

Optiflow™ matters

Guideline recommendations for the use of Nasal High Flow (NHF), aka High Flow Nasal Cannula (HFNC), are supported by analyzed data from research investigating the effect of NHF on clinical outcomes, such as the reduced need for tracheal intubation. When selecting an NHF system, it is important to ensure the entire system, including design and device limits, can provide the therapy proven to deliver the expected outcomes.

Summary

- The National Institutes of Health (NIH)* and the Surviving Sepsis Campaign (SSC)** recommend NHF for use in COVID-19 related hypoxemia.^{1,2}
- These recommendations are supported by findings from four systematic reviews with meta analysis.³⁻⁶
- A survey conducted by Fisher & Paykel Healthcare (F&P) showed that the flow rates used in the controlled published studies⁷⁻²³ (analyzed by the four meta-analyses) ranged from 10 L/min to 60 L/min and 88% of the studies required flows \geq 45 L/min.
- When this survey was repeated on the 49 acute adult NHF controlled studies (with subjects $n \geq 40$), found using a systematic search of the PubMed database, it again showed that the flow rates used ranged from 10 L/min to 60 L/min and that 82% of the studies required flows \geq 45 L/min.
- F&P Optiflow systems (including F&P Optiflow interfaces) and humidity settings of 37°C were widely used.

Guideline recommendations

Recent guidelines for the clinical management of COVID-19 from organisations such as the NIH and SSC recommend the use of NHF as respiratory support in adults. These recommendations are supported by systematic reviews with meta analysis, which search for, review and analyze clinical data from controlled studies such as Randomized Controlled Trials (RCTs). F&P conducted a survey of the systems and settings used in studies from which analyzed data formed the basis of these recommendations.

*The NIH, a part of the U.S. Department of Health and Human Services, is the USA's national medical research agency.

**The SSC is a collaboration between the Society of Critical Care Medicine (SCCM) and the European Society of Intensive Care Medicine (ESICM).

Reviews with meta analysis

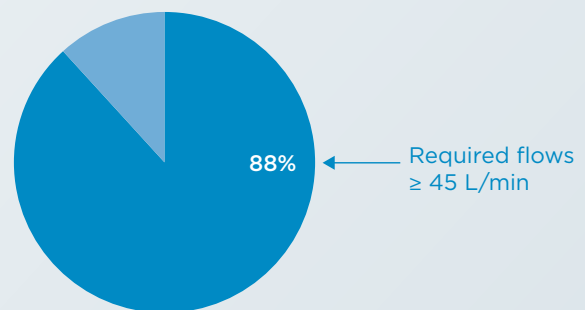
NHF recommendations from NIH COVID-19 Treatment Guidelines and the SSC Guidelines on the Management of Critically Ill Adults with Coronavirus Disease 2019 (COVID-19) are supported by the following systematic reviews with meta analysis: Zhao et al. 2017, Ou et al. 2017, Ni et al. 2018, and Rochweg et al. 2019.¹⁻⁶

Analyzed published studies

These four reviews analyzed data from 17 published studies (mostly RCTs) and one presentation.⁷⁻²⁴ The studies represent various NHF applications, including primary respiratory support, pre-oxygenation prior to intubation, post extubation respiratory support and post surgical respiratory support. The studies reported the NHF systems and settings that were used.

Systems and settings

The reported flow rates ranged between 10 L/min and 60 L/min with distribution favouring the higher end of the range.



Of the 17 published and analyzed studies, 16 (94%) used F&P Optiflow systems, including an F&P Optiflow patient interface and an F&P humidity delivery system with humidity setting of 37°C.

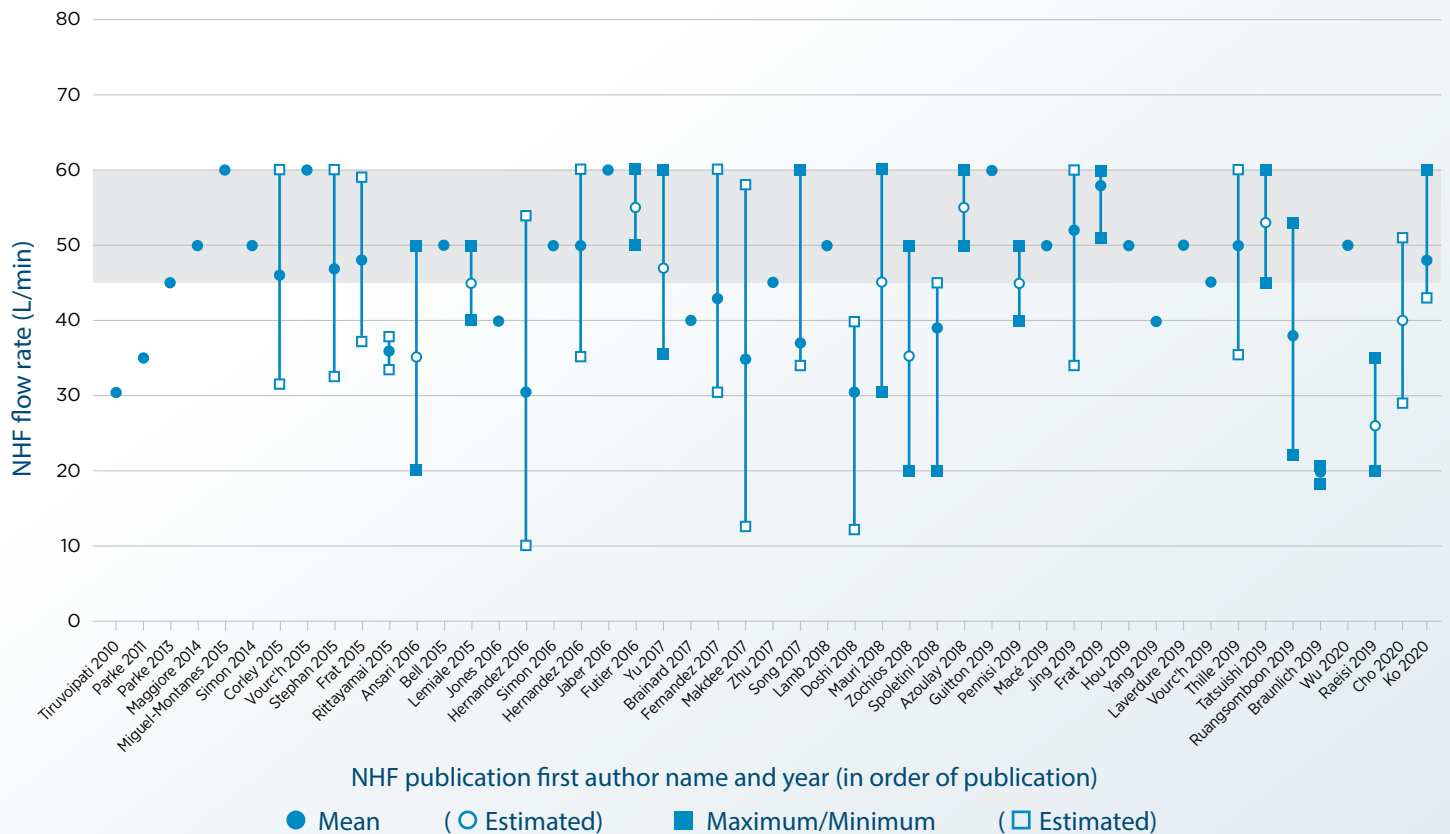
Wider body of evidence

To further investigate the body of evidence (beyond that analyzed in the four meta analyses³⁻⁶), the survey method was repeated for the 49 acute adult NHF controlled studies^{10-23,25-59}, with subjects $n \geq 40$, found using a systematic search of the PubMed database. Again, the reported flow rates ranged between 10 L/min and 60 L/min with distribution favouring the higher end of the range (82% of the studies required flows ≥ 45 L/min). The flow rates reported in the 49 controlled studies are shown in the chart below.

Of the 49 controlled studies 92% used F&P Optiflow systems, including an F&P Optiflow patient interface and an F&P humidity delivery system with humidity setting of 37°C.

When selecting an NHF system, it is important to ensure the entire system, including device capabilities such as flow rate and humidity delivery, can provide the therapy to deliver the expected outcomes proven in the clinical body of evidence.

Flow rates used in the 49 controlled studies on acute adult NHF (with subjects $n \geq 40$)



Definitions

Systematic search of the PubMed database: Conducted on 12 July 2020 using pre-defined search terms. Filtered using an Excel database and checked by an internal clinical team.

Acute adult NHF: All NHF applications used in hospital acute treatment areas, including primary respiratory support, pre-oxygenation prior to intubation, post extubation respiratory support, post surgical respiratory support and respiratory support during medical recovery.

Hospital acute treatment areas: All in-patient treatment areas and emergency department. Excluding operating theatres, procedural suites, outpatient clinics and rehabilitation.

Controlled studies: Outcomes RCTs, pilot RCTs, physiological RCTs, non-randomized controlled trials and randomized crossover trials which were either open label or blinded, single or multicentre.

Estimated max/min flow: Calculated from the reported mean and standard deviation or interquartile range, and/or the known flow limits of the system used. Where the mean alone is reported, no estimated maximum or minimum is calculated unless an initial flow (different to the mean) is reported in which case it is taken as one of the limits.

Estimated mean: Calculated as the mean of the reported range limits, or range limits and initial flow rate.

F&P Optiflow system: An F&P purpose-built system for NHF – either an Airvo™ Optiflow system or a non-Airvo Optiflow system.

Airvo Optiflow system: An F&P Airvo system with integrated flow source, humidifier and humidity delivery system (F&P heated breathing tube and F&P auto-fill chamber). Used with an F&P Optiflow patient interface and able to deliver NHF anywhere in the hospital independent of medical air supply.

Non-Airvo Optiflow system: An F&P humidifier (e.g. MR850 system) and humidity delivery system (F&P heated breathing tube and F&P auto-fill chamber). Used with an F&P Optiflow patient interface and an independent flow generator such as a HFNC-capable ventilator.

For further information, please visit www.fphcare.com/optiflow or click on the hyperlinked reference below.

- National Institutes of Health. Coronavirus Disease 2019 (COVID-19) Treatment Guidelines. Available from: <https://www.covid19treatmentguidelines.nih.gov/> [Accessed 11 Jun 2020].
- Surviving Sepsis Campaign. COVID-19 Guidelines. Available from: <https://www.sccm.org/SurvivingSepsisCampaign/Guidelines/COVID-19> [Accessed 11 Jun 2020].
- Zhao H, Wang H, Sun F, et al. High-Flow Nasal Cannula Oxygen Therapy Is Superior to Conventional Oxygen Therapy but Not to Noninvasive Mechanical Ventilation on Intubation Rate: A Systematic Review and Meta-Analysis. *Crit Care*. 2017 Jul 12;21(1):184.
- Ou X, Hua Y, Liu J, et al. Effect of High-Flow Nasal Cannula Oxygen Therapy in Adults With Acute Hypoxic Respiratory Failure: A Meta-Analysis of Randomized Controlled Trials. *CMAJ*. 2017 Feb 21;189(7):E260-E267.
- Ni YN, Luo J, Yu H, et al. Can High-Flow Nasal Cannula Reduce the Rate of Endotracheal Intubation in Adult Patients With Acute Respiratory Failure Compared With Conventional Oxygen Therapy and Noninvasive Positive Pressure Ventilation? A Systematic Review and Meta-analysis. *Chest*. 2017 Apr;151(4):764-775.
- Rochweg B, Granton D, Wang DX, et al. High Flow Nasal Cannula Compared With Conventional Oxygen Therapy for Acute Hypoxic Respiratory Failure: A Systematic Review and Meta-Analysis. *Intensive Care Med*. 2019 May;45(5):563-572.
- Roca O, de Acilu MG, Caralt B, et al. Humidified High Flow Nasal Cannula Supportive Therapy Improves Outcomes in Lung Transplant Recipients Readmitted to the Intensive Care Unit Because of Acute Respiratory Failure. *2015 May*;99(5):1092-8.
- Nagata K, Morimoto T, Fujimoto D, et al. Efficacy of High-Flow Nasal Cannula Therapy in Acute Hypoxic Respiratory Failure: Decreased Use of Mechanical Ventilation. *Respir Care*. 2015 Oct;60(10):1390-6.
- Coudroy R, Jamet A, Petua P, et al. High-flow Nasal Cannula Oxygen Therapy Versus Noninvasive Ventilation in Immunocompromised Patients With Acute Respiratory Failure: An Observational Cohort Study. *Ann Intensive Care*. 2016 Dec;6(1):45.
- Parke R, McGuinness S, Dixon R, Jull A. Open-label, Phase II Study of Routine High-Flow Nasal Oxygen Therapy in Cardiac Surgical Patients. *Br J Anaesth*. 2013 Dec;111(6):925-31.
- Maggiore SM, Idrone FA, Vaschetto R, et al. Nasal High-Flow Versus Venturi Mask Oxygen Therapy After Extubation. Effects on Oxygenation, Comfort, and Clinical Outcome. *Am J Respir Crit Care Med*. 2014 Aug 1;190(3):282-8.
- Simon M, Braune S, Frings D, et al. High-Flow Nasal Cannula Oxygen Versus Non-Invasive Ventilation in Patients With Acute Hypoxaemic Respiratory Failure Undergoing Flexible Bronchoscopy - A Prospective Randomised Trial. *Crit Care*. 2014 Dec 22;18(6):712.
- Corley A, Bull T, Spooner A, et al. Direct Extubation Onto High-Flow Nasal Cannulae Post-Cardiac Surgery Versus Standard Treatment in Patients With a BMI <=30: A Randomised Controlled Trial. *Intensive Care Med*. 2015 May;41(5):887-94.
- Frat JP, Thille AW, Mercat A, et al. High-flow Oxygen Through Nasal Cannula in Acute Hypoxic Respiratory Failure. *N Engl J Med*. 2015 Jun 4;372(23):2185-96.
- Stéphan F, Barrucand B, Petit P, et al. High-Flow Nasal Oxygen vs Noninvasive Positive Airway Pressure in Hypoxic Patients After Cardiothoracic Surgery: A Randomized Clinical Trial. *JAMA*. 2015 Jun 16;313(23):2331-9.
- Rittayamai N, Tscheikuna J, Praphruetkit N, Kijpinyochai S. Use of High-Flow Nasal Cannula for Acute Dyspnea and Hypoxemia in the Emergency Department. *Respir Care*. 2015 Oct;60(10):1377-82.
- Lemiale V, Mokart D, Mayaux J, et al. The Effects of a 2-h Trial of High-Flow Oxygen by Nasal Cannula Versus Venturi Mask in Immunocompromised Patients With Hypoxic Acute Respiratory Failure: A Multicenter Randomized Trial. *Crit Care*. 2015 Nov 2;19:380.
- Bell N, Hutchinson C, Green T, et al. Randomised Control Trial of Humidified High Flow Nasal Cannulae Versus Standard Oxygen in the Emergency Department. *Emerg Med Australas*. 2015 Dec;27(6):537-541.
- Jones PG, Kamona S, Doran O, et al. Randomized Controlled Trial of Humidified High-Flow Nasal Oxygen for Acute Respiratory Distress in the Emergency Department: The HOT-ER Study. *Respir Care*. 2016 Mar;61(3):291-9.
- Hernández G, Vaquero C, González P, et al. Effect of Postextubation High-Flow Nasal Cannula vs Conventional Oxygen Therapy on Reintubation in Low-Risk Patients: A Randomized Clinical Trial. *JAMA*. 2016 Apr 5;315(13):1354-61.
- Hernández G, Vaquero C, Colinas L, et al. Effect of Postextubation High-Flow Nasal Cannula vs Noninvasive Ventilation on Reintubation and Postextubation Respiratory Failure in High-Risk Patients: A Randomized Clinical Trial. *JAMA*. 2016 Oct 18;316(15):1565-1574.
- Makdee O, Mongsomboon A, Surabenjawong U, et al. High-Flow Nasal Cannula Versus Conventional Oxygen Therapy in Emergency Department Patients With Cardiogenic Pulmonary Edema: A Randomized Controlled Trial. *Ann Emerg Med*. 2017 Oct;70(4):465-472.e2.
- Azoulay E, Lemiale V, Mokart D, et al. Effect of High-Flow Nasal Oxygen vs Standard Oxygen on 28-Day Mortality in Immunocompromised Patients With Acute Respiratory Failure: The HIGH Randomized Clinical Trial. *JAMA*. 2018 Nov 27;320(20):2099-2107.
- Perbet S, Gerst A, Chabanne R, et al. High-flow nasal oxygen versus conventional oxygen therapy to prevent postextubation lung aeration loss: a multicentric randomized control lung ultrasound study [oral session 0446]. Abstracts ESICM LIVES 2014 27th Annual Congress, Barcelona Spain. *Intensive Care Med*. 2014;40(Suppl 1):S128.
- Tiruvoipati R, Lewis D, Hagi K, Botha J. High-flow nasal oxygen vs high-flow face mask: a randomized crossover trial in extubated patients. *J Crit Care*. 2010;25(3):463-468.
- Parke RL, McGuinness SP, Eccleston ML. A preliminary randomized controlled trial to assess effectiveness of nasal high-flow oxygen in intensive care patients. *Respir Care*. 2011;56(3):265-270.
- Miguel-Montanes R, Hajage D, Messika J, et al. Use of high-flow nasal cannula oxygen therapy to prevent desaturation during tracheal intubation of intensive care patients with mild-to-moderate hypoxemia. *Crit Care Med*. 2015;43(3):574-583.
- Vourch M, Asfar P, Volteau C, et al. High-flow nasal cannula oxygen during endotracheal intubation in hypoxic patients: a randomized controlled clinical trial. *Intensive Care Med*. 2015;41(9):1538-1548.
- Ansari BM, Hogan MP, Collier TJ, et al. A Randomized Controlled Trial of High-Flow Nasal Oxygen (Optiflow) as Part of an Enhanced Recovery Program After Lung Resection Surgery. *Ann Thorac Surg*. 2016;101(2):459-464.
- Simon M, Wachs C, Braune S, de Heer G, Frings D, Kluge S. High-Flow Nasal Cannula Versus Bag-Valve-Mask for Preoxygenation Before Intubation in Subjects With Hypoxic Respiratory Failure. *Respir Care*. 2016;61(9):1160-1167.
- Futier E, Paugam-Burtz C, Godet T, et al. Effect of early postextubation high-flow nasal cannula vs conventional oxygen therapy on hypoxaemia in patients after major abdominal surgery: a French multicentre randomised controlled trial (OPERA). *Intensive Care Med*. 2016;42(12):1888-1898.
- Jaber S, Monnin M, Girard M, et al. Apnoeic oxygenation via high-flow nasal cannula oxygen combined with non-invasive ventilation preoxygenation for intubation in hypoxaemic patients in the intensive care unit: the single-centre, blinded, randomised controlled OPTINIV trial. *Intensive Care Med*. 2016;42(12):1877-1887.
- Yu Y, Qian X, Liu C, Zhu C. Effect of High-Flow Nasal Cannula versus Conventional Oxygen Therapy for Patients with Thoracoscopic Lobectomy after Extubation. *Can Respir J*. 2017;2017:7894631.
- Brainard J, Scott BK, Sullivan BL, et al. Heated humidified high-flow nasal cannula oxygen after thoracic surgery - A randomized prospective clinical pilot trial. *J Crit Care*. 2017;40:225-228.
- Zhu Z, Liu Y, Wang Q, Wang S. Preliminary Evaluation of Sequential Therapy by High Flow Nasal Cannula Oxygen Therapy Following Endotracheal Tube Extubation in Mechanically Ventilated Patients. *Chinese J Crit Care Med*. 2017;29(9):778-782.
- Song HZ, Gu JX, Xiu HQ, Cui W, Zhang GS. The value of high-flow nasal cannula oxygen therapy after extubation in patients with acute respiratory failure. *Clinics (Sao Paulo)*. 2017;72(9):562-567.
- Fernandez R, Subira C, Frutos-Vivar F, et al. High-flow nasal cannula to prevent postextubation respiratory failure in high-risk non-hypercapnic patients: a randomized multicenter trial. *Ann Intensive Care*. 2017;7(1):47.
- Lamb KD, Spilman SK, Oetting TW, Jackson JA, Trump MW, Sahr SM. Proactive Use of High-Flow Nasal Cannula With Critically Ill Subjects. *Respir Care*. 2018;63(3):259-266.
- Mauri T, Galazzi A, Binda F, et al. Impact of flow and temperature on patient comfort during respiratory support by high-flow nasal cannula. *Crit Care*. 2018;22(1):120. Published 2018 May 9.
- Doshi P, Whittle JS, Bublewick M, et al. High-Velocity Nasal Insufflation in the Treatment of Respiratory Failure: A Randomized Clinical Trial. *Ann Emerg Med*. 2018;72(1):73-83.e5.
- Spoletini G, Mega C, Pisani L, et al. High-flow nasal therapy vs standard oxygen during breaks off noninvasive ventilation for acute respiratory failure: A pilot randomized controlled trial. *J Crit Care*. 2018;48:418-425.
- Zochios V, Collier T, Blanduszun G, et al. The effect of high-flow nasal oxygen on hospital length of stay in cardiac surgical patients at high risk for respiratory complications: a randomised controlled trial. *Anaesthesia*. 2018;73(12):1478-1488.
- Pennis MA, Bello G, Congedo MT, et al. Early nasal high-flow versus Venturi mask oxygen therapy after lung resection: a randomized trial. *Crit Care*. 2019;23(1):68. Published 2019 Feb 28.
- Macé J, Marjanovic N, Faranpour F, et al. Early high-flow nasal cannula oxygen therapy in adults with acute hypoxic respiratory failure in the ED: A before-after study. *Am J Emerg Med*. 2019;37(11):2091-2096.
- Frat JP, Ricard JD, Quenot JP, et al. Non-invasive ventilation versus high-flow nasal cannula oxygen therapy with apnoeic oxygenation for preoxygenation before intubation of patients with acute hypoxaemic respiratory failure: a randomised, multicentre, open-label trial. *Lancet Respir Med*. 2019;7(4):303-312.
- Guillon C, Ehrmann S, Volteau C, et al. Nasal high-flow preoxygenation for endotracheal intubation in the critically ill patient: a randomized clinical trial. *Intensive Care Med*. 2019;45(4):447-458.
- Vourch M, Nicolet J, Volteau C, et al. High-Flow Therapy by Nasal Cannulae Versus High-Flow Face Mask in Severe Hypoxemia After Cardiac Surgery: A Single-Center Randomized Controlled Study -The HEART FLOW Study. *J Cardiothorac Vasc Anesth*. 2020;34(1):157-165.
- Laverdure F, Genty T, Rezaiguia-Delclaux S, Herve P, Stephan F. Ultrasound Assessment of Respiratory Workload With High-Flow Nasal Oxygen Versus Other Noninvasive Methods After Chest Surgery. *J Cardiothorac Vasc Anesth*. 2019;33(11):3042-3047.
- Yang S, Zhang G, Liu Z, et al. Effect of High-Flow Nasal Cannula Oxygen Therapy on Diaphragmatic Function in Patients With Acute Exacerbation of Chronic Obstructive Pulmonary Disease: A Prospective Randomized Controlled Trial. *Chinese J Crit Care Med*. 2019;31(5):551-555.
- Hou Q, Zhang Z, Lei T, et al. Clinical efficacy of high-flow nasal humidified oxygen therapy in patients with hypoxemia. *PLoS One*. 2019;14(6):e0216957. Published 2019 Jun 6.
- Jing G, Li J, Hao D, et al. Comparison of high flow nasal cannula with noninvasive ventilation in chronic obstructive pulmonary disease patients with hypercapnia in preventing postextubation respiratory failure: A pilot randomized controlled trial. *Res Nurs Health*. 2019;42(3):217-225.
- Bräunlich J, Dellweg D, Bastian A, et al. Nasal high-flow versus noninvasive ventilation in patients with chronic hypercapnic COPD. *Int J Chron Obstruct Pulmon Dis*. 2019;14:1411-1421. Published 2019 Jul 5.
- Raeisi S, Fakharian A, Ghorbani F, Jamaati HR, Mirenayat MS. Value and Safety of High Flow Oxygenation in the Treatment of Inpatient Asthma: A Randomized, Double-blind, Pilot Study. *Iran J Allergy Asthma Immunol*. 2019;18(6):615-623. Published 2019 Oct 16.
- Tatsuishi W, Sato T, Kataoka G, Sato A, Asano R, Nakano K. High-Flow Nasal Cannula Oxygen Therapy With Early Extubation for Subjects Undergoing Off-Pump Coronary Artery Bypass Graft Surgery. *Respir Care*. 2020;65(2):183-190.
- Thille AW, Muller G, Gacouin A, et al. Effect of Postextubation High-Flow Nasal Oxygen With Noninvasive Ventilation vs High-Flow Nasal Oxygen Alone on Reintubation Among Patients at High Risk of Extubation Failure: A Randomized Clinical Trial [published online ahead of print, 2019 Oct 2] [published correction appears in *JAMA*. 2020 Feb 25;323(8):793]. *JAMA*. 2019;322(15):1465-1475.
- Ruangsomboon O, Dorongthom T, Chakorn T, et al. High-Flow Nasal Cannula Versus Conventional Oxygen Therapy in Relieving Dyspnea in Emergency Palliative Patients With Do-Not-Intubate Status: A Randomized Crossover Study. *Ann Emerg Med*. 2020;75(5):615-626.
- Wu CN, Xia LZ, Li KH, et al. High-flow nasal-oxygenation-assisted fiberoptic tracheal intubation in critically ill patients with COVID-19 pneumonia: a prospective randomised controlled trial [published online ahead of print, 2020 Mar 19]. *Br J Anaesth*. 2020;S0007-0912(20)30135-5.
- Cho JY, Kim HS, Kang H, et al. Comparison of Postextubation Outcomes Associated with High-Flow Nasal Cannula vs. Conventional Oxygen Therapy in Patients at High Risk of Reintubation: A Randomized Clinical Trial. *J Korean Med Sci*. 2020;35(25):e194. Published 2020 Jun 29.
- Ko DR, Boom J, Lee HS, You JS, Chung HS, Chung SP. Effects of High-Flow Nasal Cannula Therapy for Acute Pulmonary Edema in Patients with Heart Failure in the Emergency Department: A Prospective Multi-Center Randomized Controlled Trial. *J Clin Med*. 2020;9(6):E1937. Published 2020 Jun 21.