**Title:**

**Oxygen Prescribing and Compatibility Issues in Infants Requiring Long Term Ventilation**

**To the Editor**

Improved neonatal care has resulted in pre-term infants surviving from a younger gestational age,1 however a reduction in the proportion of these patients with bronchopulmonary dysplasia (BPD) is only moderately reduced, leading to more infants with a clinical diagnosis of BPD2 and an exponential rise in the use of long term ventilation in these children.3 Long term ventilation (LTV) can be delivered invasively via a tracheostomy (tr-LTV) or non-invasively (NIV). Non-invasive ventilation prevents associated problems such as loss of voice, feeding complications, impact on development and infection issues. As a result infants with BPD are increasingly being discharged from hospital on NIV.4

A serious adverse incident occurred following discharge from our NICU, whereby an ex-preterm infant with BPD was discharged on NIV and oxygen. The infant did not receive the required amount of oxygen in the home setting, resulting in a significant desaturation. There was calculated to be a 14% discrepancy in the amount of pressurised oxygen delivered through the portable ventilator via a static concentrator at home compared to that administered via piped oxygen delivered in hospital. This disparity is due to the forcing of oxygen at a lower outlet pressure through the narrow aperture of the NIV circuit.4 This is recognised in adult patients but has not previously been described in ex-preterm infants being discharged on NIV.5

This study sought to investigate if clinicians in other hospitals discharging infants on NIV and oxygen had knowledge and experience of this important safety issue.

There are no current guidelines in the UK regarding the maximum amount of oxygen it is safe to discharge an infant home on via a portable ventilator and when to perform a sleep study following discharge on LTV. We sought to explore current practice, with a view to improve our guidelines and knowledge in this area.

**Methods**

We performed a national survey of UK centres with an online questionnaire using Google Documents (Appendix 1; OLS). This was distributed electronically via groups including the UK Kids PPLTV group, South & North Thames Paediatric Network & the Paediatric Pan London Oxygen Group.

The questionnaire assessed if other units had noticed oxygen discrepancies when using LTV in infants, and their experience of using home oxygen with home ventilators. We asked about the ease of oxygen prescribing. We asked when sleep studies are routinely performed following discharge.

We compared practice across the UK.

**Results**

**General**

Twenty health care professionals (HCPs) completed the survey. A wide variety of ventilators and oxygen providers are used across the UK (Table 1; OLS). Less than half of ventilators had integrated oxygen sensors; without sensors the exact delivered oxygen concentration is not discernible. Thirty percent of HCPs noticed compatibility issues between the oxygen concentrator and the portable ventilator (Table 2; OLS). Over 50% of HCPs do not perform home testing of the equipment prior to discharge. Twenty-five percent of HCPs said parents/carers, noticed their child de-saturate when using the ventilator shortly after discharge and therefore had to increase the oxygen.

**Oxygen prescribing**

A third of HCPs found oxygen prescribing difficult. Ten percent found it very complicated, and some centres found it easier to prescribe oxygen with certain providers. Forty percent feel there is not enough support in prescribing oxygen with LTV.

The maximum amount of home oxygen prescribed via LTV varied dramatically across the UK (Figure 1).

**Sleep monitoring post discharge**

There was a wide variety of practice in the timing of the sleep study post discharge (Figure 2), 5% perform it the night after discharge, 20% within a month, 25% within 3 months and 5% within a year.

**Discussion**

This National survey, prompted by a serious adverse incident, revealed a third of children discharged home on LTV showed discrepancies in their prescribed pressurised piped oxygen delivered in the hospital, compared to that delivered at home via the portable ventilator and oxygen concentrator. There seems little knowledge amongst HCPs about the difference between delivered oxygen at home through LTV devices compared to that delivered by the same device in the hospital setting using pressurised wall oxygen. We advocate that HCPs should be trained and informed about this potentially life threatening issue.

The discrepancy in oxygen delivery has previously been reported in a group of adult patients with COPD.5 This is the first time it has been described in children. The issue is such a serious risk factor that we should check ventilator oxygenation at home or in a simulated home setting prior to discharge and improve education of HCPs. Our team were not aware of this issue before the incident occurred.

Our questionnaire is the first to reveal that many HCPs found oxygen prescribing difficult and felt there is inadequate support with this. In addition we report that, in the absence of guidelines the maximum prescribed oxygen given via home ventilators varied widely from 2L/min to no limit in some centres. We propose that support in oxygen prescribing should be improved. We advocate the introduction of national guidelines for the safe discharge of infants on LTV and home oxygen. We suggest the guideline should include a limit on the amount of oxygen that can be delivered through a portable ventilator safely at home.

Currently, there is no guidance on when a sleep study should be performed following discharge on LTV. Some centres completed the sleep study within a year of discharge, whereas others completed within a night of discharge. If a sleep study is delayed and there is a subtle discrepancy in oxygen delivered (via the portable ventilator), a child could potentially become hypoxic at home. We recommend that a sleep study should be performed within a week of discharge for those on LTV and we recommend National guidance on this.

Following on from the adverse incident and results from our study we are piloting an oxygen checklist (Appendix 2; OLS). This checklist has been endorsed by the PPLOG, and should improve the safety of children discharged on LTV.

Limitations of this survey include that it was voluntary so there could have been selection bias on reporting of issues. There were also no measured discrepancies, and a further important study would be to accurately measure the differences in oxygenation between devices in the different settings.

**Summary**

This is the first UK National survey, reviewing HCPs knowledge and practice of prescribing oxygen via LTV for home. We have discovered that a third of HCPs have noticed a discrepancy in oxygen delivered via LTV at home compared to oxygen piped in the hospital. We revealed that there was little knowledge about this discrepancy amongst HCPs. This study showed a large variation in practice of the maximum oxygen delivered via a home ventilator and timing of sleep study after discharge. We describe a PPLOG endorsed oxygen checklist for children discharged on LTV which is instituted in our hospital prior to discharge and recommend the introduction of national guidelines for the safe discharge of children on LTV and home oxygen.

**References**

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**There are no perceived COI for EM, KH, JP & CJB. CL works for an oxygen company as a health care professional.**

**Figure 1. What is the maximum amount of oxygen you use with a portable ventilator in a home setting?**

25%

10%

10%

10%

10%

30%

**Figure 2. When would you perform the next sleep study after discharge?**

5%

25%

20%

25%

5%