

Risk of COVID-19 Infection in Healthcare Workers Exposed During Use of Non-invasive Ventilation in a Tertiary Care Hospital in Oman

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ABSTRACT

Objectives: Healthcare workers (HCWs), especially those working on the front line, are considered to be at high risk of nosocomial acquisition of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus that causes coronavirus disease 2019 (COVID-19). Little is known about the effectiveness of the recommended protective methods as few reports have described spread of the disease in hospital settings among this high-risk population. We describe the hospital-based transmission of SARS-CoV-2 related to non-invasive ventilation (NIV) in one of the main tertiary care hospitals in Oman. **Methods:** All exposed patients and HCWs from Royal Hospital were screened, quarantined, and underwent telephone interviews to stratify their risk factors, clinical symptoms, and exposure risk assessment. **Results:** A total of 46 HCWs and patients tested positive for SARS-CoV-2 after exposure to an index case who received 48 hours of NIV before diagnosing COVID-19 infection. Over half of the exposed (56.5%; n = 26) were nurses, 26.1% (n = 12) were patients, and 15.2% (n = 7) were doctors. None of the HCWs required hospitalization. Sore throat, fever, and myalgia were the most common symptoms. **Conclusions:** NIV poses a significant risk for SARS-CoV-2 transmission within hospital settings if appropriate infection control measures are not taken.

In December 2019, a novel coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was isolated from several patients presenting with pneumonia in Wuhan City, China. The virus was responsible for coronavirus disease 2019 (COVID-19) across China and globally.¹ Presently, there are no definitive treatments for COVID-19 infection, and current management strategies focus on supportive care, infection control, and investigational therapies.² Healthcare workers (HCWs), especially those in the front line, are considered among the high-risk populations for acquiring the virus with a high case fatality rate.³ Although non-invasive ventilation (NIV) is considered an aerosol generating procedure (AGP), there are conflicting data about its risk in transmitting SARS-CoV-2, and no direct acquisitions related to NIV has yet been reported.⁴

We describe SARS-CoV-2 transmission directly related to the use of NIV in a high dependency

medical unit (HDU) after exposure to a patient with chronic kidney disease who presented with clinical features suggestive of pulmonary edema. The index patient was commenced on NIV for respiratory distress. He was screened and tested positive for SARS-CoV-2 later when he deteriorated clinically and required mechanical ventilation.

METHODS

On 2 July 2020, an epidemiological investigation was conducted when the index patient was diagnosed with COVID-19 infection. The patient had stayed in an open HDU cubicle at the Royal Hospital with four other patients for 48 to 72 hours, including 48 hours of NIV, before COVID-19 diagnosis and implementation of contact and airborne isolation precautions. A total of 22 HCWs were assigned to the HDU but were unaware of the index case COVID-19 status at the time of contact and, as a result, were only wearing surgical masks as per hospital policy. All

exposed cases were screened by SARS-CoV-2 real-time polymerase chain reaction. Positive cases were thoroughly investigated to determine demographic data, occupation, acquisition risk, and clinical outcomes. Data were entered in Microsoft Excel and analyzed accordingly as numbers and percentages.

Close contact is defined as a patient or staff who stayed or worked in the same ward as the index patient.

Significant exposure is defined as staff who had contact within two meters to the index case for a cumulative time of > 15 min, had performed AGPs without appropriate personal protective equipment (PPE), or patients who shared the same cubicle with the index case.

Ethical approval was obtained from the Research Ethics Committee of the Royal Hospital (SRC#26/2020).

RESULTS

A total of 38 HCWs and 28 patients were screened after exposure to the index case, 46 (69.7%) tested positive for SARS-CoV-2. Among them were 26 nurses, seven doctors, one paramedical personnel, and 12 patients. Twenty-two HCWs and four patients (over half of those who tested positive, 56.5%; $n = 26$) were in the same cubicle as the index case and were identified as close contacts with significant exposure. An additional seven patients and 13 HCWs were exposed indirectly through contact with other HCWs or patients in the same ward. Out of the 12 exposed patients, three died from their original disease (two had advanced malignancies and one had terminal cardiomyopathy), while none of the HCWs required hospitalization. Sore throat (60.9%; $n = 28$), fever (58.7%; $n = 27$), and myalgia (47.8%; $n = 22$) were the commonest symptoms.

Antipyretics and multivitamins were the most commonly used medication. Demographic and clinical outcomes of patients, HCWs, and the index case are described in Table 1.

DISCUSSION

COVID-19 infection poses unique challenges for infection prevention and control within health facilities.³ HCWs were at increased risk to occupational exposures during outbreaks of SARS, MERS-CoV, and recently SARS-CoV-2, all transmitted by contact or respiratory droplets,

Table 1: Demographic and clinical outcomes of the patients (including the index case) and healthcare workers infected with SARS-CoV-2.

Variables	Patients	Nurses	Doctors
Age, mean	55.0	35.0	28.0
Gender			
Male	3	2	2
Female	10	24	5
Nationality			
Omani	10	9	7
Non-Omani	3	17	0
Risk factors			
Diabetes mellitus	4	0	0
Hypertension	9	0	0
Symptoms			
Fever	6	14	7
Sore throat	1	20	7
Myalgia	2	16	4
Outcome			
Recovered	10	26	7

aerosols, or fomites.¹ During the COVID-19 outbreak, HCWs were at high risk of developing COVID-19 even when infection prevention measures at hospitals were in place, including using PPE, hand hygiene, and patient placement in negative pressure isolation rooms.⁵ Most of these acquisitions were related to community exposures.⁶ In some reports, the risk of acquisition within health care settings was highest among HCWs exposed to COVID-19 patients with low clinical suspicion and, therefore, were unlikely to adhere to strict infection control measures such as wearing the appropriate PPE or performing hand hygiene.^{6,7} Asymptomatic infected front-line HCWs could contribute to nosocomial transmission to their colleagues or patients. Compared to the general population, studies from the UK and USA suggest that front-line HCWs account for 10–20% of all COVID-19 positive cases.⁸ Locally, we reported 4.3% acquisition of the virus among HCWs.⁹

Factors associated with increased risk of SARS-CoV-2 transmission in health care settings include close proximity, ineffective droplet precautions, inadequate PPEs while performing AGP, and lack of infection prevention training.⁴ Where NIV is used, improper fitting of the patient's facial

interface was found to increase the risk of spreading the exhaled air in a radius up to a meter around the patient.⁴ It is believed that the primary transmission mode of COVID-19 is through large respiratory droplets and close contact, although limited data indicates it may also spread through aerosol or indirect contact with contaminated surfaces.⁵ Additional sources could be asymptomatic or undiagnosed patients, visitors, or staff members.³

Similar to other studies, fever, sore throat, and myalgia were common symptoms.^{10,11} None of the 33 HCWs complained of lower respiratory tract symptoms or required hospitalization, and all recovered fully. In contrast, survived patients were discharged after an average of 23 days of hospitalization.

The risk of NIV in the transmission of SARS-CoV-2 is thought to be very low. This conclusion was extrapolated from four observational studies investigating the risk of SARS-CoV-2 transmission, one study examining dispersal of air during NIV and the other study measuring aerosols/droplets produced.⁴ Three observational studies showed a trend towards increased risk of SARS-CoV-2 transmission that was not shown in multivariate analysis.¹² The fourth observational study showed no infection risk in 105 HCWs exposed to NIV despite air dispersal detected to around one meter; nevertheless, there was no significant increase in aerosol production.^{4,13}

Knowledge gaps on the potential role of NIV in airborne transmission of SARS-CoV-2 may result in serious outbreaks among HCWs if appropriate protective measures are not taken, and could deprive patients of lifesaving procedures due to safety concerns among HCWs. Following this incident, the hospital issued more regulations to prevent similar acquisition, including wearing N95 masks when dealing with patients on NIV regardless of their COVID-19 status, restricting NIV use to predetermined areas, and screening all patients requiring NIV for SARS-CoV-2.

Our study has limitations as it included single-center data, and the number of the screened individuals was small relative to the total number of hospitalized patients on NIV.

CONCLUSION

Early recognition and screening of patients for SARS-CoV-2 and strict adherence to infection

control measures including appropriate PPE, should be encouraged at all times when HCWs are dealing with patients.

Disclosure

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