The impact of high-flow nasal cannula (HFNC) on coughing distance: implications on its use during the novel coronavirus disease outbreak

Ne-Hooi Will Loh, MBBS · Yanni Tan, MBBS · Juvel Taculod, BSRT · Billy Gorospe, BSRT · Analine S. Teope, BSN · Jyoti Somani, MD · Addy Yong Hui Tan, MBBS

To the Editor,

Novel coronavirus disease (COVID-19) caused by severe acute respiratory syndrome coronavirus-2 threatens healthcare resources throughout the world. This is particularly true for the patients who develop moderate to severe respiratory failure and require oxygen supplementation devices such as high-flow nasal cannula (HFNC). The HFNC uses humidification to allow the delivery of up to 100% oxygen at flow rates of up to 60 L·min⁻¹; however, there is a concern this may aerosolize respiratory tract pathogens.

The World Health Organization (WHO) released interim guidance on the management of severe respiratory infection when COVID-19 is suspected. Using evidence from several recently published studies, WHO guidance proffers that HFNC do not create wide-spread dispersion of exhaled air and therefore should be associated with low risk of transmission of respiratory viruses. This document also recommends wearing a standard medical face mask if the healthcare worker is within 2 m of the patient and there is a physical bed separation of at least 1 m.

We carried out an experiment to simulate a patient coughing while using HFNC to assess the maximum distance of droplet dispersion. Formal ethics approval was waived by the Office of Human Research Protection Programme, National Healthcare Group, Singapore. The authors (n = 5), with no history of lung disease, participated. All gargled 10 mL of diluted red then blue food dye. They were then seated with their mouths approximately 1.30 m from the floor, inhaled to vital capacity, and coughed with an open mouth. Each participant coughed twice and the furthest distance that a visible food dye droplet travelled on the ground was measured. The process was repeated while wearing a well-fitting HFNC (2004F7015 High/Low Blender, Bio-Med USA and Optiflo, Fisher Paykel Healthcare New Zealand) at 60 L·min⁻¹ flow.

We showed that in these healthy volunteers, cough-generated droplets spread to a mean (standard deviation) distance of 2.48 (1.03) m at baseline and 2.91 (1.09) m with HFNC. A maximum cough distance of 4.50 m was reported when using HFNC (Table).

Hui et al. used a simulator model and a smoke-laser illumination technique to investigate the dispersion of droplets amplified by HFNC. They showed that when HFNC flow rates were increased from 10–60 L·min⁻¹, non-cough exhaled air distances (in the forward direction) increased from 6.5 to 17.2 cm, and up to 62 cm (in the lateral direction). It is uncertain if such short distances are accurate in patients who are coughing. Leung et al. found no evidence of increased surrounding surface contamination when using HFNC in patients with gram negative bacterial pneumonia. Nevertheless, extrapolating findings from patients with bacterial pneumonia to those
with viral pneumonia may not be rational. In our study, four of the five volunteers’ cough droplets travelled further than the WHO-recommended 2 m safe exclusion zone. Overall, the distance of droplet dispersion from coughing increased by an average of 0.42 m with HFNC. Using the other studies\textsuperscript{3,4} as a guide, the safest way to use HFNC during the current COVID-19 outbreak is to embrace the potential of nosocomial airborne transmission and ensure HFNC devices are at least used in single occupancy rooms or negative pressure airborne isolation rooms\textsuperscript{5} when possible. Healthcare workers caring for those using HFNC should be wearing full airborne personal protective equipment (i.e., N95 mask or equivalent, gown, gloves, goggles, hair covers, and face shield or hoods).

Acknowledgement Dr. Matt Cove for his help in the drafting of this manuscript.

Conflicts of interest None.

Funding statement None.

Editorial responsibility This submission was handled by Dr. Hilary P. Grocott, Editor-in-Chief, Canadian Journal of Anesthesia.

References

1. Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet 2020. DOI: https://doi.org/10.1016/S0140-6736(20)30566-3.
2. World Health Organization. Clinical management of severe acute respiratory infection when novel coronavirus (2019-nCoV) infection is suspected. Interim guidance. Available from URL: https://www.who.int/publications-detail/clinical-management-of-severe-acute-respiratory-infection-when-novel-coronavirus-(ncov)-infection-is-suspected (accessed March 2020).
3. 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. DOI: https://doi.org/10.1183/13993003.02339-2018.
4. Leung CC, 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; 101: 84-7.
5. Wax RS, Christian MD. Practical recommendations for critical care and anesthesiology teams caring for novel coronavirus (2019-nCoV) patients. Can J Anesth 2020. DOI: https://doi.org/10.1007/s12630-020-01591-x.

Publisher’s Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.