

# Management of Oxygen Saturations in Preterm Infants

## 1. Introduction and who this guideline applies to:

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This guideline is aimed at all Health Care Professionals involved in the care of infants within the Neonatal Service.

### Key Points:

1. Large trials have demonstrated the importance of keeping oxygen saturations in preterm infants within defined limits (Appendix)
2. Target ranges for oxygen saturations are based on available evidence.
3. It is extremely important not to allow saturations of preterm babies receiving oxygen to rise inappropriately; as this is likely to cause an increase in the risk of Retinopathy of Prematurity (ROP) and other consequences of oxidative stress.
4. Alternative oxygen saturation targets and limits may be appropriate for certain clinical situations and specific conditions. The decision should be taken at consultant level and documented in the infants notes.

**Until 36 weeks corrected age, aim to maintain oxygen saturations in the**



**target range 91 - 96% by setting the alarm limits below:**

**<36 weeks of gestation and in oxygen:**



Lower saturation alarm limit: **90%**  
Higher saturation alarm limit: **96%**

**>36 weeks of gestation and in oxygen:**



Lower saturation alarm limit: **92%**  
Higher saturation alarm limit: **98%**

**For babies of any gestation being nursed in air,  
alarm limits may be increased to 100%**

## 2. Evidence summary

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Decades of research has been invested in attempting to deliver sufficient tissue oxygenation whilst avoiding potential harmful effects of oxidative stress in preterm infants. A number of randomised trials of oxygen saturation targets have been performed in preterm infants using pulse oximetry. Evidence from these trials forms the basis of the current recommendations.

The Supplemental Therapeutic Oxygen for Prethreshold Retinopathy of Prematurity (STOP-ROP) trial demonstrated that an oxygen target of between 96 to 99% (commenced in preterm infants at a mean corrected age of 35 weeks) was associated with greater morbidity (including greater risk of CLD and longer duration of hospitalisation) than a lower target range of 89 to 94% <sup>1</sup>.

The Benefits of Oxygen Saturation Targeting trial (BOOST) <sup>2</sup> studied oxygen saturation targets of 91 to 94% versus 95 to 98% in infants born <30 weeks of gestation who remained in oxygen after 3 weeks (32 weeks CGA). Targeting higher oxygen saturations prolonged oxygen use and increased length of hospital stay without any demonstrable improvement in growth or development. A number of compelling contemporaneous cohort studies suggested that lower oxygen saturation targets improved short term outcomes; however, effects on mortality and important longer term outcomes remained unknown.<sup>3,4</sup>

This prompted a number of large international trials, designed with similar protocols (NeOProM Collaborative Group <sup>3</sup>) comparing oxygen saturation targets between a higher oxygen saturation range (91 to 95%) and a lower oxygen saturation range (85 to 89%). Infants were born before 28 weeks' gestation and enrolled within 24 hours of birth. The primary outcome was a composite outcome of death and major disability at two years corrected age. A prospective meta-analysis was planned as part of the collaborative design. The trials included the Canadian Oxygen Trial [COT]<sup>5</sup>; Surfactant, Positive Pressure, and Pulse Oximetry Randomized Trial [SUPPORT]<sup>6</sup>; and Benefits of Oxygen Saturation Targeting trial [BOOST II]<sup>7</sup>. During the course of these trials, calibration software was revised because of an anomaly noted in the algorithm used for the pulse oximeters. The results of the meta-analysis (including a total of 4965 infants) were published in a 2017 Cochrane review <sup>8</sup> are summarised below:

### **Primary outcome:**

No significant difference in the composite primary outcome of death or major disability (typical RR 1.04, 95% confidence interval (CI) 0.98 to 1.10; typical RD 0.02, 95% CI -0.01 to 0.05; 5 trials, 4754 infants).

### **Secondary outcomes:**

Targeting the lower oxygen saturation range (below 90%) resulted in:

- A significant increase in death at 18 to 24 months corrected age associated with the lower target range (RR 1.16, 95% CI 1.03 to 1.31)

- A significant increase in necrotising enterocolitis associated with the lower target range (RR 1.24, 95% CI 1.05 to 1.47)
- A significant decrease in retinopathy of prematurity requiring treatment (typical RR 0.72, 95% CI 0.61 to 0.85)

**Other outcomes:**

There were no significant differences between the two treatment groups for major disability including blindness, severe hearing loss, cerebral palsy, or other important neonatal morbidities.

When subgroup analyses were performed comparing the original and revised calibration software, a significant difference in the treatment effect between the two groups was seen, with a significantly larger treatment effect seen for those infants using the revised algorithm (death by 18-24 months - typical RR 1.38, 95% CI 1.13 to 1.68; 3 trials, 1716 infants)<sup>8</sup>. Post-hoc unadjusted analysis of the BOOST-II study showed the low oxygen saturation group (85 to 89%) had higher rates of death than the high oxygen saturation group (91 to 95%) (21 versus 18 percent, RR 1.2, 95% CI 1.01-1.43); irrespective of the monitor algorithm<sup>9</sup>. Further post-hoc SUPPORT trial analyses showed SGA infants specifically had the highest mortality. Being most vulnerable to experiencing the lowest median oxygen saturations and more episodes of intermittent hypoxia in the early neonatal period.<sup>10</sup>

**Interpreting this into practice:**

Current National<sup>11</sup> and International<sup>12</sup> guidelines recommend saturations targets aligned to the higher oxygen saturation range of the NeOProm trials (avoid <90 % and >95%). Recommended alarm limits vary; except in suggesting tight control, minimising fluctuations and an upper limit of 95%.<sup>11-16</sup>

Pulse oximeters estimate arterial oxygen saturations (SaO<sub>2</sub>) within limits of accuracy (+/- 3%) that widen as the saturations (SpO<sub>2</sub>) fall below 93%.<sup>17</sup> Maintaining a tight oxygen saturation range is challenging;<sup>13-15</sup> adjusting FiO<sub>2</sub> in small increments or decrements can help avoid extreme fluctuations.

Our recommendation for oxygen saturation targeting for preterm infants is detailed in the figure above. Guidance is also given for term-corrected infants, but for those infants with other conditions, such as CLD, pulmonary hypertension and congenital heart disease the required oxygen saturation targets may need to be individualised.

**3. Education and Training**

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None

**4. Monitoring Compliance**

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None

## 5. Supporting References

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## 6. Key Words

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Pulse Oximetry, Retinopathy of Prematurity

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**The Trust recognises the diversity of the local community it serves. Our aim therefore is to provide a safe environment free from discrimination and treat all individuals fairly with dignity and appropriately according to their needs. As part of its development, this policy and its impact on equality have been reviewed and no detriment was identified.**

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Dec 2010	1		Interim Guidance (EMB)
Oct 2015	2	Author (EMB) Neonatal Guidelines Meeting Neonatal Governance Meeting	For further review in one year
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