

Possible transmission of Covid-19 infection among healthcare professionals; first defense to early wave of the pandemic

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ABSTRACT

Objective: Healthcare professionals play an essential role in the COVID-19 pandemic on the front lines. There have been a limited number of publications and national status reports on COVID-19 infected healthcare professionals. We aimed to determine the factors that play a role in transmitting COVID-19 infection to healthcare professionals.

Material and methods: Among healthcare professionals, those evaluated as a possible COVID-19 case and whose Polymerase Chain Reaction (PCR) tests were studied in our Emergency Service and Employee Health Polyclinic were included in the study. Age, gender, task, unit, working in COVID-19 units, Thorax Computerized Tomography (CT) and PCR test result, hospitalization status, suspicious contact, and appropriate use of personal protective equipment (PPE) in the work environment and social environment were investigated.

Results: A total of 369 cases were included in the study. 54.7% (n = 207) of potential COVID-19 healthcare professionals worked in COVID-19 units, 22.5% (n = 83) had PCR positive. Employee groups with the highest PCR positivity rate were security guards (88.9%), cleaning staff (31.6%), doctors (26.3%) and nurses (18.8%), respectively. When contact histories with COVID-19 infection were examined; 46.3% of the cases had in-hospital social contact (PCR positivity rate 21.6%), 39.6% had a history of contact with COVID-19 patients (PCR positivity rate 11%). It was determined that 3.3% of the cases (n = 12) were treated in the COVID-19 service, 0.3% (n = 1) was hospitalized in intensive care, 26% (n = 96) were isolated at home, and 70.5 % (n = 260) continued to work. All of the participants were discharged after treatment and returned to their duties.

Conclusion: Adequate training should be given to healthcare professionals to protect them against COVID-19 infection. Additionally, healthcare professionals should show the care to prevent infection in social areas inside and outside the hospital as well as at contact points with patients.

Keywords: COVID-19; pandemic, employee health; infection; healthcare professionals

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INTRODUCTION

The new type of coronavirus infection, named COVID-19 by the World Health Organization (WHO), has spread rapidly, first in China and then all over the world, causing a pandemic. There have been 13 million confirmed cases and approximately 568000 deaths associated with this infection (1). Healthcare professionals play an important role in the COVID-19 pandemic by providing care to patients on the front lines. Despite infection prevention and control measures, 22073 cases of COVID-19 among healthcare professionals from 52 countries have been reported to WHO as of 8 April 2020. Due to the fact that infected healthcare professionals are not systematically reported to WHO by governments, the actual number is unknown (2). There have been a limited number of publications and national status reports on COVID-19 infected healthcare professionals. More than 3,000 cases have been reported in 422 medical facilities by the Chinese Center for Disease Control and Prevention (3). In Italy, currently, 29735 (12.2%) infected healthcare professionals have been reported out of a total of 243000 COVID-19 cases (4).

According to US Center for Disease Control and Prevention data, 9,287 (19%) of 49,370 COVID-19 patients diagnosed between February 12 and April 9, 2020 were healthcare professionals, and 27 deaths were reported (5).

In Turkey, the first COVID-19 case was diagnosed on March 11, 2020. Although the number of infected healthcare professionals was not officially announced, it was reported by the Minister of Health on 29 April 2020 that 7428 out of about 1 million healthcare professionals were infected with COVID-19, and the rate of the total number of cases diagnosed with COVID-19 was approximately 6.5% (6). This study has been planned as there are not enough studies about COVID -19 infected healthcare professionals both in our country and worldwide.

In our study, it was aimed to determine the factors that play a role in the transmission of COVID-19 infection to healthcare professionals in our hospital, which operates as a pandemic hospital.

MATERIAL and METHODS

In this study, healthcare professionals of all age groups of both genders who presented to the emergency department in the first one month period of pandemic with COVID-19 symptoms due to a possible contact with COVID-19 positive patient and whose Polymerase Chain Reaction (PCR) tests were studied by taking a combined nose and throat swab sample were included. The age, gender, duty, unit, working status in hospital units specialized for COVID-19, Thorax Computerized Tomography (CT) results, hospitalization status and clinical follow-up were analyzed retrospectively from the patient files in the hospital automation system. Patients whose study data could not be reached and those who were pregnant were excluded from the study. The subjects were contacted by phone and the suspicious contact point, if any, and the proper and necessary use of personal protective equipment in the work and social environment were questioned. PCR test results of the patients were examined from the Public Health Management System Tracking Module of the Ministry of Health.

Whether the healthcare professionals appropriately used the recommended personal protective equipment (PPE) customized for hospital use for fighting against COVID-19 in the unit was evaluated in accordance with the recommendations of the Ministry of Health COVID-19 Infection Guide dated 13.04.2020 (Table 1) and the risk levels of cases were identified (Table 2).

Statistical analysis

The data were analyzed using the SPSS 22.0 for Windows (SPSS Inc., Chicago, IL, USA) computer program. Categorical variables were expressed as numbers and percentages (%), while continuous numerical variables were expressed as mean \pm standard deviation (minimum - maximum). Kolmogorov-Smirnov test used for the normality distribution of the data. Chi-square and Fisher's exact tests were used to analyze whether there was a relationship between categorical variables. $P < 0.05$ was considered statistically significant.

Ethics statement: The present study protocol was reviewed and approved by the Institutional Ethical Review Board of

our academic hospital (2011-KAEK-25 2020 / 05-13) and the permissions taken from Republic of Turkey the Ministry of Health, General Directorate of Health Services.

RESULTS

The study was conducted in Bursa Yuksek Ihtisas Training and Research Hospital, which has 1520 beds and serves the 4th largest city of Turkey has 3 million inhabitants. A total of 3829 personnel, including 722 doctors, 1776 nurses, 652 cleaners, 216 security guards, 382 office workers, 20 pharmacists, and 61 management services employees, work in the hospital.

A total of 369 cases were included in the study. 65.3% ($n = 241$) of these cases were females and the median age was 32 (minimum = 20, maximum = 62) years. While 53.4% ($n = 197$) of the cases were nurses, 20.6% ($n = 76$) were doctors (Table 3).

It was determined that 54.7% ($n = 207$) of potential COVID-19 healthcare professionals worked in COVID-19 units. When the use of PPE during risky contact in the units against COVID-19 was examined, it was found that 7.9% ($n = 29$) of the cases did not use any PPE, and 28.5% ($n = 105$) only used a surgical mask. It was identified that 95.9% of the cases ($n = 354$) did not use any protective equipment in social areas such as the recreation room used by healthcare personnel in the hospital. When the risky contact histories in terms of COVID-19 infection were examined, 46.3% ($n = 171$) of the cases had a history of in-hospital social contact, while the rate of those with a contact history with a COVID-19 infected patient was 39.6% ($n = 146$). High-risk contact was found in 89.7% ($n = 331$) of the cases (Table 3).

The PCR results of 77.5% ($n = 286$) of the cases were negative whereas 22.5% ($n = 83$) were found to be positive. When the Thorax CT examinations of the cases were evaluated according to the Radiological Society of North America Expert Consensus Statement on Reporting Chest CT Findings Related to COVID-19 classification (7), 89.2% ($n = 329$) of the cases did not have any findings in Thorax CT, while 5%, 7 ($n = 21$) had typical CT findings and 5.1% ($n = 19$) had atypical CT findings. When the outcomes were examined, 3.3% ($n = 12$) of the cases were treated in the COVID-19 service, 0.3% ($n = 1$) was hospitalized in intensive care, 26.0% ($n = 96$) were isolated at home, and 70.5% of the participants ($n = 260$) continued to work (Table 4).

A statistically significant correlation was found in the Chi-square analysis performed to determine the relationship between the positive PCR results of the cases and working status in COVID-19 unit ($p = 0.001$), appropriate PPE use in COVID-19 areas ($p = 0.000$), use of PPE in in-hospital social area ($p = 0.028$), role of healthcare professionals ($p = 0.000$), contact history ($p = 0.000$), and the type of PPE used ($p = 0.000$). The rate of PCR positivity was lower in those working in the COVID-19 unit and using appropriate PPE compared to others. The PCR positivity rate (88.9%) in the security staff was significantly higher than that of the others. While none of those using PPE in social areas used by in-hospital healthcare personnel had PCR positivity, 23.4% ($n = 84$) of those who did not use PPE had a positive PCR test result.

While PCR positivity rate was only 11% in patients with a history of contact with COVID-19, 100% of those with a history of contact with a family member of COVID-19, 54.5% of those with a history of out-of-hospital social contact

with COVID-19, and 21.6% of those with a history of social contact with in-hospital healthcare professionals had a positive PCR test. PCR results were found to be positive in 86.2% (n = 25) of those who did not use any PPE (Table 5).

Table 1. Protective equipment recommended being used for COVID-19 disease in terms of healthcare facility, staff and type of activity

Area	Target Staff	Type of Activity	Type of Personal protective equipment/procedure
Sickroom	Medical staff	Direct care of the patient	Medical (surgical) mask Apron Glove Visors/face shields
		Droplet / aerosol-forming procedures	N95 / FFP2 Mask Apron Glove Visors / face shields
	Cleaning staff	Entering the patient's room	Medical mask Apron Glove Visors/face shields (if there is a risk of organic material or chemical splash)
All other areas where patient transfer takes place (such as clinics, corridors)		All activities that will provide contact with the patient, including healthcare professionals	Medical mask
Triage	Medical staff	Preliminary assessment without direct contact with the patient	At least 1 meter of distance should be kept. Medical mask Visors / face shields
	Patients with/without respiratory symptoms	In every case	At least 1 meter of distance should be kept. The patient should wear a medical mask.
	Administrative staff such as security/secretary etc.	In every case	At least 1 meter of distance should be kept. Medical mask
Lab	Lab technician	Studying respiratory samples	N95 / FFP2 mask Apron Glove Visors/face shields
Office area	All staff, including medical staff	All administrative tasks that do not require contact with patients	Keeping social distance Medical mask if not

Table 2. Assessment of the Healthcare Professional's contact status with the COVID-19 patient

	Healthcare Professional's Use of Personal Protective Equipment (PPE)	Contact Risk
Intense contact with COVID-19 patient wearing a medical (surgical) mask	Not using a medical mask or N95, or used a medical mask in case of N95 indication	Moderate
	Not using eye protection	Low
	Not using gloves and aprons	Low
	Using PPE appropriately	No risk evaluated
Intense contact with COVID-19 patients without a medical mask	Not using a medical mask or N95	High
	Using a medical mask in case of N95 indication	Moderate
	Not using eye protection	Moderate
	Not using gloves and aprons	Low
	Using PPE appropriately	No risk evaluated

Table 3. The work type of healthcare professionals, their working status in COVID-19 units, PPE use, contact history of COVID-19 infection and distribution of contact risk

		n	%
Duty	Nurse	197	5.4
	Doctor	76	20.6
	Cleaning staff	38	10.3
	Lab and X-ray Technician	25	6.8
	Office worker	11	3
	Security guard	9	2.4
	Administrative Services	3	0.8
	Pharmacist	2	0.5
	Other	8	2.2
Working status in COVID-19 units	Yes	202	54.7
	No	167	45.3
PPE use during risky contact in COVID-19 combat units	N95 / FFP3 + Apron + Goggles / Visor + Gloves	118	32
	Surgical Mask	105	28.5
	Surgical Mask + Apron + Goggles / Visor + Gloves	99	26.8
	No equipment	29	7.9
	N95 / FFP3 + Overalls + Apron + Goggles / Visor + Gloves	18	4.9
PPE Use in Hospital Social Areas	No	354	95.9
	Yes	15	4.1
Contact history of COVID-19 infection	In-Hospital Social Contact	171	46.3
	Patient Contact	146	39.6
	Healthcare Professional Contact	26	7
	Out-of-Hospital Social Contact	22	6
	Contact with a Family Member with COVID-19	4	1.1
Contact Risk	High	331	89.7
	Low	34	9.2
	Moderate	1	0.3
	No risk evaluated	3	0.8
	Total	369	100

Table 4. PCR and Thorax CT examination results and outcomes of the cases

		Frequency	Percent (%)
PCR	Negative	286	77.5
	Positive	83	22.5
CT findings	Negative	329	89.2
	Typical	21	5.7
	Atypical	19	5.1
	Continuing to work	260	70.5
Outcome	Isolation at home	96	26
	Hospitalization at service	12	3.3
	Hospitalization in the intensive care	1	0.3
	Total	369	100

Table 5. Comparison of PCR results of the cases with the working status in COVID-19 units, use of PPE in COVID-19 suspected areas and in-hospital social areas, contact history and PPE use

		PCR		Chi-Square Analysis
		Negative n (%)	Positive n (%)	
The working status in COVID-19 units	No	116 (69.50%)	51 (30.50%)	$X^2=11,327$
	Yes	170 (84.20%)	32 (15.80%)	$p=0,001$
The use of PPE in COVID-19 suspected areas	No	1 (33.30%)	2 (66.70%)	$X^2=15,839$ $p=0,000$
	Yes	169 (84.90%)	30 (15.10%)	
	Not working in COVID-19 units	116 (69.50%)	51 (30.50%)	
The use of PPE in in-hospital social areas	No	271 (76.60%)	83 (23.40%)	$X^2=4,538$, $p=0,028$
	Yes	15 (100.00%)	0 (0.00%)	
Duty	Nurse	160 (81.20%)	37 (18.80%)	$X^2=33,381$, $p=0,000$
	Doctor	56 (73.70%)	20 (26.30%)	
	Cleaning staff	26 (68.40%)	12 (31.60%)	
	Lab and X-ray Technician	23 (92.00%)	2 (8.00%)	
	Office worker	10 (90.90%)	1 (9.10%)	
	Security guard	1 (11.10%)	8 (88.90%)	
	Administrative Services	3 (100.00%)	0 (0.00%)	
	Pharmacist	2 (100.00%)	0 (0.00%)	
	Other	5 (62.50%)	3 (37.50%)	
Contact history	In-Hospital Social Contact	146 (78.40%)	51 (21.60%)	$X^2=52,62$, $p=0,000$
	Patient Contact	130 (89.00%)	16 (11.00%)	
	Out-of-Hospital Social Contact	10 (45.50%)	12 (54.50%)	
	Contact with a Family Member with COVID-19	0 (0.00%)	4 (100.00%)	
Type of PPE	N95 / FFP3 + Apron + Goggles / Visor + Gloves	107 (90.70%)	11 (9.30%)	$X^2=83,03$, $p=0,000$
	Surgical Mask	84 (80.00%)	21 (20.00%)	
	Surgical Mask + Apron + Goggles / Visor + Gloves	80 (80.80%)	19 (19.20%)	
	No PPE was used	4 (13.80%)	25 (86.20%)	
	N95 / FFP3 + Overalls + Apron + Goggles / Visor + Gloves	11 (61.10%)	7 (38.90%)	
Total		286 (77.50%)	83 (22.50%)	

DISCUSSION

Struggling at the forefront of the COVID-19 pandemic by providing treatment services to COVID-19 positive patients, healthcare professionals are at serious risk in terms of COVID-19 infection transmission. The importance of PPE use has been gaining importance in cases of confirmed or probable COVID-19 disease as well as in-hospital and daily life social contact areas.

A limited number of publications have reported that healthcare professionals are infected both in the workplace and in the community, mostly through infected family members. Healthcare professionals have been reported to be contaminated due to late COVID-19 diagnosis of patients, working in a high-risk department, longer working hours, inadequate hygiene, lack of training on infection prevention and control measures for respiratory pathogens, including COVID-19 virus, prolonged viral exposure in areas where a

large number of COVID-19 patients are cared for, and incomplete or improper use of PPE (2, 6, 8)

During the study period, a total of 369 healthcare professionals who were evaluated in the Emergency Department of our hospital with COVID-19 symptoms or in the Employee Health Polyclinic due to high risk contact with COVID-19 positive patients, considering as possible COVID-19 cases were included in the study. 65.3% of the healthcare professionals in our study were females. When the distribution according to their occupation was examined, 53.4% of the cases were nurses, 20.6% were doctors and 10.3% were cleaning personnel. Similarly, in a study examining 43 health professionals, it was reported that the rate of females (84%) was higher than that of males and 51% of the nursing staff were affected by the infection (9). Similarly, in the CDC weekly reports, 73% of the healthcare professionals concerned were reported to be females. The fact

that the nurses are exposed to a higher risk of infection is that the majority of nurses are female, the number of nurses is higher than those with other titles, and they have proximity to patients during treatment administration.

In our study, the PCR test of 22.5% (n = 83) of the cases was found to be positive. Employee groups with the highest PCR positivity rate were security guards (88.9%), cleaning staff (31.6%), doctors (26.3%) and nurses (18.8%), respectively. The high rate of PCR test positivity in security guards and cleaning personnel may be due to the lack of training on the use of appropriate PPE and prevention measures from infection and the inefficient use of the required PPE.

When the COVID-19 contact risk groups were evaluated, it was determined that 89.7% of our healthcare professionals were in the high-risk contact group. Similarly, in another study, 121 patients, including 43 symptomatic healthcare professionals, were investigated and 3 COVID-19 positive healthcare professionals were identified as a result of multiple unprotected patient contact, especially during respiratory tract interventions, and it was emphasized that there should be no contact without PPE (9). At this stage, the use of appropriate PPE in patient management becomes very important. In our study, it was determined that the proper use of PPE at the point of contact with COVID-19 patients was associated with a negative PCR result with a rate of 84.9%.

COVID-19 can be transmitted with high potential even in asymptomatic patients, and this is enough to emphasize the problems that may be caused by the inappropriate use of PPEs. In some case reports published from Wuhan, it was reported that 14 healthcare professionals were infected with a patient even without a fever response, and significant transmission was caused by the patient who did not develop symptoms although substantial findings were detected in lung imaging. At this point, the exclusive use of PPE (N95, visor, protective apron) has been found to be very significant and effective, especially in protection from infection (10-12). In our study, similar results were obtained. It was determined that the use of N95, protective apron, visor and gloves together provided protection at the rate of 90.7% in contact with COVID-19 patients. In addition to the effective use of PPE at patient contact points, the rapid and effective isolation of these patients may also minimize patient-induced contact with healthcare professionals, especially in emergency departments (13).

Although the importance of proper PPE use at the point of contact with COVID-19 patients in preventing disease transmission is considered at the forefront, it is not possible to completely explain the transmission among our healthcare professionals in this way. When the contact histories with COVID-19 infection are examined in our study; 46.3% of the cases had in-hospital social contact (PCR positivity rate 21.6%), and 39.6% of the cases had a history of contact with COVID-19 patients (PCR positivity rate 11%). 1796 (15%) of 12,022 healthcare professionals working in 3 hospitals in South Holland were screened and 96 (5%) of them were found to be COVID-19 positive. When the genome sequences from 50 healthcare professionals and 10 patients were examined, it was found that most sequences were in three and double groups showing the local circulation in the region. The patterns indicated were consistent with local empowerment in

the community and multiple admissions to hospitals through community-based infections. At the onset of the COVID-19 outbreak in the Netherlands, it was reported that healthcare professionals were likely to be infected by the community rather than hospitals (14). This finding reveals the importance of PPE in contact areas with patients and attention to infection protection measures. In addition, it is crucial for healthcare professionals to keep the necessary social distance, wear masks and take necessary protective measures, both inside and outside the hospital.

In some reports regarding the inflectional status of the healthcare professionals, it was emphasized that 90% of the cases were followed by home isolation, while 2-5% were taken to intensive care support and 0.3-0.6% resulted in death (5). Similarly, in our hospital, 96.5% of the professionals were isolated at home or continued to work, while the need for intensive care was found to be 0.3%. No death cases were reported among healthcare professionals in our hospital. Early diagnosis and isolation of patients and early screening of healthcare professionals may have led to this result. Achieving survival with appropriate treatment, none of our healthcare professionals died due to COVID-19, even if some needed intensive care.

CONCLUSIONS

Healthcare facilities should follow CDC recommendations, country and local infection control and PPE procedures for the protection of healthcare professionals who contact with potential or confirmed COVID-19 patients. Early diagnosis of patients with possible COVID-19 infection and taking emergency isolation measures can reduce high-risk contacts of healthcare professionals. The level of knowledge of healthcare professionals should be increased in terms of the implementation of social isolation rules in in-hospital social areas as well as contact and treatment points with COVID-19 patients. Thus, the risky contact of healthcare professionals working at the forefront of combating the pandemic can be reduced.

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