# Percentage of Time in Oxygen Saturation Target Range in Extremely Preterm Infants Changes From Birth to 36 Weeks Postmenstrual Age

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## Background

- AAP on $SpO_2$
  - Almost all extremely premature infants require respiratory support to keep their oxygen saturations ($SpO_2$) in a specific target range
  - Despite numerous studies and meta-analyses, the optimal $SpO_2$ target range remains unknown
  - The AAP clinical report on oxygen targeting in extremely low birth weight infants proposes that the ideal physiologic target range for $SpO_2$ is likely patient specific, dynamic and may depend on various factors including gestational age and chronological age
- AVIOX I Study
  - In addition to uncertainty in the ideal oxygen saturation target range, there is a difference in intended $SpO_2$ range and achieved $SpO_2$ levels
  - The AVIOX I study showed that participating NICUs maintained infants within their intended target range between 16 to 64% of the time
  - Success in keeping babies in target range varied among NICUs, among patients within NICUs and among individual patients over time
- PMCH QI Project "Delivery Oxygen Gently"
  - To minimize oxygen toxicity in extremely preterm infants, the PMCH NICU introduced the "Deliver Oxygen Gently" QI project which aims for an $SpO_2$ target range of 89 - 94%
  - The most recent analysis of QI data from 2015 to 2017 showed that infants < 29 weeks were maintained in target range approximately 40% of the time
  - Percentage in target range was shown to differ between different gestational ages and modes of ventilatory support, but the postmenstrual age (PMA) of the infants was not taken into account

## Objectives

- Determine the percentage of time with $SpO_2$ in target range for extremely preterm infants born < 29 weeks
- Describe how the percentage of time with $SpO_2$ in target range changes from birth to 36 weeks PMA
- Explore the impact of gestational age at birth, postmenstrual age and respiratory support on the percentage of time with $SpO_2$ in target range

## Methods

- This longitudinal, observational cohort study included eligible infants admitted to the PMCH NICU between 12/2019 and 01/2021
- Enrolled infants were divided into 3 gestational age groups: 22-24, 25-26 and 27-28 weeks
- Preterm infants with major cardiac or pulmonary anomalies, who are not able to meet the standard $SpO_2$ target range of 89 to 94% and infants with limited resuscitation status were excluded
- The percentage of a 24-hour period an infant spent above, in and below the $SpO_2$ target range was documented daily from a bedside Masimo pulse oximeter
- Recordings during the first week after birth were compared to recordings on day of life (DOL) 28 and at 36 weeks PMA. The mode of respiratory support for these time periods was also documented
- Maternal and neonatal data was collected from the electronic medical record (Neodata and Allscripts Sunrise Enterprise)
- The St. Vincent IRB determined that this study met criteria for exempt classification
- 402 24-hour period recordings from 64 infants were included in this analysis
- Analysis was performed with Google Sheets and an online statistics calculator

## Maternal Data

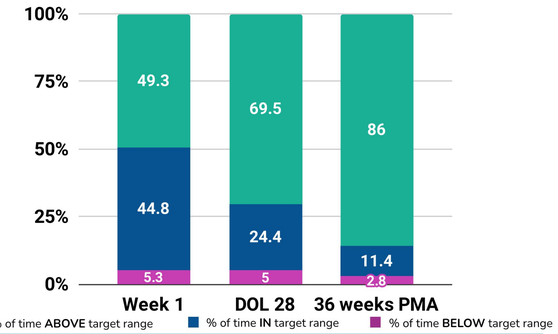
| | |
|---|---|
| Maternal age (years) * | 30 (23; 33) |
| Maternal hypertensive disorder (%) | 17 (26.6) |
| Preterm labor (%) | 45 (70.3) |
| Ruptures of membranes prior to delivery (hrs) * | 0 (0; 86) |
| Antenatal magnesium therapy (%) | 50 (78.1) |
| Antenatal steroid therapy (%) | 59 (92.2) |
| Delivered by cesarean section (%) | 45 (70.3) |
| Delayed cord clamping performed at delivery (%) | 40 (62.5) |
| * Median ($25^{th}$; $75^{th}$ percentile) | |

## Neonatal Data

| | |
|---|---|
| Gestational age at birth (weeks) * | 27.1 (25.9; 28.1) |
| Birth weight (grams) * | 985 (755; 1170) |
| Male gender (%) | 31 (48.4) |
| Singleton (%) | 45 (70.3) |
| Small for gestational age (%) | 8 (12.7) |
| Apgar score at 1 minute * | 3 (1.8; 6) |
| Apgar score at 5 minutes * | 6.5 (5; 8) |
| Received surfactant in the delivery room (%) | 34 (54.1) |
| * Median ($25^{th}$; $75^{th}$ percentile) | |

## Results: All Infants

- The median proportion of time in $SpO_2$ target range decreased significantly from 44.8% in the first week to 24.4% at DOL 28 (p=0.00187) to 11.4% at 36 weeks PMA (p<0.00001) for all gestational age groups
- In contrast, median % of time above target range increased from 49.3% to 69.5% (p=0.07) to 86% (p<0.00001)
- Median time below target range decreased from 5.3% to 5% (p=0.1123) to 2.8% (p=0.027)




## Results: Different Gestational Age Groups

- In 22-24 week infants, the % of time in and below target range decreased significantly from 66% to 27.7% (p=0.00914) and 14% to 2.4% (p=0.03144) from Week 1 to 36 weeks PMA, while the % time above target range increased from 15.3 to 71% (p=0.00326)
- Although the median proportion of time below target range in 25-26 week infants decreased from 8.9% to 4.6% at 36 weeks PMA (p=0.05262), it first increased to 21.5% at DOL 28 (p=0.04457)

## Results: Different Modes of Respiratory Support

- % of time in target range was highest (61.5%) in infants receiving invasive respiratory support during Week 1 and decreased to 43.2% at DOL 28 (p=0.00122)
- % of time below target range increased to 26.2% on DOL 28 from 14% in Week 1 (p=0.0057)
- In infants receiving noninvasive respiratory support, % time in and above target range did not change but % time below target range increased from Week 1 (1.6%) to 3.8% on DOL 28 (p=0.00169) and 4.6% at 36 weeks PMA (p=0.00114)

## Discussion

- For all infants in this study, time in target range decreased from birth to 36 weeks PMA, while time above target range increased
- Time spent below target range decreased by 36 weeks PMA for all infants except those born between 27-28 weeks for whom there was no change
- Interestingly, the % time below target range increased for infants 25-26 weeks and for infants receiving invasive or noninvasive respiratory support from Week 1 to DOL 28
- The observation of increased time spent below target range at DOL 28 is concerning and warrants further investigation, but research suggests that the number of episodes with hypoxemia increase during the first weeks after birth with a peak between DOL 28 to 35

## Conclusions

- Our results show that the percentage of time in $SpO_2$ target range is dynamic and depends on various factors including gestational age at birth, postmenstrual age and mode of respiratory support
- Our data provides guidance on achievable % time in target range for infants of different gestational ages who are at different postmenstrual ages and on different modes of respiratory support

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