Nursing Management of \( O_2 \) Therapy in Infants with Chronic Lung Disease

**Introduction:**
Chronic lung disease (CLD) is a common condition and has been defined as oxygen requirements beyond 28 days \(^1\) or oxygen requirements near term which better reflects subsequent respiratory disease – see chronic lung disease policy.

**Incidence:**
The majority (80-90%) of infants born less than 27 weeks in RPA still require oxygen therapy at 28 days of life, with 40-60% still needing supplemental oxygen at 36 weeks post conceptual age. Therefore there are significant numbers of infants in the special care nursery that require titration, stabilisation and weaning of oxygen therapy. In addition, approximately 14% (19/136 born 1998-2000) of infants are discharged home on oxygen (~6 infants each year).

![Incidence (%) of chronic lung disease by gestation (weeks) in survivors discharged home from JSN 1988-1997.](image)

**Non invasive oxygen monitoring**
The most appropriate methods of continuous monitoring and assessing the oxygen needs of infants remain controversial - see small baby protocol, oxygen therapy & nursing policies for the administration of oxygen therapy, use of transcutaneous PaO\(_2\) and saturation monitors in Newborn Care.

The use of pulse oximetry for infants with chronic lung disease has now been routinely accepted in clinical practice. The literature however remains contentious and while pulse oximetry has been reported to be a reliable measure of oxygenation in infants with CLD \(^2\) there are authors that would oppose that view \(^3\). Nevertheless there are some major limitations with its use in the clinical setting and these include movement artifact \(^4\), the risk of hyperoxia \(^5,6\) and the possible underestimation of hypoxaemia at SpO\(_2\) values less than 80% \(^7\).
In a recent study artifact was present 19% of the total recorded time with the Nellcor N-200 and Fletcher et al., demonstrated that signal artifact was dependent on behavioural state and affected up to 50% of recordings. The resulting large number of false alarms may have the potential to result in the under (or over) reporting of hypoxic events. In addition it also well reported that less than 40% of apnoea and associated hypoxic events are reported by nurse clinicians.

Nursing strategies to optimise interpretation of SpO2 values

**Reduction of artifact**
- excessive motion artifact and elimination of inadvertent optical shunting can be optimised by careful placement of the signal probe.
- periods of infant crying or handling have been identified as periods of high artifact and must be considered when interpreting SaO2 values.
- in addition to clinical assessment a difference in heart rate of > than 5 beats per minute simultaneously displayed on the pulse oximeter and independent ECG suggest artifact.

**Detection of hypoxia**
- precision of pulse oximeters decreases with decreasing SaO2 and this may lead to an under estimation of hypoxaemia when SpO2 values fall below 75% or 80%.
- when SpO2 values are less than 85% arterial oxygen tensions are generally less than 52 mmHg.
- lower alarm set at 85%.

**Detection of hyperoxia**
- the ability of pulse oximeters to detect hyperoxia also remains problematic, as small changes in saturation above 90%, are associated with relatively large changes in arterial oxygen tension (PaO2).
- the oxygen target range for infants with CLD for all infants receiving supplemental oxygen is 90-95%. Two recent randomised studies found that targeting higher oxygen saturations (>96%) resulted in increased duration of oxygen therapy, incidence of home oxygen and possibly increased respiratory illness compared to targeting lower levels (90-95%). However, the optimal oxygen targeting of infants with ROP requires further research.
- as Nellcor technology measures functional Hb upper alarm limits are set at 96% (sensitivity 96%, specificity 57%) to detect hyperoxia.

The realistic issues of maintaining infants within the oxygen target range and what strategies can be best utilised to achieve this goal remain problematic. There are no studies that have been designed to measure this important clinical problem and no studies to measure the impact of continuous monitoring of SpO2 values on neonatal outcomes.
Trending versus continuous SpO2 monitoring

With increasing maturity there is a reduction in the magnitude of desaturations and the variability of saturation. Trials to date have set oxygen target ranges with the goal of achieving a median oxygen saturation within this range.\textsuperscript{16, 17} Inspired oxygen was adjusted according to intermittent downloads to achieved this target range. In the latter trial\textsuperscript{17} it was estimated that infants spent more than 50\% of their download recordings outside their target range. In addition, infants near term who no longer require supplemental oxygen have frequent desaturations that are not observed by caregivers\textsuperscript{19}.

Protocol

\textbf{Oxygen targeting:}

\textit{Infants suitable for trial of intermittent SpO2 monitoring in the special care unit include}

\textbf{Otherwise well preterm infants who}

- are > 34 weeks post conceptual age
- have had stable oxygen requirements for at least seven days
- are receiving \leq 200\text{mls O}_2/\text{min.} via short nasal prongs (Hudson / Salter)
- are not having apnoea of prematurity that routinely requires additional O\textsubscript{2} or other intervention such as suction or bagging
- do not have pre threshold retinopathy of prematurity – discuss with consultant neonatologist

\textbf{Management}

- Infants suitable for intermittent SpO2 monitoring will have 24 hour downloads 2-3 times per week
- Downloads to be reviewed by consultant or CMO and adjustments made to ambient oxygen concentration as appropriate
- Nurse clinician is to manage infant at the prescribed O\textsubscript{2} concentration during and between downloads unless there is a clinical indication to modify management plan – discuss with senior medical officer
- Continuous SpO2 monitoring may be reintroduced if there is a suspected intercurrent illness such as sepsis / URTI
### Oxygen targeting

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<thead>
<tr>
<th>Preterm infant &lt; 37 weeks</th>
<th>Target Oxygen</th>
<th>Alarm limits</th>
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<tbody>
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<td>Target greater than 90%</td>
<td>88-100%</td>
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<tr>
<td>Infant in oxygen SpO₂%</td>
<td>90 -95%</td>
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<td>Transcutaneous TcO₂ mmHg</td>
<td>50-60 mmHg</td>
<td>45-70 mmHg</td>
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For the term infant with Persistent Pulmonary Hypertension of the Newborn (PPHN) then discuss target oxygen and alarm limits with staff specialist & document on NICU chart. Modify target oxygen only after discussion with staff specialist / Fellow.

| Transcutaneous TcCO₂ mmHg | 45-55 mmHg | 40-60 mmHg |

### References


