

Nasal High Flow Therapy

Effective. Gentle. Easy.



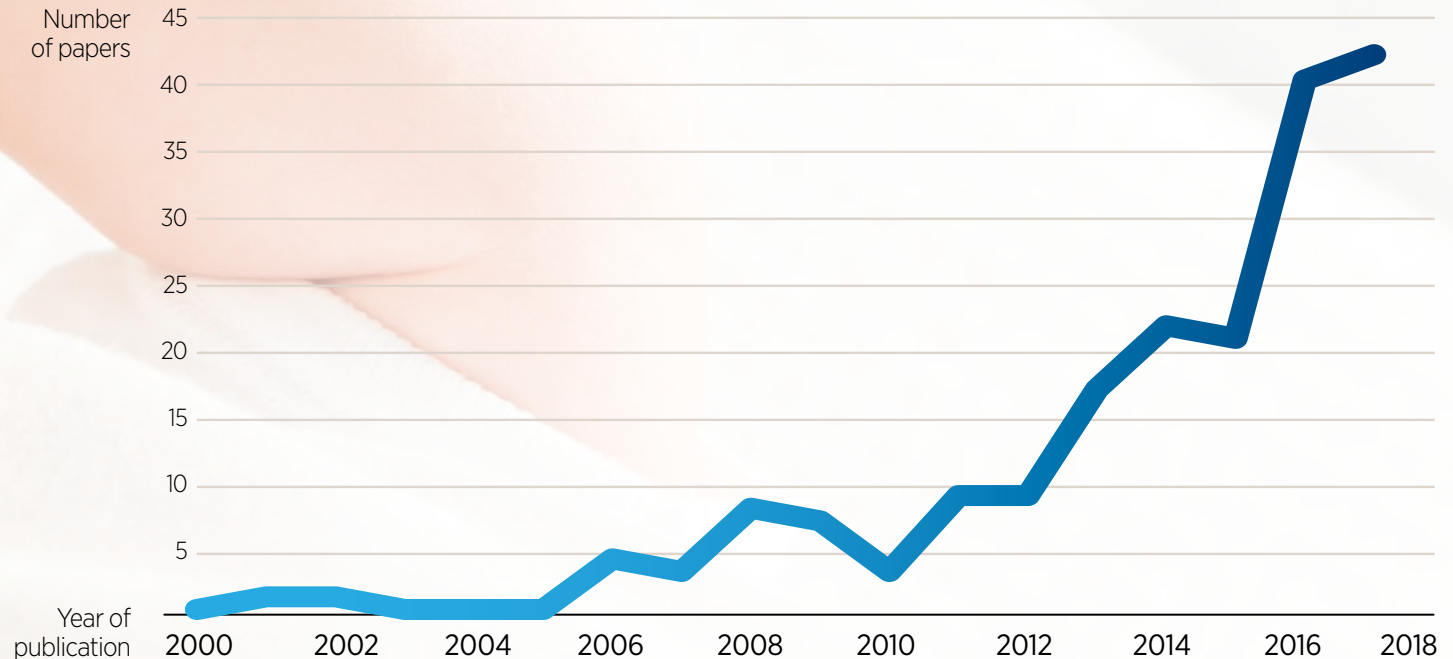
NASAL HIGH FLOW **DEFINITION:**¹⁻³

Delivery of heated and humidified blended oxygen at optimal flow rates directly into the nares via a non-sealing nasal cannula.



Increasing evidence supporting the use of nasal high flow therapy in neonates

Nasal high flow publications - neonatal and pediatric



>140 PUBLICATIONS

>10 RANDOMIZED CONTROLLED TRIALS
IN THE NEONATAL POPULATION

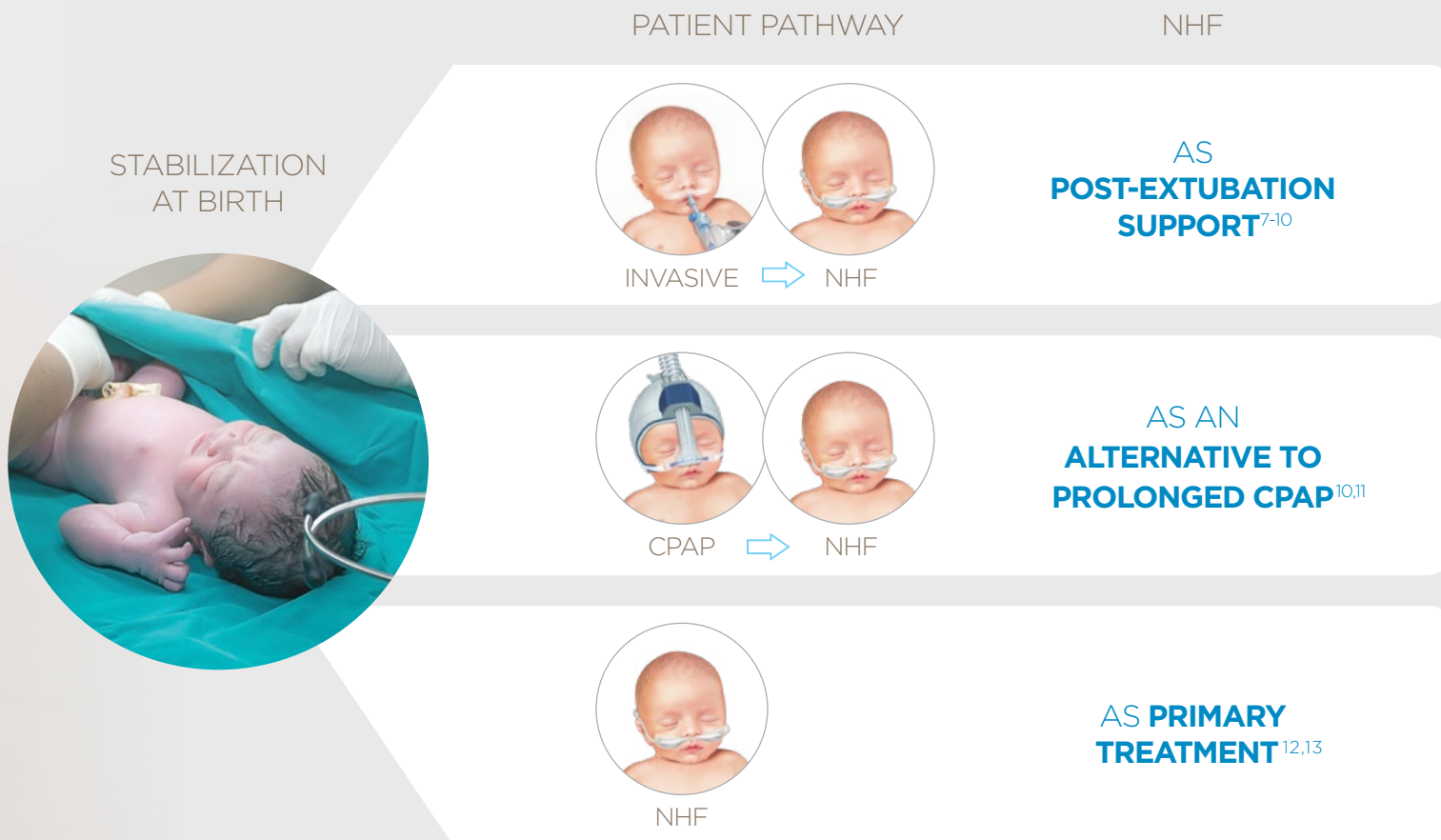
Evidence-based applications for nasal high flow

Nasal high flow (NHF) can be used to support the neonatal patient pathway through the hospital.¹⁻³

The need to avoid more invasive therapies, along with an increasing evidence base for NHF, is driving clinical practice change.⁴⁻⁶



There are three approaches to integrating NHF in the neonatal patient pathway that have been identified in the literature:



Clinical judgement is necessary to assess the appropriate treatment for an individual patient.

Supporting babies on NHF for **post-extubation care**



INVASIVE



NHF

For infants ≥ 28 weeks gestational age, there is well-established evidence supporting the use of NHF for post-extubation care.

Manley et al. 2013¹

N Engl J Med.

- 303 infants
- Single center in Australia
- Primary outcome: Treatment failure within 7 days

Collins et al. 2013²

J Pediatr.

- 132 infants
- Single center in Australia
- Primary outcome: Treatment failure within 7 days

Yoder et al. 2013³

Pediatrics

- 432 infants (226 in post-extubation arm)
- 4 centers in USA, 1 center in China
- Primary outcome: Need for intubation within 72 hours

Wilkinson et al. 2016⁴

Cochrane Database Syst Rev.

- Includes data analysis of a subset of six post-extubation RCTs

A Cochrane Review by Wilkinson et al.⁴ found that compared to CPAP, the use of NHF in infants ≥ 28 weeks gestational age is associated with:

- **NO DIFFERENCE**
in rate of **treatment failure**
- **NO DIFFERENCE**
in rate of **re-intubation**
- **SIGNIFICANT REDUCTION**
in rate of **nasal trauma**
- **NO DIFFERENCE**
in rates of **other adverse outcomes**
such as death, pneumothorax, or bronchopulmonary dysplasia



NHF for post-extubation care



GESTATIONAL
AGE (WEEKS):

23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

< 28 weeks GA

CPAP first ⁴

Limited data and insufficient evidence
to change clinical practice

Consider NHF once stable to:

- Reduce nasal trauma and head molding^{5,6}
- Facilitate developmental care⁵

> 28 weeks GA

NHF + Rescue CPAP^{4,5,6}

Consider CPAP as a
“rescue therapy” if required

Supporting babies on NHF as an **alternative to prolonged CPAP**



CPAP



NHF

More than 25 leading NHF researchers have contributed to two consensus publications.

These publications provide guidance on how to use NHF therapy in the NICU.

CONSENSUS: Roehr CC et al. 2016¹

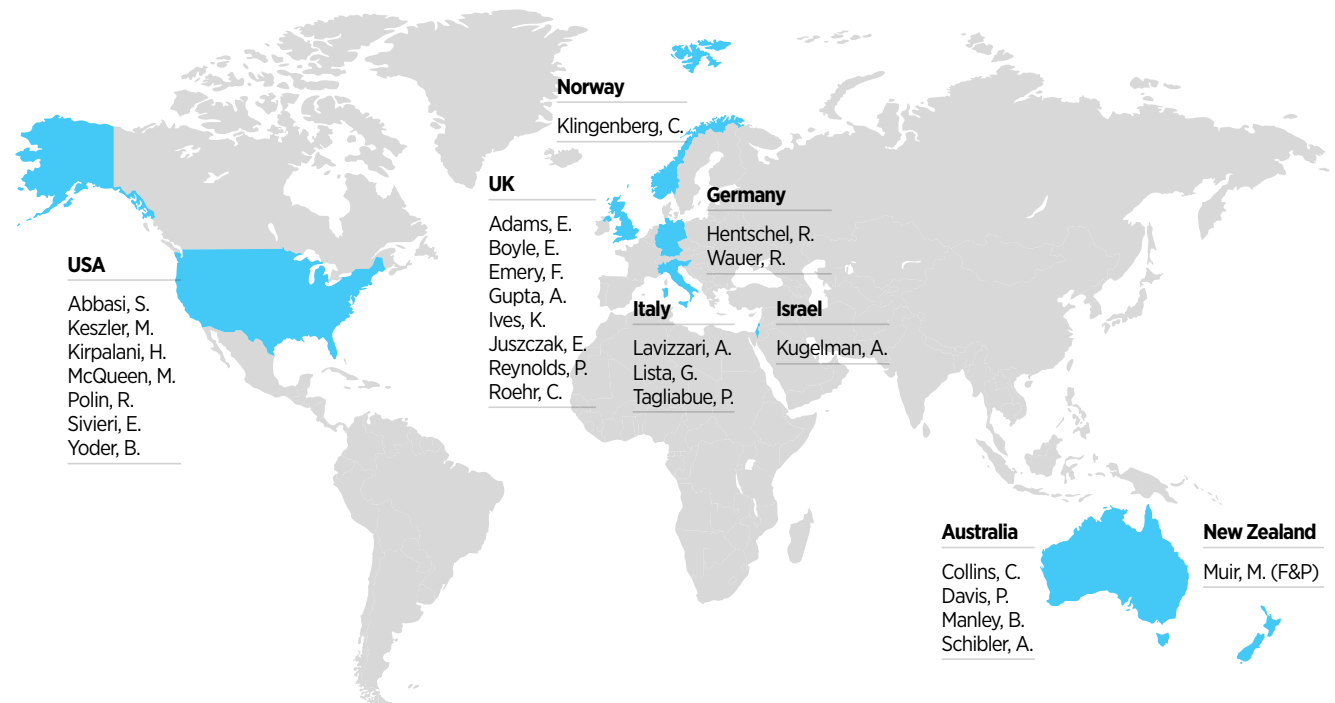
Clin Perinatol.

Evidence support and guidelines for using heated, humidified, high-flow nasal cannulae in neonatology: Oxford nasal high-flow therapy meeting, 2015.

CONSENSUS: Yoder BA et al. 2017²

J Perinatol.

Consensus approach to nasal high-flow therapy in neonates.



Expert consensus indicates that for infants who require prolonged periods of noninvasive ventilation, NHF is a suitable alternative to CPAP.^{1,2}

NHF as an alternative to prolonged CPAP



GESTATIONAL
AGE (WEEKS):

23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

CPAP

Once infants are stable on CPAP, NHF can be considered as an alternative noninvasive therapy at the clinician's discretion.²

Supporting babies on NHF as **primary treatment**



CPAP

OR

NHF

There is emerging evidence comparing the safety and efficacy of NHF vs. CPAP for initial respiratory support, in infants ≥ 28 weeks gestational age.

Roberts et al. 2016¹

N Engl J Med.

- 564 infants
- 4 centers in Australia, 5 centers in Norway
- Primary outcome: Treatment failure within 72 hours

Lavizzari et al. 2016²

JAMA Pediatr.

- 316 infants
- Single center in Italy
- Primary outcome: Intubation and mechanical ventilation within 72 hours

Yoder et al. 2013³

Pediatrics

- 432 infants (125 in primary treatment arm)
- 4 centers in USA, 1 center in China
- Primary outcome: Need for intubation within 72 hours

Shin et al. 2017⁴

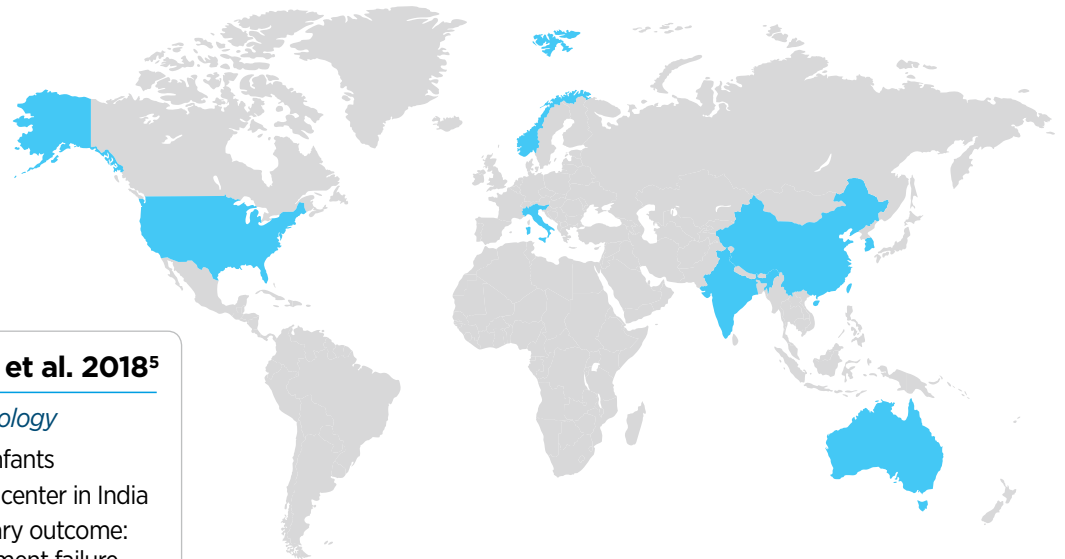
J Korean Med Sci.

- 85 infants
- Single center in Korea
- Primary outcome: Treatment failure

Murki et al. 2018⁵

Neonatology

- 272 infants
- Multi-center in India
- Primary outcome: Treatment failure within 72 hours



NHF or CPAP for primary respiratory support



GESTATIONAL
AGE (WEEKS):

23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

< 28 weeks GA

CPAP first

Limited data and insufficient evidence to change clinical practice

Consider NHF once stable to:

- Reduce nasal trauma and head molding^{6,7}
- Facilitate developmental care⁶

≥ 28-32 weeks GA

CPAP OR NHF +
Rescue CPAP

Expect ~80% to avoid the need for intubation¹

Expect ~70% to avoid the need for “rescue” CPAP^{1,7}

≥ 32 weeks GA

CPAP OR NHF +
Rescue CPAP

Expect ~90% to avoid the need for intubation¹

Expect ~80% to avoid the need for “rescue” CPAP^{1,7}

Infants ≥ 28 weeks GA can be treated with either NHF or CPAP first, with no significant difference to intubation rates; however “Rescue” CPAP should be made available at all times.

What are the benefits of NHF therapy?

The growing momentum of NHF stems from these therapy attributes:



Effective

- Clinical evidence suggests that NHF has a similar efficacy and safety to CPAP therapy when used for infants ≥ 28 weeks gestational age¹⁻⁵
- “Rescue” CPAP should be available



Gentle

Compared to CPAP, NHF therapy has been shown to result in:

- Significantly lower rates of nasal trauma^{1,2,5}
- No significant difference in adverse outcomes^{1,4,5}
- Better mother-infant bonding^{6,7}
- Improved comfort, tolerance, and patient satisfaction^{6,8-11}




Easy

Surveys of practice describe the benefits of NHF as:

- Easier application and ongoing care^{1,2,5}
- Parents have confidence to play a greater role in the infant's care^{6,7}
- Improved caregiver satisfaction¹²

How does NHF therapy work?



In addition to the benefit of humidification which is essential to protect the delicate lungs of a neonate, there are several mechanisms of action associated with NHF therapy:

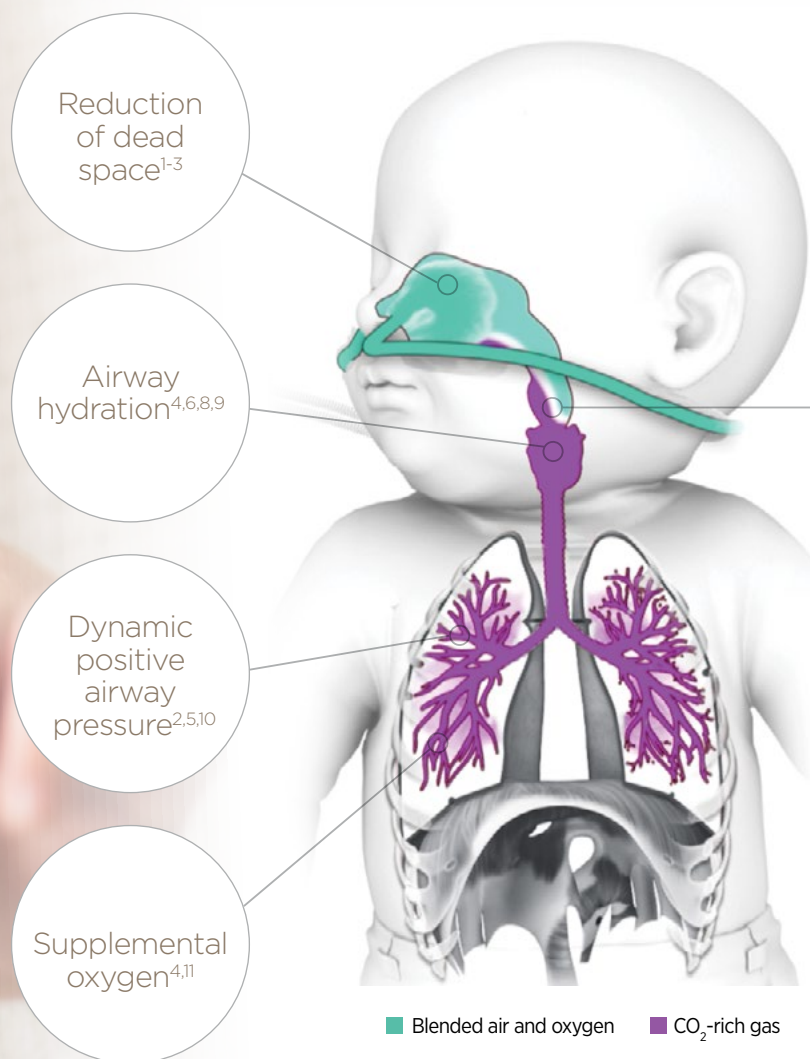
- **Reduction of dead space¹⁻³**

Reduces re-breathing of gas with high CO₂ and depleted O₂, which promotes gas exchange.

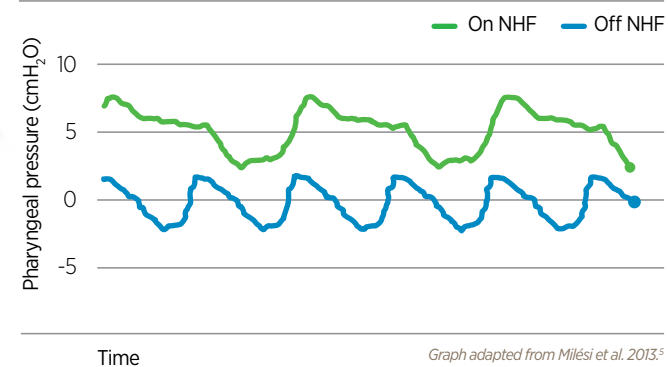
- **Dynamic positive airway pressure⁴⁻⁷**

Reduces inspiratory effort and work of breathing, which promotes slow and deep breathing.

Mechanisms of action



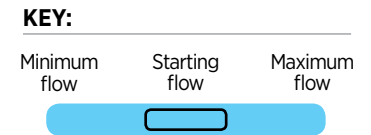
Pharyngeal pressures on and off NHF





Setting flow rates

Guidance from the neonatal literature and expert consensus indicates that flows can be used in the following manner:



		Flow rate (L/min)									
Publication		1	2	3	4	5	6	7	8	9	10
POST-EXTUBATION	Collins et al. 2013 ¹										
	< 32 weeks GA										
	Manley et al. 2013 ²										
	Premature and neonatal cannula										
	Infant, intermediate infant cannula										
	Pediatric cannula										
	Yoder et al. 2013 ³										
	< 2 kg										
	2-3 kg										
PRIMARY SUPPORT	Roberts et al. 2017 ⁴										
	≥ 28 weeks GA										
	Lavizzari et al. 2016 ⁵										
	≥ 29 weeks GA										

* Optiflow Junior cannula was used in this trial. The corresponding Optiflow Junior 2 cannula sizes are:
Premature size = S size OJ2, Neonatal size = M size OJ2, Infant size = L size OJ2, and Pediatric size = XL size OJ2.

Managing pressure on NHF



Prong-to-nare ratio

Sivieri et al. 2012¹ demonstrated the importance of prong-to-nare ratio as a key safety feature.

Sizing to approx. half the nare limits the possibility of harmful pressure.^{1,3,5}

Use of the pressure relief valve is also mandated.^{1,4}



Similar to CPAP

The evidence from > 8 RCTs, which included nearly 2,500 babies, suggests that NHF is associated with a similar risk of barotrauma compared to CPAP.⁴⁻⁸



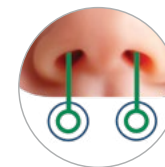
Pressure relief valve

This valve is designed to allow flow and pressure to vent from the circuit in case of the unlikely scenario where the prongs completely occlude the nares and the mouth is held closed.^{1,9}



Open system

Patients can vent flow and pressure around the cannula. In addition, patients can open their mouths.⁹

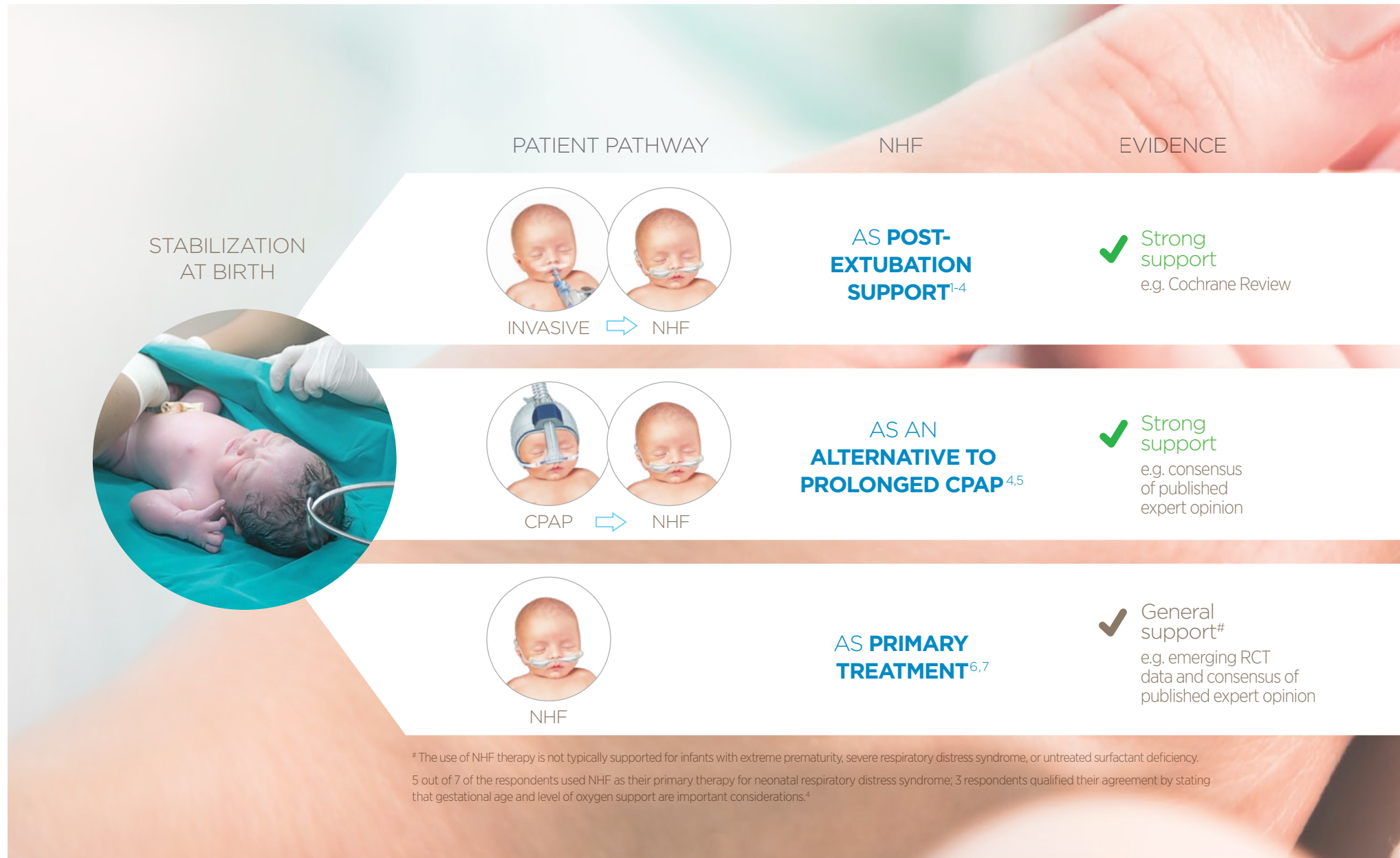


Pressures are typically low

Pressures generated with NHF are typically between 2 and 5 cmH₂O.^{1,10,11}



Evidence-based guidance supporting the use of NHF therapy in neonates



	< 28 weeks GA	≥ 28-32 weeks GA	≥ 32 weeks GA
NHF AS POST-EXTUBATION SUPPORT	CPAP	NHF + Rescue CPAP	
NHF AS AN ALTERNATIVE TO PROLONGED CPAP	CPAP	CPAP, then NHF once stable at the clinician's discretion ⁴	
NHF AS PRIMARY TREATMENT	CPAP	CPAP OR NHF + Rescue CPAP	NHF + Rescue CPAP

Clinical judgement is necessary to assess the appropriate treatment for an individual patient.

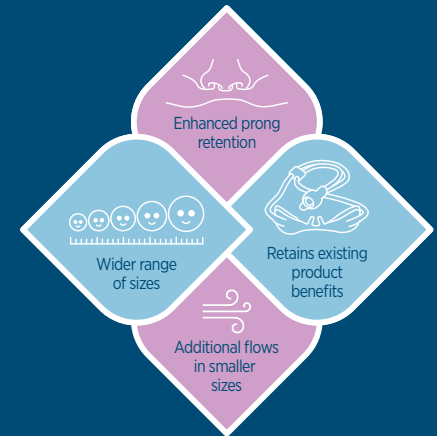
References

- Chidekel, A., Zhu, Y., Wang, J., Mosko, J., Rodriguez, E., & Shaffer, T. (2012). The effects of gas humidification with high-flow nasal cannula on cultured human airway epithelial cells. *Pulm Med*, 2012, 380686. <https://doi.org/10.1155/2012/380686>
- Collins, C., Holberton, J., Barfield, C., & Davis, P. (2013). A randomized controlled trial to compare heated humidified high-flow nasal cannulae with nasal continuous positive airway pressure postextubation in premature infants. *J Pediatr*, 162(5), 949–54.e1. <https://doi.org/10.1016/j.jpeds.2012.11.016>
- Dysart, K., Miller, T., Wolfson, M., & Shaffer, T. (2009). Research in high flow therapy: mechanisms of action. *Respir Med*, 103(10), 1400–1405. <https://doi.org/10.1016/j.rmed.2009.04.007>
- Franklin, D., Babl, F., Schlapbach, L., Oakley, E., Craig, S., Neutze, J., ... Schibler, A. (2018). A randomized trial of high-flow oxygen therapy in infants with bronchiolitis. *N Engl J Med*, 378(12), 1121–1131. <https://doi.org/10.1056/NEJMoA1714855>
- Frizzola, M., Miller, T., Rodriguez, M., Zhu, Y., Rojas, J., Hesele, A., ... Dysart, K. (2011). High-flow nasal cannula: impact on oxygenation and ventilation in an acute lung injury model. *Pediatr Pulmonol*, 46(1), 67–74. <https://doi.org/10.1002/ppul.21326>
- Hough, J., Shearman, A., Jardine, L., & Davies, M. (2012). Humidified high flow nasal cannulae: current practice in Australasian nurseries, a survey. *J Paediatr Child Health*, 48(2), 106–113. <https://doi.org/10.1111/j.1440-1754.2011.02070.x>
- Kepreotes, E., Whitehead, B., Attia, J., Oldmeadow, C., Collison, A., Searles, A., ... Mattes, J. (2017). High-flow warm humidified oxygen versus standard low-flow nasal cannula oxygen for moderate bronchiolitis (HFWHO RCT): an open, phase 4, randomised controlled trial. *Lancet*, 389(10072), 930–939. [https://doi.org/10.1016/S0140-6736\(17\)30061-2](https://doi.org/10.1016/S0140-6736(17)30061-2)
- Klingenberg, C., Pettersen, M., Hansen, E., Gustavsen, L., Dahl, I., Leknessund, A., ... Nordhov, M. (2014). Patient comfort during treatment with heated humidified high flow nasal cannulae versus nasal continuous positive airway pressure: a randomised cross-over trial. *Arch Dis Child Fetal Neonatal Ed*, 99(2), F134–7. <https://doi.org/10.1136/archdischild-2013-304525>
- Kotecha, S., Adappa, R., Gupta, N., Watkins, W., Kotecha, S., & Chakraborty, M. (2015). Safety and efficacy of high-flow nasal cannula therapy in preterm infants: a meta-analysis. *Pediatrics*, 136(3), 542–553. <https://doi.org/10.1542/peds.2015-0738>
- Lavizzari, A., Colnaghi, M., Ciuffini, F., Veneroni, C., Musumeci, S., Cortinovis, I., & Mosca, F. (2016). Heated, humidified high-flow nasal cannula vs. nasal continuous positive airway pressure for respiratory distress syndrome of prematurity: a randomized clinical noninferiority trial. *JAMA Pediatr*. <https://doi.org/10.1001/jamapediatrics.2016.1243>
- Manley, B. (2016). Nasal High-Flow Therapy for Preterm Infants: Review of Neonatal Trial Data. *Clin Perinatol*, 43(4), 673–691. <https://doi.org/10.1016/j.clp.2016.07.005>
- Manley, B., Owen, L., Doyle, L., Andersen, C., Cartwright, D., Pritchard, M., ... Davis, P. (2013). High-flow nasal cannulae in very preterm infants after extubation. *N Engl J Med*, 369(15), 1425–1433. <https://doi.org/10.1056/NEJMoA1300071>
- Mayfield, S., Bogossian, F., O'Malley, L., & Schibler, A. (2014). High-flow nasal cannula oxygen therapy for infants with bronchiolitis: pilot study. *J Paediatr Child Health*, 50(5), 373–378. <https://doi.org/10.1111/jpc.12509>
- Milési, C., Baleine, J., Matecki, S., Durand, S., Combes, C., Novais, A., & Cambonie, G. (2013). Is treatment with a high flow nasal cannula effective in acute viral bronchiolitis? A physiologic study. *Intensive Care Med*, 39(6), 1088–1094. <https://doi.org/10.1007/s00134-013-2879-y>
- Milesi, C., Boubal, M., Jacquot, A., Baleine, J., Durand, S., Odena, M., & Cambonie, G. (2014). High-flow nasal cannula: recommendations for daily practice in pediatrics. *Ann Intensive Care*, 4, 29. <https://doi.org/10.1186/s13613-014-0029-5>
- Milési, C., Essouri, S., Pouyau, R., Liet, J., Afanetti, M., Portefaix, A., ... Groupe Francophone de Réanimation et d'Urgences Pédiatriques (GFRUP). (2017). High flow nasal cannula (HFNC) versus nasal continuous positive airway pressure (nCPAP) for the initial respiratory management of acute viral bronchiolitis in young infants: a multicenter randomized controlled trial (TRAMONTANE study). *Intensive Care Med*, 43(2), 209–216. <https://doi.org/10.1007/s00134-016-4617-8>
- Moller, W., Celik, G., Feng, S., Bartenstein, P., Meyer, G., Oliver, E., ... Tatkov, S. (2015). Nasal high flow clears anatomical dead space in upper airway models. *J Appl Physiol* (1985), 118(12), 1525–1532. <https://doi.org/10.1152/jappphysiol.00934.2014>
- Mundel, T., Feng, S., Tatkov, S., & Schneider, H. (2013). Mechanisms of nasal high flow on ventilation during wakefulness and sleep. *J Appl Physiol* (1985), 114(8), 1058–1065. <https://doi.org/10.1152/jappphysiol.01308.2012>
- Murki, S., Singh, J., Khant, C., Kumar Dash, S., Oleti, T., Joy, P., & Kabra, N. (2018). High-flow nasal cannula versus nasal continuous positive airway pressure for primary respiratory support in preterm infants with respiratory distress: a randomized controlled trial. *Neonatology*, 113(3), 235–241. <https://doi.org/10.1159/000484400>
- Ojha, S., Gridley, E., & Dorling, J. (2013). Use of heated humidified high-flow nasal cannula oxygen in neonates: a UK wide survey. *Acta Paediatr*, 102(3), 249–253. <https://doi.org/10.1111/apa.12090>
- Roberts, C., & Hodgson, K. (2017). Nasal high flow treatment in preterm infants. *Matern Health Neonatol Perinatol*, 3, 15. <https://doi.org/10.1186/s40748-017-0056-y>
- Roberts, C., Owen, L., Manley, B., Frøisland, D., Donath, S., Dalziel, K., ... HIPSTER Trial Investigators. (2016). Nasal high-flow therapy for primary respiratory support in preterm infants. *N Engl J Med*, 375(12), 1142–1151. <https://doi.org/10.1056/NEJMoA1603694>
- Roehr, C., Yoder, B., Davis, P., & Ives, K. (2016). Evidence support and guidelines for using heated, humidified, high-flow nasal cannulae in neonatology: Oxford nasal high-flow therapy meeting, 2015. *Clin Perinatol*, 43(4), 693–705. <https://doi.org/10.1016/j.clp.2016.07.006>
- Rubin, S., Ghuman, A., Deakers, T., Khemani, R., Ross, P., & Newth, C. (2014). Effort of breathing in children receiving high-flow nasal cannula. *Pediatr Crit Care Med*, 15(1), 1–6. <https://doi.org/10.1097/PCC.0000000000000011>
- Sarkar, M., Sinha, R., Roychowdhury, S., Mukhopadhyay, S., Ghosh, P., Dutta, K., & Ghosh, S. (2018). Comparative study between noninvasive continuous positive airway pressure and hot humidified high-flow nasal cannulae as a mode of respiratory support in infants with acute bronchiolitis in pediatric intensive care unit of a tertiary care hospital. *Indian J Crit Care Med*, 22(2), 85–90. https://doi.org/10.4103/ijccm.IJCCM_274_17
- Schiffmann, H. (2006). Humidification of respired gases in neonates and infants. *Respir Care Clin N Am*, 12(2), 321–336. <https://doi.org/10.1016/j.rcc.2006.03.002>
- Shetty, S., Hickey, A., Rafferty, G., Peacock, J., & Greenough, A. (2016). Work of breathing during CPAP and heated humidified high-flow nasal cannula. *Arch Dis Child Fetal Neonatal Ed*, 101(5), F404–7. <https://doi.org/10.1136/archdischild-2015-309310>
- Shin, J., Park, K., Lee, E., & Choi, B. (2017). Humidified High Flow Nasal Cannula versus Nasal Continuous Positive Airway Pressure as an Initial Respiratory Support in Preterm Infants with Respiratory Distress: a Randomized, Controlled Non-Inferiority Trial. *J Korean Med Sci*, 32(4), 650–655. <https://doi.org/10.3346/jkms.2017.32.4.650>
- Sivieri, E., Gerdes, J., & Abbasi, S. (2012). Effect of HFNC flow rate, cannula size, and nares diameter on generated airway pressures: an in-vitro study. *Pediatr Pulmonol*, 48(5), 506–514. <https://doi.org/10.1002/ppul.22636>
- Spentzas, T., Minarik, M., Patters, A., Vinson, B., & Stidham, G. (2009). Children with respiratory distress treated with high-flow nasal cannula. *J Intensive Care Med*, 24(5), 323–328. <https://doi.org/10.1177/0885066609340622>
- ten Brink, F., Duke, T., & Evans, J. (2013). High-flow nasal prong oxygen therapy or nasopharyngeal continuous positive airway pressure for children with moderate-to-severe respiratory distress? *Pediatr Crit Care Med*, 14(7), e326–31. <https://doi.org/10.1097/PCC.0b013e31828a894d>
- Walsh, B., Brooks, T., & Grenier, B. (2009). Oxygen therapy in the neonatal care environment. *Respir Care*, 54(9), 1193–1202.
- Ward, J. (2013). High-flow oxygen administration by nasal cannula for adult and perinatal patients. *Respir Care*, 58(1), 98–122. <https://doi.org/10.4187/respcare.01941>
- Wilkinson, D., Andersen, C., O'Donnell, C., De Paoli, A., & Manley, B. (2016). High flow nasal cannula for respiratory support in preterm infants. *Cochrane Database Syst Rev*, 2, CD006405. <https://doi.org/10.1002/14651858.CD006405.pub3>
- Yoder, B., Manley, B., Collins, C., Ives, K., Kugelman, A., Lavizzari, A., & McQueen, M. (2017). Consensus approach to nasal high-flow therapy in neonates. *J Perinatol*, 37(7), 809–813. <https://doi.org/10.1038/jp.2017.24>
- Yoder, B., Stoddard, R., Li, M., King, J., Dimberger, D., & Abbasi, S. (2013). Heated, humidified high-flow nasal cannula versus nasal CPAP for respiratory support in neonates. *Pediatrics*, 131(5), e1482–90. <https://doi.org/10.1542/peds.2012-2742>

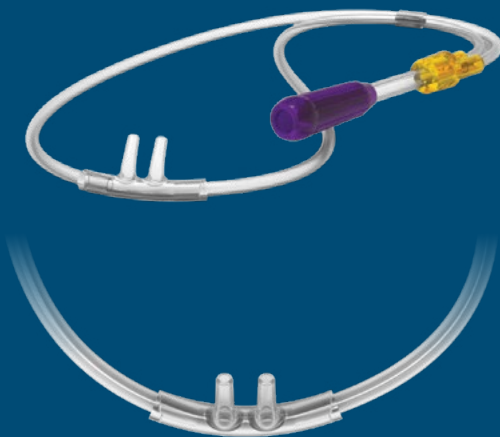
Evaluate F&P Optiflow Junior 2



The evolution of the F&P Infant Nasal Cannula

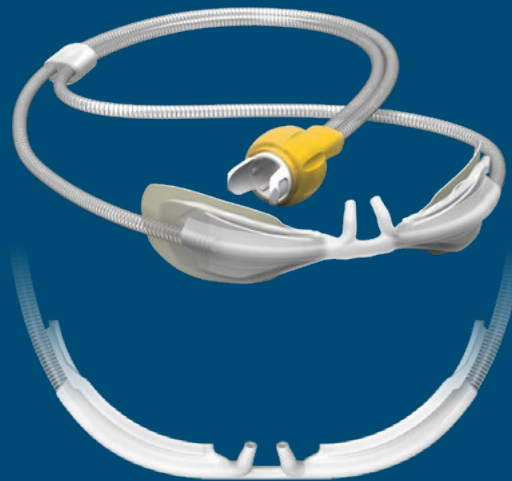


1ST GENERATION



F&P Infant Nasal Cannula

2ND GENERATION



F&P Optiflow *junior*

3RD GENERATION



F&P Optiflow Junior 2

Please contact your local Fisher & Paykel Healthcare representative
about an evaluation or for further information.

www.fphcare.com

Fisher & Paykel
HEALTHCARE