High-Flow Oxygen During the COVID-19 Pandemic

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Recommendation: High-flow oxygen is a recommended therapy for hypoxia associated with COVID-19 disease.

Definition: *High-flow nasal cannula (HFNC) is comprised of an air/oxygen blender, humidifier, heated circuit, and nasal cannula. Medical gas is heated and humidified and delivered at up to 60 L/min. HFNC improves patient flow matching, provides Positive End-Expiratory Pressure (PEEP), reduces anatomic dead space and improves patient comfort when compared to supplemental oxygen by nasal cannula.*

Remark: *Limited evidence suggests HFNC has a low risk of causing nosocomial transmission; however, healthcare workers should use N95 respirators in addition to other personal protective equipment when their patients are using HFNC until further evaluation of safety can be completed. The use of a negative pressure room is preferred if available, but not required.*

Rationale:

The current COVID-19 pandemic is causing global mortality and overwhelming healthcare systems internationally. The demand for healthcare workers and life support devices like ventilators is greater than the supply in many regions making prevention of transmission to healthcare workers and judicious use of life support devices a priority. HFNC has been demonstrated to reduce need for mechanical ventilation in acute hypoxemic respiratory failure in a general ICU population (1).

Preferentially placing COVID-19 patients on HFNC may prevent intubation and mechanical ventilation, which will likely facilitate earlier mobilization, reduce respiratory muscle atrophy, and result in shorter ICU and hospital length of stay to help reduce resource strain. Similar logic applies to extubating to HFNC to facilitate earlier mobilization and reduced length of stay. The World Health Organization (WHO), Society of Critical Care Medicine (SCCM), European Society of Intensive Care Medicine (ESICM), Australian and New Zealand Intensive Care Society (ANZICS) and Chinese Medical Association recommend the use of HFNC in COVID-19 with respiratory failure (2–5). However, there is concern that HFNC may be an aerosol generating medical procedure (AGMP) that increases the risk of nosocomial transmission of COVID-19. Below is a review of the available evidence to better assess the risk of HFNC causing healthcare worker transmission of COVID-19.

Hui et al. have published numerous simulation studies investigating exhaled air dispersion using a high-fidelity human patient simulator (6–9). They have tested multiple oxygen delivery modalities in an experimental design where smoke was delivered to the simulator's right main bronchus and exhaled smoke dispersion was measured using laser illumination and motion video. These studies were done under similar conditions, usually in a negative pressure room, with titrated doses of oxygen, pressure, or flow, and with modifiable simulated oxygen consumption, lung compliance, respiratory rate, and tidal volume. Table 1 demonstrates the maximal dispersion for different oxygen modalities from these studies. These data suggest HFNC cause less air dispersion than even normal nasal cannula, which may be due to air humidification in HFNC therapy generating larger droplets with a shorter trajectory. Further data from healthy volunteers suggest that HFNC does not increase dispersion of aerosols in healthy volunteers compared to no HFNC (10).

Table 1:

Oxygen Delivery Modality	**Maximal Dispersion (cm)**
High-Flow Nasal Cannula (up to 60 lpm)	17.2 +/- 3.3
CPAP (up to 20 cmH2O)	33.2 +/- 3.4
Nasal cannula (up to 5 lpm)	100
Simple oxygen face mask	40
NIPPV (up to IPAP 18 and EPAP 4)	50

Maximal air dispersion from Hui et al. simulation studies. lpm: litres per minute, IPAP: inspiratory positive airway pressure, EPAP: expiratory positive airway pressure

There are limited real world data investigating HFNC and transmission of infectious disease. A retrospective Canadian study looking at risk factors for SARS transmission from patients requiring intubation to healthcare workers estimated HFNC to be protective; however, this result was not statistically significant (11). This is compared to intubation having a pooled odds ratio of 6.6 for transmission of SARS to healthcare workers and additional data from the SARS outbreak in Toronto also suggesting intubation is a procedure with a high risk of transmission (12, 13). HFNC have also been found to not be associated with increased air or contact contamination from patients with gram negative pneumonia when compared to oxygen mask (14).

In conclusion, there are no available data to definitively describe the safety of HFNC in COVID-19; however, the available data do not support the hypothesis that HFNC increases risk of transmission of COVID-19. In fact, the above data are supportive of a hypothesis that HFNC may possibly be beneficial in reducing transmission of COVID-19. There is biologic plausibility given humidified air leads to larger droplets and other lipid enveloped coronaviruses have demonstrated shorter survival time with increased relative humidity (15). Therefore, we suggest there should be comfort in using HFNC in COVID-19 patients as there is no clear risk of increased transmission from the available data. Treatment failure and subsequent emergent intubation should still be avoided as it poses an increased risk of healthcare worker transmission to the intubation team. HFNC may be considered preferentially over oxygen by nasal cannula even at lower levels of required oxygen as HFNC may be safer from an infection transmission perspective. Since there is limited safety information available, we recommend healthcare workers use an N95 respirator in addition to other personal protective equipment when caring for patients on HFNC.

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