وزارة الصحة
Ministry of Health

Use of High-Flow Nasal Oxygen in adult patients

I. Introduction:

I.I Background:

Acute respiratory failure is one of the most common causes of Intensive Care Unit (ICU) admission. Mechanical ventilation is a common intervention for 61% of acute respiratory failure. Other common condition that requires mechanical ventilation includes a decreased level of consciousness, respiratory failure, and post-operative failure of extubation. Tracheal intubation and mechanical ventilation are not without risk and adverse outcome as barotrauma, hemodynamic instabilities, ventilator-associated events, and pneumonia. It usually requires an ICU bed and high nurses to patient ratio.

High Flow Nasal Cannula (HFNC) is a noninvasive respiratory support. It can deliver a mix of air and oxygen with an inspired oxygen fraction (FiO_2) ranging between 0.21 and 1.0 at a flow rate of up to 60 L/minute. The physiological benefits of HFNC are improved oxygenation, decreased anatomical dead space, decreased metabolic demand of breathing, decreased production of carbon dioxide, superior comfort and improved work of breathing, positive nasopharyngeal and tracheal airway pressure, and better secretion clearance.

HFNC can be used in different clinical settings, including emergency departments, intensive care units, outpatient, and procedural settings (figure1). It has been gaining popularity probably due to how easy it is to use, its high tolerability, and the possibility of applying it outside the ICU setting.

I.II Aim & Scope:

The aim of this guideline is to standardize , optimize the usage and extend the utilzation of HFNC among healthcare workers in different clinical departments and for all applicable conditions of adult patients in respiratory distress.

I.III Methodology

Systematic searches of scientific literature were undertaken on MEDLINE, PEDro, Cochrane, and CINAHL, for randomized controlled studies, metanalysis, and systemic reviews to summarize the indications and contraindications of the high-flow nasal cannula in different clinical settings. The guideline was developed by doing a literature review by 3 reviewers and coming up with the written document. The next step was having a meeting with 20 ICU consultants to review the final version. Conflicts were solved by discussion and voting.

I.IV Targeted population:

adult patients requiring high oxygen therapy

I.V Setup:

all clinical departments including general wards, emergency departments, theater rooms, recovery rooms, ICU, and high dependency units (HDU).

I.VI Targeted End User:

- Adult Emergency Medicine physicians and nurses
- Anesthesia technicians, specialists, and physicians
- Critical care physicians and nurses
- Respiratory therapist.
- HDU staff
- Ward RN

I.VII Updating: next update 3 years

I.VIII Funding: None

I.IX Conflict of Interest: None

II. Indications /contracindication of HFNC:

II.I: Indications:

a. Acute hypoxemic respiratory failure
b. Increased work of breathing
c. Preoxygenation before intubation
d. Acute COPD exacerbation
e. Severe pneumonia requiring high flow oxygen
f. Acute pulmonary edema
g. Post extubation support.
h. Postoperative respiratory failure.
i. In severely distressed DNR patients
j. Patients with do-not-intubate (DNI) status and respiratory failure.

II.II Contraindications of HFNC:

a. Need immediate mechanical ventilation
b. Low level of consciousness with Glasgow Coma Scale score < 9 (HFNC can be used in these patients to facilitate intubation)
c. Abnormalities or surgery of the face, nose, or airway that preclude an appropriate-fitting nasal cannula
d. Post-CPR or respiratory arrest

III. General HFNC rules of use:

The following are general rules for use of HFNC:
a. It can be used in Critical Care Units, ED, and General wards.
b. Infection control rules should be applied for communicable diseases
c. Frequent clinical (with venous/ arterial blood gases as indicated) evaluation every 2 hours to ensure efficacy and safety.
d. The patient should be monitored for the need for escalation to mechanical ventilation

IV. Steps of setting the HFNO parameters and further adjustment:

The HFNC allows the modification of only two variables: the percentage of oxygen being delivered and the rate of gas flow.

IV.I initial setup:

a. Set Humidity as close to 37° as possible and titrate to affect airway hydration and patient comfort.
b. Start with high flow rates (50-60 L/min) and titrate to affect Respiratory Rate (RR) and patient comfort.
c. Set FiO_2 between 0.21 to 1.0 and titrate to affect SpO_2 (within target range).
d. SpO_2 target range from 92% to 94% or 88% to 92% for patients with a risk of hypercapnia.
e. When increasing support is needed, move flow up first then Oxygen.
f. When reducing support, move Oxygen down first then flow.
g. The flow rate should be increased if:
    - Respiratory rate fails to improve,
    - Oxygenation fails to adequately improve,
    - Breathing remains labored.
h. As required to reduce oxygen down to 0.21 and keep humidified air going.

IV.II. Weaning of HFNC:

a. When O2 goals are achieved and the patient is clinically improving (decrease in respiratory rate and respiratory distress): reduce FiO2 gradually by 5-10% every 2-4 hours.
b. When FiO2 ≤ 40% is reached, flow can be gradually reduced by 5-10 L/min every 2-4 hours.
c. Switching to conventional O2 therapy should be considered when FiO2 < 35% and flow < 20 L/min. The conventional O2 flow should not be above 2 L/min, without an active humidification system being introduced to add a base flow of humidified air (HFNC machines can be used for this purpose).

V. Signs of Failure of HFNO (one of the following)

Worsening or non-improvement of oxygenation:

1. Increased FiO2 while target SpO2 is not achieved,
2. Increased work on breathing

Worsening or non-improvement of ventilation and/or work of breathing:

1. Respiratory rate is worsening or not improving,
2. Thoraco-abdominal asynchrony worsening or not improving,
3. Clinical signs of exhaustion,
4. PaCO2 worsening or not improving,
5. pH worsening or not improving.

VI. References

1. Bellani G, Laffey JG, Pham T, et al. Epidemiology, Patterns of Care, and Mortality for Patients With Acute Respiratory Distress Syndrome in Intensive Care Units in 50 Countries. *JAMA* 2016;315:788-800. 10.1001/jama.2016.0291.
2. Fowler RA, Abdelmalik P, Wood G, et al. Critical care capacity in Canada: results of a national cross-sectional study. Crit Care 2015;19:133. 10.1186/s13054-015-0852-6.
3. SRLF Trial Group. Hypoxemia in the ICU: prevalence, treatment, and outcome. Ann. Intensive Care 8, 82 (2018). https://doi.org/10.1186/s13613-018-0424-4
4. Wunsch H, Linde-Zwirble WT, Angus DC, et al.: The epidemiology of mechanical ventilation use in the United States. Crit Care Med 2010; 38:1947–1953
5. Russotto V, Myatra SN, Laffey JG, et al. Intubation Practices and Adverse Peri-intubation Events in Critically Ill Patients From 29 Countries. *JAMA*. 2021;325(12):1164–1172. doi:10.1001/jama.2021.1727
6. O'Driscoll BR, Smith R: Oxygen use in critical illness. Respir Care 2019; 64:1293–1307

7. Beitler JR, Malhotra A, Thompson BT: Ventilator-induced lung injury. Clin Chest Med 2016; 37:633–646
8. Magill SS, Li Q, Gross C, Dudeck M, Allen-Bridson K, Edwards JR. Incidence and characteristics of ventilator-associated events reported to the National Healthcare Safety Network in 2014. Crit Care Med 2016;44(12):2154–2162
9. Wunsch H, Wagner J, Herlim M, et al.: ICU occupancy and mechanical ventilator use in the United States. Crit Care Med 2013; 41:2712–2719
10. Spicuzza L, Schisano M. High-flow nasal cannula oxygen therapy as an emerging option for respiratory failure: the present and the future. Ther Adv Chronic Dis. 2020 May 13;11:2040622320920106. doi: 10.1177/2040622320920106. PMID: 32489572; PMCID: PMC7238775.
11. Wyatt KD, Goel NN, Whittle JS. Recent advances in the use of high flow nasal oxygen therapies. Front Med (Lausanne). 2022 Oct 10;9:1017965. doi: 10.3389/fmed.2022.1017965. PMID: 36300187; PMCID: PMC9589055.
12. Long B, Liang SY, Lentz S. High flow nasal cannula for adult acute hypoxemic respiratory failure in the ED setting. Am J Emerg Med. 2021 Nov;49:352-359. doi: 10.1016/j.ajem.2021.06.074. Epub 2021 Jul 3. PMID: 34246166; PMCID: PMC8555976.
13. Ricard, JD., Roca, O., Lemiale, V. et al. Use of nasal high flow oxygen during acute respiratory failure. Intensive Care Med 46, 2238–2247 (2020). https://doi.org/10.1007/s00134-020-06228-7
14. Rochwerg B, Granton D, Wang DX, Helviz Y, Einav S, Frat JP, Mekontso-Dessap A, Schreiber A, Azoulay E, Mercat A, Demoule A, Lemiale V, Pesenti A, Riviello ED, Mauri T, Mancebo J, Brochard L, Burns K. High flow nasal cannula compared with conventional oxygen therapy for acute hypoxemic respiratory failure: a systematic review and meta-analysis. Intensive Care Med. 2019 May;45(5):563-572. doi: 10.1007/s00134-019-05590-5. Epub 2019 Mar 19. PMID: 30888444.
15. Kuo HC, Liu WC, Li CC, Cherng YG, Chen JT, Wu HL, Tai YH. A comparison of high-flow nasal cannula and standard facemask as pre-oxygenation technique for general anesthesia: A PRISMA-compliant systemic review and meta-analysis. Medicine (Baltimore). 2022 Mar 11;101(10):e28903. doi: 10.1097/MD.0000000000028903. PMID: 35451383; PMCID: PMC8913129.
16. Cutuli SL, Grieco DL, Menga LS, De Pascale G, Antonelli M. Noninvasive ventilation and high-flow oxygen therapy for severe community-acquired pneumonia. Curr Opin Infect Dis. 2021 Apr 1;34(2):142-150. doi: 10.1097/QCO.0000000000000715. PMID: 33470666.
17. Agarwal A, Basmaji J, Muttalib F, Granton D, Chaudhuri D, Chetan D, Hu M, Fernando SM, Honarmand K, Bakaa L, Brar S, Rochwerg B, Adhikari NK, Lamontagne F, Murthy S, Hui DSC, Gomersall C, Mubareka S, Diaz JV, Burns KEA, Couban R, Ibrahim Q, Guyatt GH, Vandvik PO. 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. doi: 10.1007/s12630-020-01740-2. Epub 2020 Jun 15. PMID: 32542464; PMCID: PMC7294988.
18. Burnim MS, Wang K, Checkley W, Nolley EP, Xu Y, Garibaldi BT. The Effectiveness of High-Flow Nasal Cannula in Coronavirus Disease 2019 Pneumonia: A Retrospective Cohort Study. Crit Care Med. 2022 Mar 1;50(3):e253-e262. doi: 10.1097/CCM.0000000000005309. PMID: 34637419; PMCID: PMC8855780.
19. Song JL, Sun Y, Shi YB, Liu XY, Su ZB. Comparison of the effectiveness of high-flow nasal oxygen vs. standard facemask oxygenation for pre- and apneic oxygenation during anesthesia induction: a systematic review and meta-analysis. BMC Anesthesiol. 2022 Apr 6;22(1):100. doi: 10.1186/s12871-022-01615-7. PMID: 35387583; PMCID: PMC8985355.

20. Dipayan Chaudhuri, David Granton, Dominic Xiang Wang, Karen E.A. Burns, Yigal Helviz, et al.. High flow nasal cannula in the immediate post-operative period: a systematic review and meta-analysis. Chest, 2020, 158 (5), pp.1934-1946. ⟨10.1016/j.chest.2020.06.038⟩. ⟨hal-02889236⟩
21. Granton D, Chaudhuri D, Wang D, Einav S, Helviz Y, Mauri T, Mancebo J, Frat JP, Jog S, Hernandez G, Maggiore SM, Hodgson CL, Jaber S, Brochard L, Trivedi V, Ricard JD, Goligher EC, Burns KEA, Rochwerg B. High-Flow Nasal Cannula Compared With Conventional Oxygen Therapy or Noninvasive Ventilation Immediately Postextubation: A Systematic Review and Meta-Analysis. Crit Care Med. 2020 Nov;48(11):e1129-e1136. doi: 10.1097/CCM.0000000000004576. PMID: 32947472.
22. Hao X, Zhao S, Cheng J, Yang L, Jiang H, Qu F. The Clinical Effect of High-Flow Oxygen Therapy through the Nose on Patients with Acute Left Heart Failure and Hypoxemia. J Healthc Eng. 2022 Mar 14;2022:7117508. doi: 10.1155/2022/7117508. PMID: 35321000; PMCID: PMC8938071.
23. Rochwerg B, Einav S, Chaudhuri D, Mancebo J, Mauri T, Helviz Y, Goligher EC, Jaber S, Ricard JD, Rittayamai N, Roca O, Antonelli M, Maggiore SM, Demoule A, Hodgson CL, Mercat A, Wilcox ME, Granton D, Wang D, Azoulay E, Ouanes-Besbes L, Cinnella G, Rauseo M, Carvalho C, Dessap-Mekontso A, Fraser J, Frat JP, Gomersall C, Grasselli G, Hernandez G, Jog S, Pesenti A, Riviello ED, Slutsky AS, Stapleton RD, Talmor D, Thille AW, Brochard L, Burns KEA. The role for high flow nasal cannula as a respiratory support strategy in adults: a clinical practice guideline. Intensive Care Med. 2020 Dec;46(12):2226-2237. doi: 10.1007/s00134-020-06312-y. Epub 2020 Nov 17. PMID: 33201321; PMCID: PMC7670292.
24. Oczkowski S, Ergan B, Bos L, Chatwin M, Ferrer M, Gregoretti C, Heunks L, Frat JP, Longhini F, Nava S, Navalesi P, Ozsancak Uğurlu A, Pisani L, Renda T, Thille AW, Winck JC, Windisch W, Tonia T, Boyd J, Sotgiu G, Scala R. ERS clinical practice guidelines: high-flow nasal cannula in acute respiratory failure. Eur Respir J. 2022 Apr 14;59(4):2101574. doi: 10.1183/13993003.01574-2021. PMID: 34649974.
25. Tan D, Walline JH, Ling B, Xu Y, Sun J, Wang B, Shan X, Wang Y, Cao P, Zhu Q, Geng P, Xu J. High-flow nasal cannula oxygen therapy versus non-invasive ventilation for chronic obstructive pulmonary disease patients after extubation: a multicenter, randomized controlled trial. Crit Care. 2020 Aug 6;24(1):489. doi: 10.1186/s13054-020-03214-9. PMID: 32762701; PMCID: PMC7407427.
26. Ioannis Pantazopoulos, Zoi Daniil, Melanie Moylan, Konstantinos Gourgoulianis, Athanasios Chalkias, Spyros Zakynthinos & Eleni Ischaki (2020) Nasal High Flow Use in COPD Patients with Hypercapnic Respiratory Failure: Treatment Algorithm & Review of the Literature, COPD: Journal of Chronic Obstructive Pulmonary Disease, 17:1, 101-111, DOI: 10.1080/15412555.2020.1715361.
27. Reimer AP, Simpson B, Brown AS, Passalacqua M, Keary J, Hustey FM, Kralovic D. High-Flow Nasal Cannula in Transport: Process, Results, and Considerations. Air Med J. 2022 Jan-Feb;41(1):42-46. doi: 10.1016/j.amj.2021.09.008. Epub 2021 Oct 27. PMID: 35248341; PMCID: PMC8549608.
28. Park S. High-flow nasal cannula for respiratory failure in adult patients. Acute Crit Care. 2021 Nov;36(4):275-285. doi: 10.4266/acc.2021.01571. Epub 2021 Nov
29. PMID: 35263823; PMCID: PMC8907461.

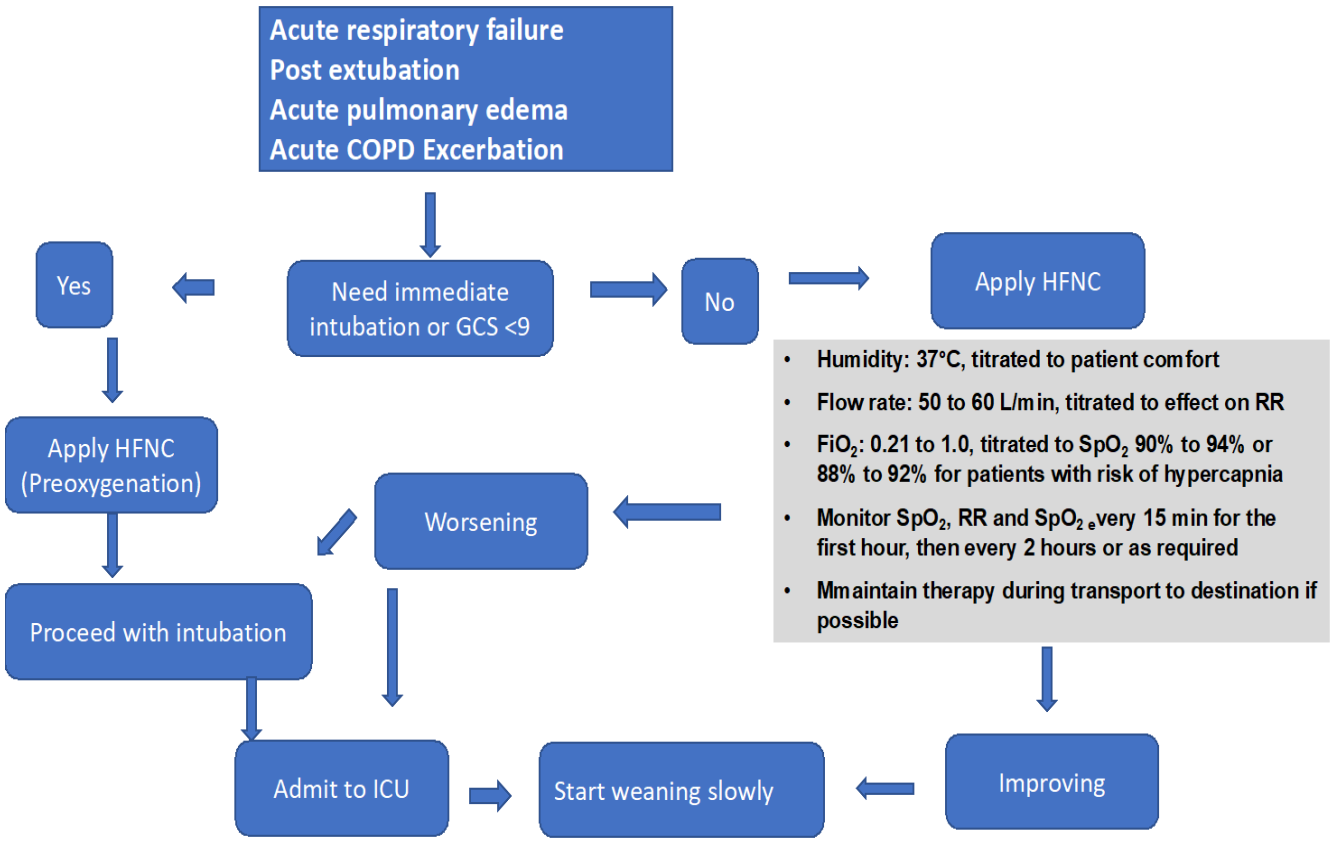

Figure 1 Flowchart, management of acute respiratory failure using high flow nasal cannula