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CORRESPONDENCE

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

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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).[1] The HFNC uses humidification to allow the delivery of up to 100% oxygen at flow rates of up to 60 $L{\cdot}min^{-1}$; 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.[2] Using evidence from several recently published studies,[2,3] 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 $L{\cdot}min^{-1}$ 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.*[3] 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 $L{\cdot}min^{-1}$, 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.*[4] 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

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Table Droplet dispersion distances during simulated coughing

Participant	Distance without HFNC (m)	Distance with HFNC (m)	Difference in distance (m)
Female, 159 cm, 46 kg	1.03	1.53	0.50
Male, 171 cm, 76 kg	2.33	3.17	0.84
Male, 171 cm, 79 kg	3.90	4.50	0.60
Male, 170 cm, 70 kg	2.43	2.41	− 0.02
Female, 161 cm, 71 kg	2.73	2.92	0.19
Mean (SD) values	2.48 (1.03)	2.91 (1.09)	0.42 (0.34)

HFNC = high-flow nasal cannula; SD = standard deviation

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[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[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).

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