

## Prevalence and Predisposing Factors Associated with Covid-19 Disease among Anesthesia Healthcare Providers

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### ABSTRACT

**Introduction:** Covid-19 pandemic has put high pressure on the anesthesia healthcare workforce due to imposing heavy workload as well as high risk of disease transmission. Identifying the risk factors for the disease is the first step to reduce the risk of infection. We aimed to assess the prevalence and the risk factors of COVID-19 among anesthesia healthcare workers.

**Materials and Method:** Between June and September 2020, 199 members including faculty anesthesiologists working in public teaching hospitals, anesthesia assistants, anesthesia technicians, and nurses working in Covid-19 and non-Covid-19 care units were enrolled in this study. A questionnaire including demographics, medical history, job category, history of presence in areas with Covid-19 epidemic, use of safety tips, current clinical manifestations and the results of COVID-19 tests was sent by email to the healthcare workers. Evidence of COVID-19 disease according to WHO diagnostic recommendations, was assessed in all participants.

**Results:** Of 199 participants in our study, 43.7% were Covid-19 positive and 56.3% had no evidence of Covid-19 disease. Comparison of the two groups of personnel with and without Covid-19 disease showed no differences in demographics and blood groups. While, physicians were more infected than nurses and presence of infected cases in COVID zone was much longer. Regarding observance of safety points, there was no difference between the personnel with and without Covid-19 but using filtered N95 masks was significantly more prevalent in infected cases ( $p = 0.019$ ). During follow-up, 38.0% of infected cases showed some evidence of end organ damages including cardiac complications in 4.3% and renal dysfunction in 4.3%.

**Conclusion:** Our study showed a high rate of Covid-19 infection in anesthesia personnel involving in the care centers of patients with Covid-19. Using filtered N95 masks could not effectively protect the personnel against Covid-19 infection. History of presence in epidemic areas and working in Covid-19 patients' wards were identified as the main risk factor for Covid-19 infection among personnel.

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## Introduction

Coronavirus 2019 disease (Covid-19), officially named by the World Health Organization (WHO) on February 12, 2020, has spread at an unprecedented rate (1). Because the main route of transmission is through aerosols and close contact, anesthesia healthcare providers have been at high risk of infection during endotracheal intubation and cardiopulmonary resuscitation (CPR) and similar procedures (2).

Adequate knowledge of infection prevention and control, vigilance in protective measures, standard and appropriate use of personal protective equipment (PPE) including N95 masks, goggles, gowns, double gloves, nylon shoe protector, and strict preparation for caring of infected patients are important preventive measure (3). Nonetheless, there is concern about the involvement of health care providers despite seemingly appropriate PPE (4). The protection of health care workers is not limited only to PPE and includes all principles of prevention and infection control behaviors (5). To date, age, history of hypertension, chronic lung disease, immunodeficiency, and diabetes are identified as risk factors of disease severity in patients with COVID-19 (6).

Covid-19 has put pressure on global health systems, leading to longer working hours and increasing workload as well as high risk of disease for healthcare providers (7). Therefore, identifying risk factors for the disease is the first step in taking appropriate action to reduce these risks (8). Hence, in the present study, we aimed to assess the prevalence and the risk factors of COVID-19 among anesthesiology workers in the teaching hospitals of Mashhad University of Medical Sciences.

## Materials and Method

This cross-sectional study was performed on 199 anesthesia healthcare providers in the teaching hospitals of Mashhad University of Medical Sciences between March and September 2020. From these cases, 161 participants responded to our

correspondence. Therefore, the subjects were selected from the available samples. The participants were all anesthesiologists, assistants, and nurses working at all educational and medical centers of Mashhad University of Medical Sciences.

A questionnaire was sent through email to all the eligible individuals. The study questionnaire included baseline characteristics including demographics (gender, age, and body weight), blood group, workplace in the hospital, job category, history of close contact with the animals, history of Covid-19 disease among family members and relatives, history of presence in Covid-19 zone, full observance of safety tips (using surgical masks, N95 masks, special clothes or gowns, latex gloves, glasses, face shield, hand rub, and footwear), underlying comorbidities (any known underlying acute or chronic disorders under medications), history of receiving the influenza vaccine, smoking, and current clinical manifestations and the results of COVID-19 diagnostic tests.

Our criteria for COVID-19 disease included WHO diagnostic recommendations (9): the positive test for molecular assessment (detecting virus RNA by the polymerase chain reaction (PCR), or clinical manifestations based on the infectious disease specialist judgment, or a combination of clinical manifestations and evidence of pulmonary involvement in high-resolution computed tomography (HRCT) or positive serum immunoglobulin M and/or G.

The study protocol was approved by the Institutional Medico-Ethical Review Committee of MUMS (registration ID: IR.MUMS.REC.1399.174) and written informed consent was signed by each participant prior to enrollment.

All the data were collected prospectively on standard forms and entered into a computerized database. Descriptive analysis was used to describe the data, including mean  $\pm$  standard deviation (SD) for quantitative variables and frequency (percentage) for categorical variables. Chi square test, independent t test and Mann-Whitney U test were used when appropriate for comparing the variables. For the statistical analyses, the

statistical software IBM SPSS Statistics for Windows version 22.0 (IBM Corp. Released 2013, Armonk, New York) was used. P values <0.05 were considered statistically significant.

## Results

Of 161 participants in the study (mean age of  $36.63 \pm 8.12$  years), 61.3% are female and 38.7% male. Overall, 64.6% of the staff worked in the Covid-19 patient healthcare ward and 35.4% in other wards. Also, 31.1% of the cases were anesthesiologists and residents, 68.3% were nurses, and 0.6% were secretaries.

Of 161 participants, 43.7% had Covid-19 disease and 56.3% had no evidence of Covid-19 disease. The PCR test had been performed on 149 participants. Among them, 44.4% were Covid-19 positive. HRCT was requested for 22.4% of Covid-19 patients confirming the diagnosis in 100% of them. Among infected patients, positive PCR was recorded only in 73.6%, positive IgG test in 11.1% and positive IgM test in 16.7% of patients. Overall, 1.5% experienced re-infection with corona virus.

Among personnel suffering from Covid-19, 4.8% of cases had close contact with an infected person in their family before the infection, while 24.7% infected their family members after infection. In the Covid-19 disease group, 60.2% had a close contact with other patients suffering acute respiratory distress symptoms. Comparing the two groups of personnel with and without Covid-19 disease, regarding the baseline characteristics, there was no difference between the two groups in demographics and blood groups (Table 1).

Nonetheless, physicians were more infected than nurses and presence of infected cases in COVID zone was much longer. Regarding observance of safety points (Table 2), there was no difference between the personnel with and without Covid-19 but using filtered N95 masks was significantly more prevalent in infected cases ( $p = 0.019$ ). Comparing comorbidities and history of medications between the two groups of personnel with and without Covid-19 showed no significant difference (Table 3).

**Table 1:** Baseline characteristics among personnel with and without Covid-19

Item	Covid-19 (+) (n =71)	Covid-19 (-) (n =90)	P value
Male gender	1.7%	38.2%	0.695
Mean Age, year	37.04±7.71	36.23±9.08	0.555
Mean BMI, kg/m <sup>2</sup>	24.96±3.57	23.99±4.07	0.118
Occupation			0.012
Physician	42.9%	20.9%	
Nurse/others	47.1%	74.4%	
Nurse aid	10	4.7	
Blood group			0.084
A	29.2%	28.1%	
B	26.4%	24.7%	
AB	8.3%	10.1%	
O	36.1%	37.1%	
Rh situation			0.522
Rh+	87.5%	89.9%	
Rh-	12.5%	10.1%	
Positive HRCT result	22.4%	0	
Staff in Covid-19 wards	76.4%	55.1%	0.005
Covid-19 operating room	35.8%	28.8%	0.37
Contact with animals	6.9%	14.6%	0.125
History of presence in epidemic area	54.4%	15.5%	0.001
Close contact with Covid-19 patients	87.0%	74.7%	0.057

As shown in Figure 1, in our study the most common clinical manifestations related to Covid-19 in patient groups included fatigue in 61.1% followed by fever in 59.7%, headache in 51.4%, and cough in 50.0% and others were: chilling, sore throat, anorexia, dyspnea, myalgia, anosmia, nausea, vomiting, diarrhea, stomachache, vertigo, arthralgia, arthritis. Overall, clinical symptoms appeared in 75.0% of patients. All of the cases infected by Covid-19 were treated with different medications.

During a follow-up of 180 days, 38.0% of patient group showed some evidence of end organ damages including cardiac complications in 4.3% and renal dysfunction in 4.3% which improved in 32.4% completely and partially in others.

### Discussion

At the time of the SARS outbreak, 21% of infected people worldwide were health care workers (3). The pattern of transmission of the Ebola virus is comparable to SARS-CoV-2. During the Ebola virus crisis, healthcare workers accounted for 9.3% of all cases (21-32 times higher than the general population) which revealed inadequate PPE was associated with an increased risk (10-11). It also confirmed the importance of PPE in preventing H1N1 subtype influenza virus much higher among health care workers in isolated units (12). About Covid-19, in a study in the United Kingdom and the United States in April 2020, the prevalence of the disease in healthcare workers was three times higher than in the general population, and it was five times higher in blacks, asians and minorities than in non-Hispanic whites (13). Inadequate

or reuse of PPE was closely associated with an increased risk of COVID-19, but increased susceptibility was evident even in people with adequate PPE. Front-line healthcare providers working in inpatient centers (where providers typically report PPE reuse) and nursing homes (where service providers typically report inadequate PPE); and Individuals at direct contact with patients with COVID-19 had the highest risk for disease (3). Since, adequate availability of PPE reduces COVID-19 risk, but inadequate or reuse of PPE may pose a relatively higher risk. However, even with adequate PPE, healthcare workers caring for patients with COVID-19 are at greater risk (13). As shown in our study, the rate of using PPE in personnel with and without Covid-19 exposure was mainly similar emphasizing the importance of using supportive tools.

In our study, 43.72% of healthcare personnel including physicians and nurses were infected despite using protection and safety tools. Overall, 98.5% of infected personnel using protective and safety equipments, misused or reused them and it might be the cause of infection. Since, proper training for wearing and removing the equipments is recommended. In this regard, just filtered N95 masks solely played a negative role in protection against virus during exposure to aerosol such as intubation. Since, it is currently recommended by the World Health Organization to use filtered N95 masks with surgical masks on them during intubation and face shields as well.

**Table 2:** Personal protective equipment among personnel with and without Covid-19

Item	Covid-19 (+) (n = 71)	Covid-19 (-) (n = 90)	P value
Observance of safety points	98.6%	96.6%	0.628
Simple surgical mask	65.3%	75.0%	0.179
N95 mask	90.3%	76.1%	0.019
Special clothes	79.2%	68.2%	0.119
Surgical Gan	30.6%	53.4%	0.004
Latex glove	87.5%	90.9%	0.486
Glass	76.4%	68.2%	0.251
Shield	80.3%	72.7%	0.267
Hand rub	88.9%	92%	0.496
Footwear	70.8%	61.4%	0.210

In a review study on April 2020, the lack of PPE, exposure to infected patients, poor infection control, long working time and underlying diseases were identified as risk factors for Covid-19 among healthcare providers (3). The routes of transmission of Covid-19 disease to the personnel included direct transmission such as coughing, sneezing, inhaling drops, and contact transmission such as contact with the mucous membranes of the mouth, nose, and eyes (14). In early February 2020, scientists demonstrated that disease transmission among communities was associated with overcrowding, lack of isolation room facilities, and environmental pollution (15). Exposing to infected patients and overtime contact have been found as the two important factors infecting the staff. In the United States, 55% of health care workers are at risk (16). Compared to the general public, the incidence is higher for healthcare professionals because

they have long-term contact with infected people (17). According to our results, working as a nurse or physician in the wards, operating rooms, and intensive care units of Covid-19 patients, were found as a risk factor of Covid-19 infection in personnel. Among high-risk health care personnel, those who were exposed to the airway and oral cavity secretions for a long time, such as dentists, were more likely to be infected (18). Also, more experienced healthcare personnel, mostly physicians and nurses, are forced to serve as front-line personnel despite having previous underlying illnesses such as hypertension, diabetes mellitus, cardiovascular disease, chronic lung disease, and immunosuppression which are important predisposing factors. These factors identified as major risk factors for Covid-19 disease in other studies (19, 20).

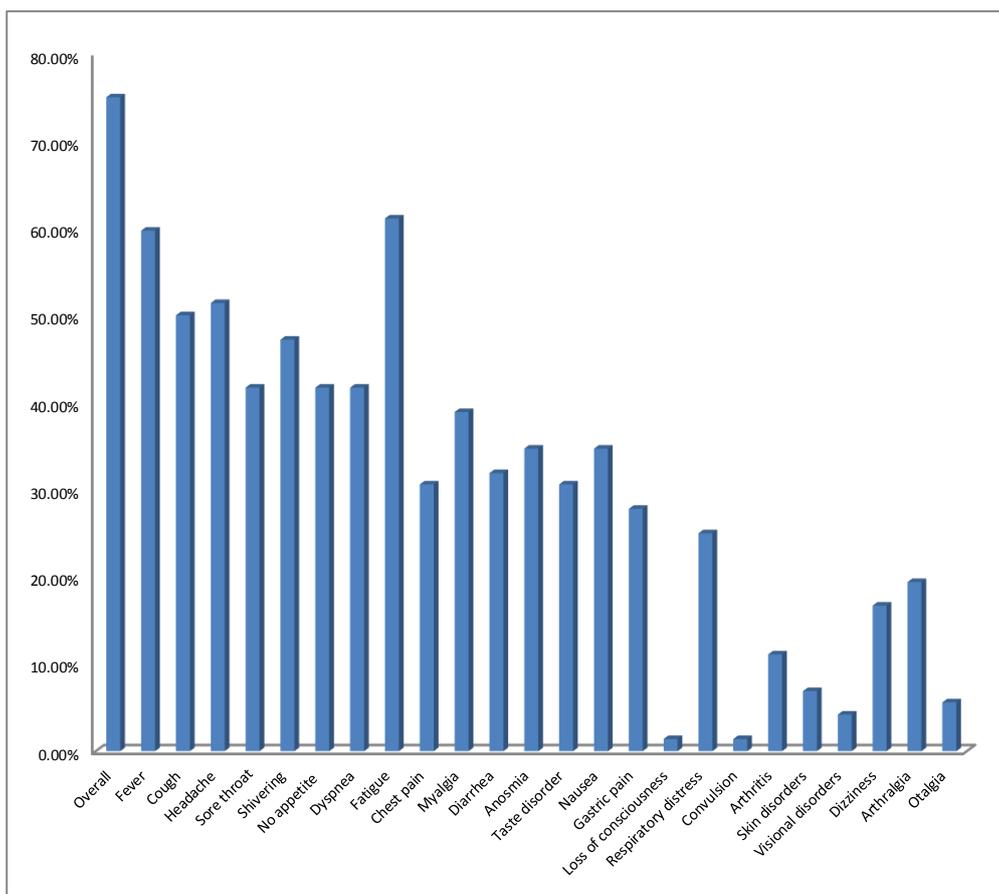


Figure 1: Clinical manifestation in Covid-19 patients

In our study, a history of chronic drug use was associated with Covid-19 disease, while the role of these comorbidities was not demonstrated in our study. Therefore, medical centers should assign tasks to personnel based on age and background conditions. Furthermore, proper infection control training is essential for health care providers. Public education through careful hand hygiene, self-inoculation prevention (touching mucous membranes), regular cleaning of surfaces and maintenance of social distance (at least 2 meters) are the basis for controlling and preventing infection (3). In another study, ethnicity, race, and social, economic, and cultural conditions contributed to the incidence of the disease

(21) that were not assessed in the present study.

Evidence suggests that COVID-19 infection has a dose-dependent quality of the virus, and therefore people who perform high-risk interventions may develop more severe disease (22). In our study, 60-80% of infected personnel had close contact with a patient with acute respiratory symptoms or Covid-19 positive, about 14 days before the onset of symptoms. Epidemiological factors, including recent traveling to epidemic areas within 14 days or close contact with a confirmed patient within 14 days of the onset of the disease, or close contact with a person with fever and shortness of breath, have been confirmed factors in increasing of incidence (23).

**Table 3:** Underlying disorders among personnel with and without Covid-19

Item	Covid-19 (+) (n = 71)	Covid-19 (-) (n = 90)	P value
<b>Underlying disorders</b>			
Diabetes mellitus	2.8%	3.4%	0.829
Cardiac disorders	2.8%	1.1%	0.440
Hypertension	2.8%	1.1%	0.440
Hyperlipidemia	2.8%	0.0%	0.114
Asthma	5.6%	1.1%	0.107
Chronic pulmonary disease	1.4%	0.0%	0.265
Renal disease	1.4%	0.0%	0.114
History of dialysis	1.4%	0.0%	0.265
Hepatic disorders	1.4%	0.0%	0.265
Immune disorders	1.4%	1.1%	0.999
History of cancer	1.4%	0.0%	0.265
History of chemotherapy	1.4%	0.0%	0.265
stroke	1.4%	0.0%	0.265
History of corticosteroid use	1.4%	0.0%	0.265
Morbid obesity	2.8%	0.0%	0.114
Chronic blood disease	2.8%	0.0%	0.114
Inheritance disorders	2.8%	0.0%	0.114
History of organ grafting	2.8%	2.2%	0.830
History of smoking	2.8%	2.2%	0.830
History of chronic medication	8.3%	6.7%	0.702

In our study, the number of working hours per week and the time of exposure to patients were not associated with risk. However, in some studies, due to the lack of personnel and safety equipment, nurses' working hours were considered longer. This may cause complications in the quality of caring for patients and make a danger for nurses and healthcare providers (24). Moreover, old age and underlying disorders, have been revealed as risk factors for disease among personnel (25) that were not found in the present study.

It has been well understood that surgical smoke from heat destruction of tissue (electrocautery) and even the soles of surgical team's shoes may be risk factors in the transmission of SARS-CoV-2 in the operating rooms. Ensuring social distancing, even while using masks in operating rooms, may be helpful since health care workers may be asymptomatic carriers (25).

In the present study, of 161 participants, 43.7% had Covid-19 infection and 56.3% had no evidence of Covid-19 disease. Comparing the two groups of personnel with and without Covid-19 disease showed no difference in demographics and blood groups. While, physicians were more infected than nurses and presence of infected cases in COVID zone was much longer. Regarding observance of safety points, there was no difference between the personnel with and without Covid-19 but using filtered N95 masks was significantly more prevalent in infected cases ( $p = 0.019$ ).

In final, only three-fourth of personnel with Covid-19 had initial clinical symptoms emphasizing the diagnosis based on a holistic view and attention to the set of clinical signs, imaging findings, and molecular assessments.

### Limitations

The study had some potential limitations. First of all, since the method of data collection was correspondence with the participants through sending them the checklists via email and some people did not respond, we inevitably had a drop in the number of participants. Secondly, due to the lack of direct oversight on completing the checklists, we likely encountered bias resulted from information recall. Furthermore, due to the

fact that in many cases the diagnosis of Covid-19 was only on the basis of clinical symptoms, accurate and definitive diagnosis of the disease, was difficult. Therefore, we may have encountered miscalculations about the diagnosis. In the first few months, PCR tests were not available enough and only some cases were tested by PCR. On the other hand, since some patients had no clinical symptoms, neither symptoms nor negative PCR tests could rule out the disease.

### Conclusions

As the conclusion, in our study the majority of hospital personnel, especially those working in the wards and caring for Covid-19 patients, are at high risk of Covid-19 infection. According to our observations, using only filtered N95 masks cannot protect the personnel against the infection. Demographic characteristics, comorbidities, and even the type of supportive tools do not appear to play important role in reducing the risk of Covid-19 disease.

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