CPAP and NHF in neonatal intensive care

An overview of current neonatal literature and practices globally

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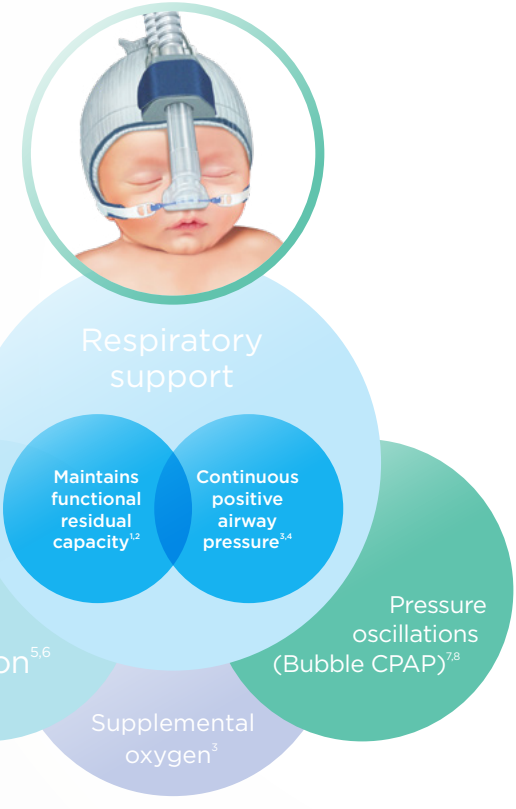
Mechanisms of action and key benefits of CPAP and NHF

The patterns of respiratory support in neonatal critical care are changing, with an increasing number of neonates being managed with noninvasive therapies.

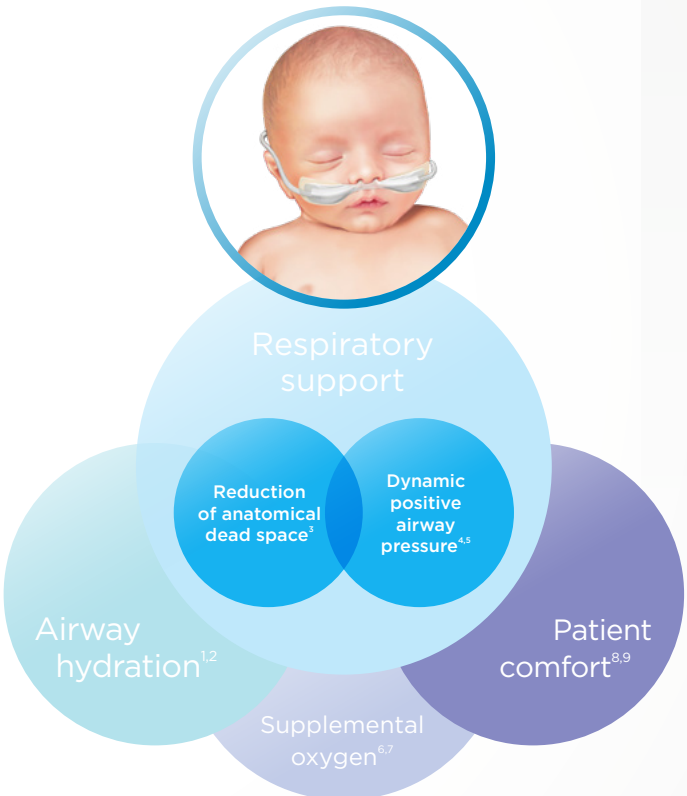
Continuous positive airway pressure (CPAP) and nasal high flow (NHF) are prevalent in the body of literature describing modes of noninvasive respiratory support.

CPAP



1. Magnenant, E. et al. Pediatr. Pulmonol. 37, 485–491 (2004).
2. Bhutani, V. K. Manual of Neonatal Respiratory Care 3–15 (Springer US, 2012).
3. Gupta, S. & Donn, S. M. Semin. Fetal Neonatal Med. 21, 204–211 (2016).
4. Courtney, S. E. & Barrington, K. J. Clin. Perinatol. 34, 73–92, vi (2007).
5. Pollett H.F., Reid W.D. Can Anaesth Soc J. 24(5): 615-617 (1997).
6. de Klerk, A. In: Physiology of Humidification in Critically Ill Neonates. Springer Berlin Heidelberg (2012).
7. Lee, K. S. et al Biol. Neonate 73, 69–75 (1998).
8. Hough, J. L. et al. Pediatr. Crit. Care Med. 13, 446–451 (2012).

NHF



While there is an overlap in the key mechanisms delivered by pressure-based and flow-based therapies, the primary mechanism of each therapy is different. This is important to consider when deciding choice of therapy:

NHF

When adequate flow is delivered on NHF (meeting or exceeding peak inspiratory demand), reducing anatomical dead space is the key mechanism.

CPAP

When delivering CPAP, the continuous distending pressure helps to establish and maintain functional residual capacity (FRC).

1. ten Brink, F. et al. Pediatri Crit Care Med. 14, e326-31 (2013).
2. Woodhead, D. D. et al. J Perinatol. 26, 481-5 (2006).
3. de Klerk, A. Adv. Neonatal Care. 8, 98–106 (2008).
4. Saslow, J. et al. J Perinatol. 26, 476-80 (2006).
5. Milési, C. et al. Intensive Care Med. 39, 1088-1094 (2013).
6. Hough, J. et al. Pediatr Crit Care Med. 15, e214-9 (2014).
7. Sinha, I. et al. Chest. 148, 810–823 (2015).
8. Collins, C. L. et al. Eur J Pediatr. 173, 181–186 (2014).
9. Roberts, C. et al. N Engl J Med. 375, 1142–51 (2016).

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Evidence based guidance supporting the use of CPAP and NHF

The following information collates data from published literature. The body of evidence suggests that CPAP continues to be the standard of care in neonates <28 weeks gestational age (GA). There is also evidence to support the introduction of NHF (with rescue CPAP available) in the care of neonates ≥ 28 weeks GA.

< 28 weeks GA

POSTEXTUBATION SUPPORT [1-6]	**CPAP** CPAP continues to be the standard of care, however, NHF may be considered once infants are stable.
PROLONGED CPAP [1,7,8]	**CPAP** CPAP continues to be the standard of care, however, NHF may be considered once infants are stable.
PRIMARY RESPIRATORY SUPPORT [1,9-12]	**CPAP** CPAP continues to be the standard care and is used routinely as an alternative to invasive mechanical ventilation. There is emerging data describing the use of NHF in this population.

Disclaimer: Clinical judgement is necessary to assess the appropriate treatment for an individual patient. The use of NHF therapy is not typically supported for infants with extreme prematurity, severe respiratory distress syndrome, or untreated surfactant deficiency.

1. Wilkinson, D. et al. Cochrane database Syst. Rev. 2, CD006405 (2016).
2. Campbell, D. M. et al. J of Peds. 26, 546 (2006).
3. Yoder, B. et al. Pediatrics. 131, e1482-90 (2013).
4. Manley, B. et al. N Engl J Med. 369, 1425–33 (2013).
5. Collins, C. L. et al. J Pediatr. 162, 949–54.e1 (2013).
6. Liu et al. J of Peds. 52, 271-6 (2014)
7. Yoder, B.A. et al. J of Perinat. 37, 809 (2017)
8. Roehr, C.C. et al. Cli in Perinat. 43, 693-705 (2016)

≥ 28 weeks GA	Evidence
NHF + Rescue CPAP The use of NHF as an alternative to CPAP is associated with no difference in the rate of treatment failure, reintubation, and adverse outcomes (such as death, BPD and pneumothorax) and significantly less nasal trauma.	✓ **STRONG SUPPORT** e.g. Cochrane Review
CPAP, then NHF once stable at the clinician's discretion[4] The use of NHF as an alternative to prolonged CPAP may be considered once infants are stable. The benefits of NHF for older preterm infants are demonstrated in the body of literature.	✓ **STRONG SUPPORT** e.g. consensus of published expert opinion
CPAP or NHF + Rescue CPAP Emerging evidence suggests that the use of NHF (with rescue CPAP available) may be considered once infants are stable, with no significant difference to intubation rates. The benefits of NHF for older preterm infants are demonstrated in the body of literature.	✓ **GENERAL SUPPORT** e.g. emerging RCT data and consensus of published expert opinion

9. Lavizzari, A. et al. JAMA Pediatrics. (2016)
10. Murki, S. et al. Neonatology. 113, 235-241 (2018)
11. Roberts, C.T. et al. N Engl J Med. 375, 1142-1151 (2016)
12. Manley, B.J. et al. N Engl J Med. 380 (2019)

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CPAP and NHF for postextubation support in neonates ≥ 28 weeks GA

High flow nasal cannula for respiratory support in preterm infants.

Cochrane Review[1] Wilkinson et al. 2016.

Data from six post-extubation RCTs was analyzed to assess the efficacy and safety of NHF:

Manley et al. 2013 (Australia)[2]

N Engl J Med.

- → 303 infants < 32 weeks GA
- → Primary outcome: Treatment failure within 7 days
- → Result: NHF was non-inferior to CPAP (Risk difference: 8.5%, margin of non-inferiority: 20%)

Collins et al. 2013 (Australia)[5]

J Pediatr.

- → 132 infants < 32 weeks GA
- → Primary outcome: Treatment failure within 7 days
- → Result: No statistically significant difference between CPAP and NHF.

Campbell et al. 2006 (USA)[3]

J Perinatol.

- → 40 infants ≤ 1250 g at birth
- → Primary outcome: Need for intubation within 7 days
- → Result: Statistically significant difference favoring CPAP compared with NHF.

Mostafa – Gharehbahgi et al. 2015 (Iran)[6]

Zahedan J Res Med Sci.

- → 85 infants 1250-2000 g at birth
- → Primary outcome: Treatment failure within 3 days
- → Result: No statistically significant difference between CPAP and NHF.

Liu et al. 2016 (China)[4]

Chinese J Pediatr.

- → 256 infants 150 preterm < 7 days old
- → Primary outcome: Treatment failure within 7 days.
- → Result: No statistically significant difference between CPAP and NHF.

Yoder et al. 2013 (USA & China)[7]

Pediatrics.

- → 432 infants (226 in post-extubation arm)
- → Primary outcome: Need for intubation within 3 days
- → Result: No statistically significant difference between CPAP and NHF.

1. Wilkinson, D. et al. Cochrane database Syst. Rev. 2, CD006405 (2016).
2. Manley, B. et al. N Engl J Med. 369, 1425–33 (2013).
3. Campbell, D. M. et al. J of Peds. 26, 546 (2006).
4. Liu et al. J of Peds. 52, 271-6 (2014)
5. Collins, C. L. et al. J Pediatr. 162, 949–54.e1 (2013).
6. Mostafa-Gharehbaghi et al. Zahedan J Res Med Sci. 17 (2015)
7. Yoder, B. et al. Pediatrics. 131, e1482-90 (2013).

The Cochrane Review[1] found that compared with CPAP, the use of NHF for postextubation is associated with:

No statistically significant difference in rate of treatment failure	Typical relative risk: 1.21, 95% CI 0.95 to 1.55 Data from 5 studies, 786 neonates
No statistically significant difference in rate of reintubation	Typical relative risk: 0.91, 95% CI 0.68 to 1.20 Data from 6 studies, 934 neonates
No statistically significant difference in adverse outcomes i.e. pneumothorax	Typical relative risk: 0.35, 95% CI 0.11 to 1.06 Data from 5 studies, 896 neonates
Significant reduction in rates of nasal trauma	Typical relative risk: 0.64, 95% CI 0.51 to 0.79 Typical risk difference: -0.14, 95% CI -0.20 to -0.08 Data from 4 studies, 645 neonates

1. Wilkinson, D. et al. Cochrane database Syst. Rev. 2, CD006405 (2016).

Cochrane Reviews are internationally recognized as the highest standard in evidence-based health care. All the existing primary research on a topic is collated to establish whether or not there is a conclusive evidence about a specific treatment. (Cochrane Collaboration, 2076)

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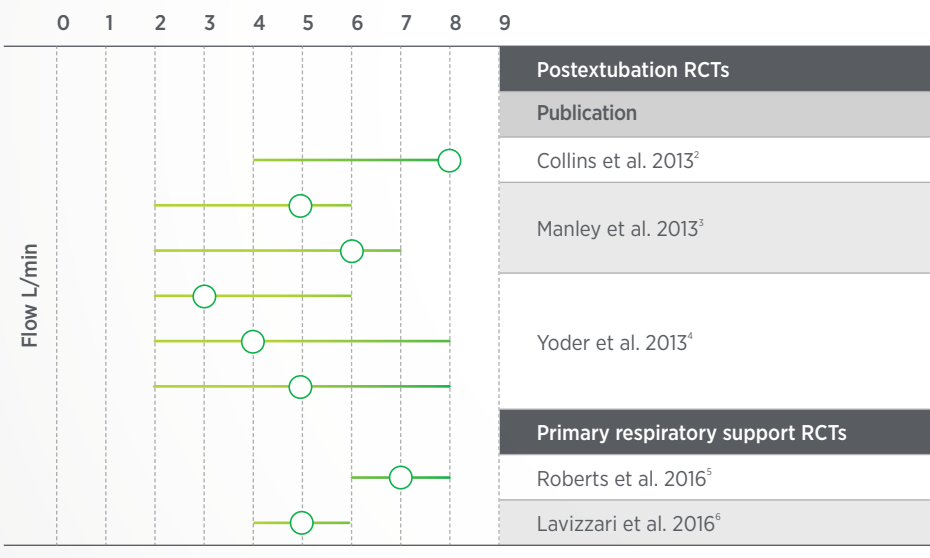
An overview of key evidence: Flow rates on NHF and pressure settings

To achieve similar clinical outcomes as described in the Cochrane Review[1], it is important to consider how much flow is sufficient to provide the physiological benefits associated with NHF.

Setting Flow (NHF)

Results from the Cochrane Review demonstrate that adequate starting flow rates provide physiological and clinical benefits. Data from RCTs and guidance from leading experts suggests that NHF can be initiated between 4-6 L/min:

RCTs investigating NHF & CPAP: Comparison of flow rates and pressure settings



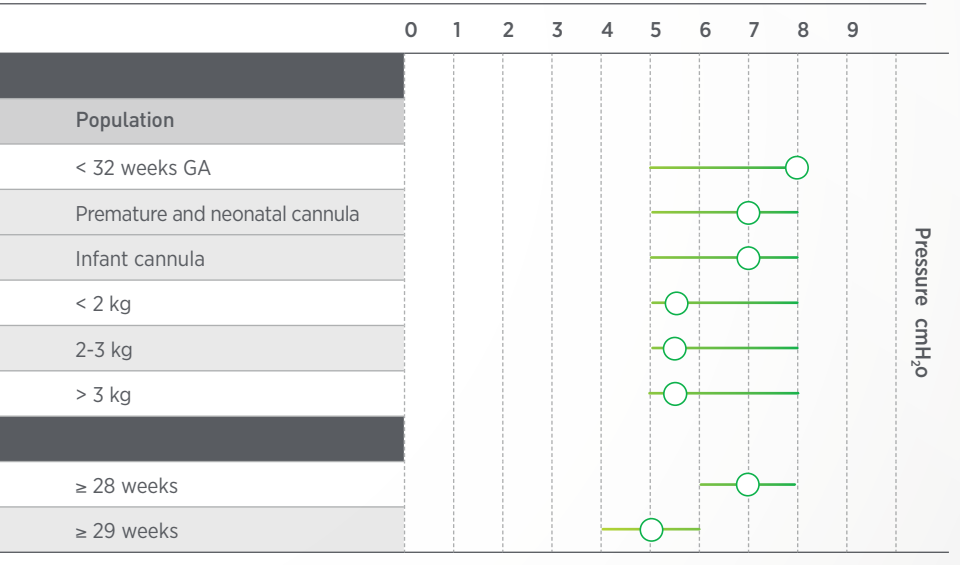
RCT: Randomized Controlled Trial

1. Wilkinson, D. et al. Cochrane database Syst. Rev. 2, CD006405 (2016).
2. Collins, C. L. et al. J Pediatr. 162, 949–54.e1 (2013).
3. Manley, B. et al. N Engl J Med. 369, 1425–33 (2013).
4. Yoder, B. et al. Pediatrics. 131, e1482-90 (2013)
5. Roberts, C.T. et al. N Engl J Med. 375, 1142-1151 (2016).
6. Lavizzari, A. et al. JAMA Pediatrics. (2016)

on CPAP

Setting Pressure (CPAP)

Data from RCTs demonstrates that CPAP is typically initiated between 5-7 cmH_2O:



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CPAP and NHF: A comparison of setup and interface design

CPAP

CPAP therapy is typically delivered using a dual limb circuit and, often a bubble generator.

Key characteristics of an interface designed to deliver pressure are:

Sealed interface

Prescribe pressure

Larger tubes lower resistance to flow

NHF

NHF therapy is typically delivered using a single-limb circuit. Flow range is dependent on the flow driver/platform used.

Key characteristics of an interface designed to deliver flow are:

- Unsealed interface
- Prescribe flow
- Narrower tubes (compared to CPAP) increase resistance to flow

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F&P FlexiTrunk

F&P Optiflow Junior 2

For more information about CPAP or NHF, please contact your local representative or scan the QR Code to request a sample.

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