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## Low-flow nasal cannula oxygen and potential nosocomial spread of COVID-19

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Editor—In the coronavirus disease 2019 (COVID-19) pandemic airway procedures such as intubation, noninvasive positive pressure ventilation, and high-flow nasal cannula are widely considered as potential risks for nosocomial transmission, and risks of infection are recognised even from asymptomatic patients.<sup>1–3</sup> Yet to date there has been little published and limited awareness regarding the risks of a far more prevalent practice: low-flow nasal cannula oxygen spread of COVID-19 from unsuspected patients. Even detailed studies of clinician exposures to unsuspected COVID-19 patients frequently do not include low-flow nasal cannula oxygen therapy as an exposure category.<sup>4</sup>

High viral loads of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) are present in human nares in symptomatic and asymptomatic patients.<sup>5</sup> Air dispersion from low-flow nasal cannulae can reach more than 1 meter away, a distance which, although less than that of an uncovered cough, produces a constant rate of dispersal similar to that of noninvasive ventilation masks set at more than double the oxygen flows.<sup>6</sup> Viral particles survive for multiple days on many surfaces, further facilitating nosocomial transmission.<sup>7</sup> Even without aerosolisation, surface contamination risks remain. During the first SARS epidemic, supplemental oxygen therapy emerged as a risk factor for nosocomial transmission on open wards, equivalent to patient bed crowding and failure to provide washing stations for providers.<sup>8</sup> Even with single-occupancy rooms, healthcare providers could be exposed to or spread SARS-CoV-2 after touching contaminated surfaces

surrounding unsuspected COVID-19 patients presenting for other reasons. In a recent study, researchers sampling air inside COVID-19 negative-pressure patient rooms found the highest concentration of viral RNA in the room of a patient who was on oxygen 1 L min<sup>-1</sup> by nasal cannula, with no documented cough,<sup>9</sup> although in this context clinicians were wearing full protective equipment.

Some institutions have begun covering low-flow nasal cannulae, at least in certain contexts,<sup>10,11</sup> although discussions with peers across specialities and institutions suggest that practice is far from uniform and is sometimes limited to known COVID-19 patients. Existing data should give institutions pause to consider the infection risks of oxygen delivery for all patients, especially in cases where oxygen use is informed by habit, rather than evidence of clinical benefit. When low-flow oxygen via nasal cannula is clearly indicated, simple strategies can be used to mitigate the risk of spread. For example before extubation, a nasal cannula can be placed and covered with a surgical mask to limit the potential for environmental contamination.<sup>11</sup>

By a conservative estimate, if 10% of the occupants of the roughly 1 million hospital beds in the USA are on low-flow nasal cannula oxygen on any given day, that translates into 100,000 patients in US hospitals whose treatment may also be adding to nosocomial spread of SARS-CoV-2. Local conditions and supplies should guide considerations of using surgical masks to cover all low-flow nasal cannulae. If surgical masks are in short supply, other coverings,

including cloth masks, might be of use. Where universal patient testing becomes feasible, or there are sufficient masks for all hospitalised patients, specifically covering the nasal cannula becomes less important. More work is necessary to determine the clinical effectiveness of covering nasal cannulae with masks, and which coverings work best.

With many governments currently encouraging everyone to wear cloth masks in public to decrease spread, our health-care systems should likewise consider the potential risks from the constant blowing of uncovered, loose-fitting, low-flow nasal cannula oxygen.

## Declarations of interest

The authors declare that they have no conflicts of interest.

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# An alternative continuous positive airway pressure system for COVID-19 patients

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**Keywords:** acute respiratory distress syndrome; continuous positive airway pressure; coronavirus; noninvasive ventilation; oxygenation; ventilation–perfusion imbalance; work of breathing

Editor—Continuous positive airway pressure (CPAP) is an ‘aerosol-generating procedure’, and its use in the management of patients with coronavirus disease 2019 (COVID-19) remains controversial.<sup>1,2</sup> Some believe CPAP ‘should never be used outside of appropriate airborne/droplet isolation’.<sup>2</sup> CPAP may also increase the risk of delayed recognition of a worrying clinical deterioration, such that tracheal intubation is performed as a ‘high staff-infection-risk’ emergency event.<sup>2,3</sup> There seems to have been little attention paid to alternative CPAP systems that are not ‘aerosol-generators’. Our search of the medical literature has revealed only two.

The first is the pressure breathing system used by fighter pilots. Developed eight decades ago in the early stages of World War II, it gave a tactical altitude advantage over pilots in similarly un-pressurised aircraft.<sup>4</sup> Oxygen is inspired from a ‘demand’ pressure source and expired via a pressure-controlled expiratory valve, with both the inlet valve and separate expiratory valve incorporated into the pilot’s face mask.<sup>5</sup> The expiratory gas flow could be ‘scavenged to safe’.

The second was designed five decades ago for a study on the cardiorespiratory physiological effects of CPAP (Fig 1). The patient inspires from a weighted bellows pressure-source via standard anaesthesia tubing and a specially designed CPAP-