
Inform CED of baby home on oxygen and provide copy of Badger discharge summary	On day of discharge	
Arrange addition to EDIS system in CED	On day of discharge	

**Ordering of home oxygen;**

Complete IHORM.	Once a sleep study has been passed	
Complete EMHORT.	Once a sleep study has been passed	
Complete HOOOF.	Once a sleep study has been passed	

**Before leaving the hospital, the baby's parents/carers must:**

Have all the equipment and replacement supplies necessary for the supply of home oxygen.	
Have had training in the technique and management of the supply of home oxygen and are confident in using the equipment. Also have safety information from the oxygen provider.	
Have had life support training and know how this can be kept up to date.	
Have learned how to observe the child's breathing pattern and know how to interpret and act on this information.	
Have a list of contact details and know who to contact for different sources of help	
Know what to do if the oxygen supply is not available.	

**The parents/carers are aware of the systems that enable them to:**

Order and reorder supplies, e.g. cannulae, tubing, etc.	
Have oxygen delivery equipment replaced, repaired and serviced.	

**The following must be checked:**

When travelling outside the home, those escorting the infant will transport the oxygen safely.	
The parents/carers have informed the car insurance company of the need to carry oxygen	
The parents/carers have informed the house insurance company of the need to have oxygen in the family home.	
The parents/carers are aware of the importance of early contact with the Neonatal Outreach Team/ Children's Community Nurses	
The child can be assured that the parents/carers will plan holidays or overnight stays in advance and approach the relevant agencies in a timely manner.	
Ongoing supplies to be ordered by Neonatal Outreach team.	
Ensure Speech and Language therapy team are aware of discharge home in oxygen plan.	
Ensure Neonatal physiotherapy team are aware of discharge home in oxygen plan.	

Neonatal Outreach Team will provide parents/carers with information regarding Disability living allowance and Blue Disabled Badge applications.	
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1. Balfour-Lynn IM, Field DJ, Gringras P, et al. *BTS guidelines for home oxygen in children. Thorax 2009; 64 Suppl 2: ii1-26.*
2. Zanardo V, Freato F. *Home oxygen therapy in infants with bronchopulmonary dysplasia: assessment of parental anxiety. Early human development 2001; 65(1): 39-46.*
3. Khetan R, Hurley M, Spencer S, Bhatt JM. *Bronchopulmonary Dysplasia Within and Beyond the Neonatal Unit. Adv Neonat Care 2016; 16(1): 17-25.*