

## COVID-19 Edition

The outbreak and ongoing surges of COVID-19 have impacted healthcare services around the world. Optiflow™ Nasal High Flow (NHF) therapy is being used to treat patients, whilst its association with the risk of transmission continues to be challenged.

“Patients acutely requiring [NHF]... are likely to present a high disease transmission risk due to their propensity to produce aerosols, but we find no basis for withholding or delaying access to [this therapy]. We conclude instead that exertional respiratory activities themselves are the primary modes of aerosol generation and represent a greater transmission risk than is widely recognised currently.” – **Wilson et al. Anaesthesia. 2021.**<sup>1</sup>

## Summary

The following dual primary objectives, applied to clinical management of all patients, are particularly relevant for COVID-19:

- Improving patient outcomes e.g. by avoiding the need for tracheal intubation.
- Maintaining health care worker (HCW) safety e.g. by avoiding an increase in widespread nosocomial transmission.

**Collectively, evidence based guidelines for COVID-19, published randomized controlled trials and clinical observations on outcomes from NHF use, investigational research on dispersion of exhaled particles, and expert recommendations indicate that:**<sup>1-56</sup>

NHF is recommended as respiratory support for patients with hypoxemia caused by viral pneumonia, such as COVID-19.<sup>2-27</sup>

- NHF is currently not considered to represent an increased risk of HCW infection via contact, droplet or airborne transmission routes.<sup>15-16,23,25-28</sup>
  - » Advocacy for NHF is called for in recommendations for hospital preparedness.<sup>29-32</sup>
  - » The aerosol generating procedure (AGP) paradigm should be discussed in the context of emerging evidence.<sup>1,30-32,49-55</sup>
  - » Cough is now considered to be a relatively high risk respiratory activity which puts all forms of respiratory therapy into perspective.<sup>1,33,45,48-53,56</sup>

# Improving patient outcomes

The use of NHF to improve outcomes for COVID-19 patients is well documented in published literature:

## Evidence based guidelines

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The number of organisations who have published evidence based guidelines recommending the use of NHF for COVID-19 patients continues to grow:

- World Health Organisation<sup>2</sup>
- National Institutes of Health<sup>3</sup>
- National Health Commission of the Peoples Republic of China<sup>4</sup>
- Surviving Sepsis Campaign<sup>5</sup>
- Australia and New Zealand Intensive Care Society<sup>6</sup>
- European Respiratory Society<sup>7</sup>
- International expert consensus statement<sup>8</sup>
- Expert recommendations from a French panel consisting of members from various intensive care societies<sup>9</sup>

## Research on outcomes for COVID-19 patients

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As NHF has been used as respiratory support throughout the pandemic, evidence on its impact on patient outcomes including randomized controlled trials, expert opinion and clinical observations have been peer reviewed, published and continue to emerge.<sup>10-27</sup>

NHF use on COVID-19 patients has been either shown or observed to:

- **Keep patients off mechanical ventilation and help them stay off.**<sup>10-11,14-21,24</sup>
- **Reduce clinical recovery time** and length of stay.<sup>10,24-25</sup>
- Reduce oxygenation failure.<sup>13</sup>
- Be successfully used outside of ICU settings.<sup>21-23</sup>
- **Increase comfort and compliance.**<sup>11-12</sup>
- **Facilitate awake prone positioning.**<sup>11-13</sup>
- **Reduce PaCO<sub>2</sub>.**<sup>12</sup>

“Among patients with severe COVID-19, use of [NHF] through a nasal cannula significantly decreased need for mechanical ventilation support and time to clinical recovery compared with conventional low-flow oxygen therapy.”- Ospina-Tascón et al. 2021.<sup>10</sup>

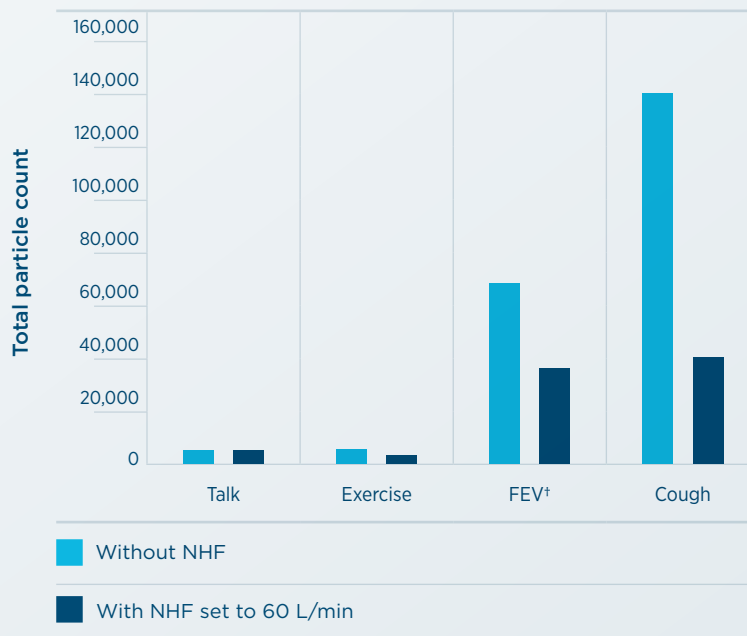
Note: Bolded outcomes above are findings from studies including randomized controlled trials. The remaining outcomes listed are from observational studies only.

# Maintaining healthcare worker safety

Collectively, clinical observations, investigative research and expert opinions highlight that NHF therapy is not considered to represent an increased risk of infection for HCWs.<sup>1,15-16,23,26-56</sup>

Wilson et al. 2021<sup>1</sup> compared the effect of respiratory activity, noninvasive respiratory support and facemasks on aerosol generation. This publication is the first to attempt to capture data from the entire respiratory plume. Results from the study are illustrated in the chart below.

Comparison of total particle count for respiratory activities\*



\* Data collated from Wilson et al. 2021.<sup>1</sup>

<sup>†</sup> FEV: Forced expiratory volume manoeuvres. Used as proxies for symptomatic laboured breathing and atelectasis.

## Expert opinions

### Advocacy for NHF

The publication from Wilson et al. adds to a body of research from experts advocating for the use of NHF for COVID-19 patients:<sup>1,29,48-50</sup>

“... administrators and policymakers must consider amending protocols to not only allow, but actually advocate for, the use of [NHF] for COVID-19 patients with significant hypoxemia who, without this option, would be placed on [mechanical ventilation].”  
- Gershengorn et al. 2020.<sup>29</sup>

## The AGP paradigm

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Publications and articles question the accuracy and helpfulness of the term AGP with particular emphasis on the classification of respiratory support therapies like NHF as AGPs.<sup>1,30-32,49-55</sup>

“Recent data have raised questions as to whether procedures currently classified as AGPs actually generate aerosols, including tracheal intubation and extubation, non-invasive ventilation and high-flow nasal oxygen.”  
– Cook et al. 2021.<sup>49</sup>

“We propose an end to the term aerosol generating procedure, as it is [not] accurate (aerosol is not generated above a cough for many of these procedures), implies aerosol emission is only from specific procedures (rather than being generated during normal respiratory events), potentially misidentifies the source of infection risk, and applies a binary definition to a situation that is more complex.” – Hamilton et al. 2021.<sup>50</sup>

## Patient-related risks to HCWs

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Researchers and experts have considered aerosols generated from COVID-19 patients’ respiratory activities (like cough) and the risk this represents to HCWs.<sup>1,33,45,48-53,56</sup>

“Aerosol emission from the respiratory tract does not appear to be increased by [NHF]. Although direct comparisons are complex, cough appears to be the main aerosol-generating risk out of all measured activities.”  
– Hamilton et al. 2021.<sup>51</sup>

“[...] HCW exposure and nosocomial transmission may be more influenced by patient factors, such as coughing at earlier stages of infection, than the type of respiratory support used.” – Winslow et al. 2021.<sup>52</sup>

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## Helpful terms

### Particle:

Matter with physical dimensions such as a water vapor molecule, a pathogen (virus or bacteria), an aerosol or a droplet.

### Water vapor molecule:

Gas particle of H<sub>2</sub>O. Size: < 0.001 microns.

### Virus:

Infectious agent replicating in living cells. Size: 0.017 to 0.3 microns.

### Bacteria:

Infectious organism. Size: 0.2 to 10 microns.

### Aerosol:

Very small liquid particle, usually suspended in the air. Size: up to about 10 microns.

### Droplet:

Larger liquid particle, usually falling to the ground. Size: about 5 microns or larger.

### Medical-particle:

Aerosol or droplet including a suspended pharmaceutical agent such as salbutamol, for delivery to a patient.

### Medical-aerosol:

Medical particle small enough to be delivered to a patient’s lower airway or lungs.

### Bio-particle:

Aerosol or droplet expelled by a patient during exhalation which includes biological material (e.g. a suspended pathogen).

### Bio-aerosol:

Very small bio-particle, usually suspended in the air. Size: up to about 10 microns.

### Bio-droplet:

Larger bio-particle, usually falling to the ground. Size: about 5 microns or larger.

### Bio-aerosol generating procedure:

A procedure which includes the type of patient airway interaction known to break fluids into aerosol sized particles.

### Bio-aerosol dispersing procedure:

A procedure which doesn’t break fluids into aerosols but may disperse bio-aerosols generated by normal airway functions.

- Wilson NM, Marks GB, Eckhardt A, et al. The effect of respiratory activity, non-invasive respiratory support and facemasks on aerosol generation and its relevance to COVID-19. *Anaesthesia*. 2021 Mar 30;10(11):1547-1547.
- World Health Organization COVID-19 clinical management: living guidance. 25 January 2021. Available from: <https://www.who.int/publications/i/item/WHO-2019-nCoV-clinical-2021-1> [Accessed 4 Feb 2022].
- National Institutes of Health. Coronavirus Disease 2019 (COVID-19) Treatment Guidelines. 19 October 2021. Available from: <https://www.covid19treatmentguidelines.nih.gov/> [Accessed 4 Feb 2022].
- National Health Commission of the People Republic of China. Diagnosis and Treatment Protocol for COVID-19 Patients (Tentative 8th Edition). Available from: [http://en.nhc.gov.cn/2020-09/07/c\\_81565.htm](http://en.nhc.gov.cn/2020-09/07/c_81565.htm) [Accessed 4 Feb 2022].
- Evans L, Rhodes A, Alhazzani W, et al. Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock 2021. *Crit Care Med*. 2021 Nov 1;49(11):e1063-e1143.
- National COVID-19 Clinical Evidence Taskforce. Australian guidelines for the clinical care of people with COVID-19. Available from: <https://covid19evidence.net.au/> [Accessed 4 Feb 2022].
- Chalmers JD, Crichton ML, Goeminne PC, et al. Management of hospitalised adults with coronavirus disease 2019 (COVID-19): a European Respiratory Society living guideline. *Eur Respir J*. 2021 Apr 15;57(4):2100048.
- Nasa P, Azoulay E, Khanna AK, et al. Expert consensus statements for the management of COVID-19-related acute respiratory failure using a Delphi method. *Crit Care*. 2021 Mar 16;25(1):106.
- French Intensive Care Societies guidelines. Expert recommendations on the intensive care of patients during a SARS-CoV-2 epidemic. Available from: <https://www.srlf.org/article/coronavirus/> [Accessed 4 Feb 2022].
- Ospina-Tascón GA, Calderón-Tapia LE, García AF, et al. Effect of High-Flow Oxygen Therapy vs Conventional Oxygen Therapy on Invasive Mechanical Ventilation and Clinical Recovery in Patients With Severe COVID-19: A Randomized Clinical Trial. *JAMA*. 2021 Dec 7;326(21):2161-2171.
- Nair PR, Haritha D, Behera S, et al. Comparison of High-Flow Nasal Cannula and Noninvasive Ventilation in Acute Hypoxemic Respiratory Failure Due to Severe COVID-19 Pneumonia. *Respir Care*. 2021 Sep 28;respacare.09130. [Epub ahead of print].
- Grieco DL, Menga LS, Cesarano M, et al. Effect of Helmet Noninvasive Ventilation vs High-Flow Nasal Oxygen on Days Free of Respiratory Support in Patients With COVID-19 and Moderate to Severe Hypoxemic Respiratory Failure: The HENIVOT Randomized Clinical Trial. *JAMA*. 2021 May 4;325(17):1731-1743.
- COVID-ICU group, for the REVA network, COVID-ICU investigators. Benefits and risks of noninvasive oxygenation strategy in COVID-19: a multicenter, prospective cohort study (COVID-ICU) in 137 hospitals. *Crit Care*. 2021 Dec 8;25(1):421.
- Munshi L, Hall JB. Respiratory Support During the COVID-19 Pandemic: Is It Time to Consider Using a Helmet? *JAMA*. 2021 May 4;325(17):1723-1725.
- Patel M, Gangemi A, Marron R, et al. Retrospective analysis of high flow nasal therapy in COVID-19-related moderate-to-severe hypoxaemic respiratory failure. *BMJ Open Respir Res*. 2020;7(1):e000650.
- Bonnet N, Martin O, Boubaya M, et al. High flow nasal oxygen therapy to avoid invasive mechanical ventilation in SARS-CoV-2 pneumonia: a retrospective study. *Ann Intensive Care*. 2021 Feb 27;11(1):37.
- Agarwal A, Basmaji J, Muttalib F, et al. High-flow nasal cannula for acute hypoxemic respiratory failure in patients with COVID-19: systematic reviews of effectiveness and its risks of aerosolization, dispersion, and infection transmission. *Can J Anaesth*. 2020 Sep;67(9):1217-1248.
- Demoule A, Vieillard Baron A, Darmon M, et al. High-Flow Nasal Cannula in Critically Ill Patients with Severe COVID-19. *Am J Respir Crit Care Med*. 2020 Oct 1;202(7):1039-1042.
- Anesi GL, Jablonski J, Harhay MO, et al. Characteristics, Outcomes, and Trends of Patients With COVID-19-Related Critical Illness at a Learning Health System in the United States. *Ann Intern Med*. 2021 May;174(5):613-621.
- Wendel Garcia PD, Aguirre-Bermeo H, Buehler PK, et al. Implications of early respiratory support strategies on disease progression in critical COVID-19: a matched subanalysis of the prospective RISC-19-ICU cohort. *Crit Care*. 2021 May 25;25(1):175.
- Calligaro GL, Lalla U, Audley G, et al. The utility of high-flow nasal oxygen for severe COVID-19 pneumonia in a resource-constrained setting: A multi-centre prospective observational study. *EClinicalMedicine*. 2020 Nov;28:100570.
- Franco C, Facciolo N, Tonelli R, et al. Feasibility and clinical impact of out-of-ICU noninvasive respiratory support in patients with COVID-19-related pneumonia. *Eur Respir J*. 2020 Nov 5;56(5):2002130.
- Guy T, Créac'hcadec A, Ricordel C, et al. High-flow nasal oxygen: a safe, efficient treatment for COVID-19 patients not in an ICU. *Eur Respir J*. 2020 Nov 12;56(5):2001154.
- Mellado-Artigas R, Ferreyro BL, Angriman F, et al. High-flow nasal oxygen in patients with COVID-19-associated acute respiratory failure. *Crit Care*. 2021 Feb 11;25(1):58.
- Deng L, Lei S, Jiang F, et al. (2020). The Outcome Impact of Early vs Late HFNC Oxygen Therapy in Elderly Patients with COVID-19 and ARDS. *medRxiv*. <https://doi.org/10.1101/2020.05.23.20111450>
- Vianello A, Arcaro G, Molena B, et al. High-flow nasal cannula oxygen therapy to treat patients with hypoxemic acute respiratory failure consequent to SARS-CoV-2 infection. *Thorax*. 2020 Nov;75(11):998-1000.
- Duan J, Chen B, Liu X, et al. Use of high-flow nasal cannula and noninvasive ventilation in patients with COVID-19: A multicenter observational study. *Am J Emerg Med*. 2020 Jul 29;S0735-6757(20)30666-5.
- Westafer LM, Soares WE 3rd, Salvador D, et al. No evidence of increasing COVID-19 in health care workers after implementation of high flow nasal cannula: A safety evaluation. *Am J Emerg Med*. 2021 Jan;39:158-161.
- Gershengorn HB, Hu Y, Chen JT, et al. The Impact of High-Flow Nasal Cannula Use on Patient Mortality and the Availability of Mechanical Ventilators in COVID-19. *Ann Am Thorac Soc*. 2021 Apr;18(4):623-631.
- Lyons C, Callaghan M. The use of high-flow nasal oxygen in COVID-19. *Anaesthesia*. 2020 Jul;75(7):843-847.
- Li J, Fink JB, Ehrmann S. High-flow nasal cannula for COVID-19 patients: low risk of bio-aerosol dispersion. *Eur Respir J*. 2020 May 14;55(5):2000892.
- Li J, Fink JB, Ehrmann S. High-flow nasal cannula for COVID-19 patients: risk of bio-aerosol dispersion. *Eur Respir J*. 2020 Oct 8;56(4):2003136.
- Gaeckle NT, Lee J, Park Y, et al. Aerosol Generation from the Respiratory Tract with Various Modes of Oxygen Delivery. *Am J Respir Crit Care Med*. 2020 Oct 15;202(8):1115-1124.
- Bem RA, van Mourik N, Klein-Blommert R, et al. Risk of Aerosol Formation During High-Flow Nasal Cannula Treatment in Critically Ill Subjects. *Respir Care*. 2021 Jun;66(6):891-896.
- Li J, Fink JB, Elshafei AA, et al. Placing a mask on COVID-19 patients during high-flow nasal cannula therapy reduces aerosol particle dispersion. *ERJ Open Res*. 2021 Jan 25;7(1):00519-2020.
- Iwashyna T, Boehman A, Capeceletro J, et al. (2020). Variation in Aerosol Production Across Oxygen Delivery Devices in Spontaneously Breathing Human Subjects. *medRxiv*. <https://doi.org/10.1101/2020.04.15.20066688>
- Jerry MC, Spence CJT, Kirton R, et al. Assessment of dispersion of airborne particles of oral/nasal fluid by high flow nasal cannula therapy. *PLoS One*. 2021 Feb 12;16(2):e0246123.
- Kotoda M, Hishiyama S, Mitsui K, et al. Assessment of the potential for pathogen dispersal during high-flow nasal therapy. *J Hosp Infect*. 2020 Apr;104(4):534-537.
- Leung CCH, Joynt GM, Gomersall CD, et al. Comparison of high-flow nasal cannula versus oxygen face mask for environmental bacterial contamination in critically ill pneumonia patients: a randomized controlled crossover trial. *J Hosp Infect*. 2019 Jan;101(1):84-87.
- Miller DC, Beamer P, Billheimer D, et al. Aerosol Risk with Noninvasive Respiratory Support in Patients with COVID-19. *J Am Coll Emerg Physicians Open*. 2020 May 21;1(4):521-6.
- McGain F, Humphries RS, Lee JH, et al. Aerosol generation related to respiratory interventions and the effectiveness of a personal ventilation hood. *Crit Care Resusc*. 2020 May 26.
- Gall ET, Laguerre A, Noelck M, et al. (2020). Aerosol generation in children undergoing high flow nasal cannula therapy. *medRxiv*. <https://doi.org/10.1101/2020.12.10.20245662>
- Hui DS, Chow BK, Lo T, et al. Exhaled air dispersion during high-flow nasal cannula therapy versus CPAP via different masks. *Eur Respir J*. 2019 Apr 11;53(4):1802339.
- Loh NW, Tan Y, Taculod J, et al. The impact of high-flow nasal cannula (HFNC) on coughing distance: implications on its use during the novel coronavirus disease outbreak. *Can J Anaesth*. 2020 Jul;67(7):893-894.
- Hamada S, Tanabe N, Inoue H, et al. Wearing of medical mask over the high-flow nasal cannula for safer oxygen therapy in the COVID-19 era. *Pulmonology*. 2021 Mar-Apr;27(2):171-173.
- Dellweg D, Kerl J, Gena AW, et al. Exhalation Spreading During Nasal High-Flow Therapy at Different Flow Rates. *Crit Care Med*. 2021 Jul 1;49(7):e693-e700.
- Kaur R, Weiss TT, Perez A, et al. Practical strategies to reduce nosocomial transmission to healthcare professionals providing respiratory care to patients with COVID-19. *Crit Care*. 2020 Sep 23;24(1):571.
- Takazono T, Yamamoto K, Okamoto R, et al. Effects of surgical masks on droplet dispersion under various oxygen delivery modalities. *Crit Care*. 2021 Feb 27;25(1):89.
- Cook TM, El-Boghdady K, Brown J, et al. The safety of anaesthetists and intensivists during the first COVID-19 surge supports extension of use of airborne protection PPE to ward staff. *Clin Med (Lond)*. 2021 Mar;21(2):e137-e139.
- Hamilton F, Arnold D, Bzdek BR, et al. Aerosol generating procedures: are they of relevance for transmission of SARS-CoV-2? *Lancet Respir Med*. 2021 Jul;9(7):687-689.
- Hamilton FW, Gregson FKA, Arnold DT, et al. Aerosol emission from the respiratory tract: an analysis of aerosol generation from oxygen delivery systems. *Thorax*. 2021 Nov 4;thorajnl-2021-217577. [Epub ahead of print].
- Winslow RL, Zhou J, Windle EF, et al. SARS-CoV-2 environmental contamination from hospitalised patients with COVID-19 receiving aerosol-generating procedures. *Thorax*. 2021 Nov 4;thorajnl-2021-218035. [Epub ahead of print].
- Dhand R, Li J. Coughs and Sneezes: Their Role in Transmission of Respiratory Viral Infections, Including SARS-CoV-2. *Am J Respir Crit Care Med*. 2020 Sep 1;202(5):651-659.
- Morgensten J. 5 Dec 2020. "Aerosol Generating Medical Procedure" is a faulty paradigm. *first10em.com*. <https://first10em.com/aerosol-generating-medical-procedure-is-a-faulty-paradigm/> [Accessed 5 Jul 2021].
- Torjesen I. Covid-19: Risk of aerosol transmission to staff outside of intensive care is likely to be higher than predicted. *BMJ*. 2021 Feb 5;372:n354.
- Addleman S, Leung Y, Asadi L, et al. Mitigating airborne transmission of SARS-CoV-2. *CMAJ*. 2021 Jul 5;193(26):E1010-E1011.