RESEARCH ARTICLE

Outcomes of COVID-19 contact tracing in hospital healthcare workers: A retrospective cohort study

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Abstract

Objective: To determine risk-group-specific rate of becoming COVID-19-positive among healthcare workers having had contact with COVID-19 cases.

Methods: The retrospective cohort study was conducted at the Ege University Hospital, Bornova, Turkey, and comprised all healthcare workers who had come into contact with COVID-19 cases between March 11 and May 31, 2020. The contacts were classified as low-risk, medium-risk and high-risk using the guidelines of the Turkish Ministry of Health. The outcome measures were the incidence of infection among contacts and the incubation period and serial interval among the new cases. Data was analysed using SPSS 23.

Results: Of the 845 cases, 312(37%) had high risk, 263(31%) medium and 270(32%) low. Overall, there were 490(58%) females, 355(41%) males, 565(67%) aged <40 years, and 277(33%) aged >40 years. Of the total, 27(3.20%) healthcare workers tested COVID-19-positive and distribution among the risk-based groups was significant (p=0.037). There was a significantly increased risk of incidence among repeated contacts, no mask use, and the source being a colleague (p<0.05).

Conclusion: The detection of high-risk contacts was found to be important for controlling COVID-19 infection in a hospital setting.

Keywords: SARS-CoV-2, Healthcare workers, Contact tracing, Contact-based surveillance. (JPMA 72: 707; 2022)

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Introduction

The first case of Coronovirus diseases-2019 (COVID-19) in Turkey was detected on March 11, 2020, and the COVID-19 was declared a pandemic by the World Health Organisation on the same date.[1] Soon after the transmission of the severe acute respiratory syndrome-coronovirus-2 (SARS-CoV-2), considered to be of zoonotic origin, to humans, there came a wave of human-to-human transmission.[2] The WHO reported that one out of every 10 healthcare workers (HCWs) had been infected in some countries.[3] HCWs have a critical role in controlling the pandemic, and, thus, their inability to continue working would cause an interruption in healthcare services.[3] Another risk is the possibility of hospitals turning into sources of infection.[4] Therefore, it is important to apply infection prevention and control measures in healthcare institutions to limit infections associated with the provision of healthcare services.[5] When management strategies for HCWs who have been in contact with a COVID-19 case and who have been infected are systematically implemented, it would be easier to control infectious disease outbreaks and to correctly use available resources.[6] The management strategies should focus on contact risk classification, isolation and isolation termination management, triage, symptom follow-up, and decision-making for early diagnosis.[7] A meta-analysis comprising 172 observational studies revealed that the use of a face mask and being at a physical distance of >1m from a case can cause a significant reduction in the risk of SARS-COV-2 infection.[8] Working at a high-risk department has been associated with a 2.13 times higher risk of COVID-19 compared to the general departments of any hospital.[9] Factors such as high-risk contact, prolonged contact time, distance, not using personal protective equipment (PPE) or errors of use, and hygiene problems increase the risk of infection in HCWs.[10,11] HCWs who have had risky contact with COVID-19 cases are evaluated in line with "Contact Tracing, Pandemic Management, Patient Follow-up at Home and Filiation" guidelines published by the Ministry of Health in Turkey, and their risk levels are categorised. Preventive measures are defined as per the risk level in the guideline and are being applied.[12]

The current study was planned to determine the rate of becoming COVID-19 positive among HCWs who had come into contact with COVID-19 cases, and the categorisation of such cases based on the risk levels.

Materials and Methods

The retrospective cohort study was conducted at the Ege University Hospital, Bornova, Turkey, and comprised all

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HCWs who had come into contact with COVID-19 cases between March 11 and May 31, 2020.

After approval from the Ministry of Health and the institutional ethics review committee, and with permission from the chief physician, hospital-based data was accessed to trace all HCWs who had been involved in the management of COVID-19 cases who were subsequently followed up. As most of the contact-tracing data was collected through telephone interviews, only verbal approval was taken from the participants. Contacts beginning two days before the appearance of the symptoms, or two days before the reverse transcription-polymerase chain reaction (RT-PCR) test if asymptomatic, among those diagnosed with COVID-19 were included for contact assessment.

Data was collected using a pre-designed form that included information obtained from the interviews with the contacts and the electronic health records of the surveillance group. The form had 21 questions: 1 for case assessment, 8 for determining the contact risk group, and 12 for descriptive variables.

With the first COVID-19 case detected in the hospital on March 18, a COVID-19 contact-based surveillance team was created by public health professionals within the Occupational Health and Safety Unit (OHSU). The hospital surveillance study group contacted the relevant clinic using the list of positive cases received from the laboratory and reached the contacts of the cases within a maximum of 24 hours by phone.

Contact risk assessment was performed and recorded during surveillance studies. In the process of contact assessment, the updated guideline of the Turkish Ministry of Health was primarily used, and WHO, the United States Centers for Disease Control and Prevention (CDC) and the European Centre for Disease Prevention and Control (ECDC) sources were accessed in case of doubt.[10-13] Healthcare workers coming into contact with COVID-19 cases face-to-face without PPE within a distance of <1m and indoors for >15min, unprotected physical contact with the cases or their infected material and being in environments where an aerosol-generating process was performed without full protection were evaluated as "high-risk exposure" in terms of contact assessment.[12] Contacts with COVID-19 cases for <15min and other contacts with a distance of >1m and contacts where PPE was used by both parties were defined as "medium- or low-risk exposure". The personal characteristics and contact details of the contacts were questioned, and contact risk classification was made according to the guidelines of the Ministry of Health and all preventive measures were taken in line with the guidelines.[12]

The attack rate was determined as the number of infected persons in the first peak time in the COVID-19 outbreak, as a percentage of the contact HCW. The primary outcome was determined as the rate of HCWs testing COVID-19 RT-PCR positive following 14 days after their COVID-19 case contact. It was recorded as "SARS-CoV-2 infection attack rate" specific to risk groups in HCWs with contact. The attack rates were calculated overall, for all HCWs followed during contact-tracing, and it was also calculated for the high, medium and low categories of risk, and their 95% confidence intervals (CIs) were calculated by bootstrapping based on 1,000 simulations.[13] HCWs who were confirmed as having COVID-19 with molecular methods in the laboratory were accepted as "SARS-CoV-2 infected." Mean incubation period and serial interval (the time between symptom onset in the confirmed case and their infected contacts) values were planned as secondary outcomes.

Under the title of "personal characteristics", age, gender, profession and the status of having received training about PPE were noted. Under the title "health status", concomitant chronic diseases and use of immunosuppressants were noted. Under the title "contact characteristics", contact start time, place of contact, source of contact, and number of contacts were noted. And under the title of "monitoring," symptoms, presence of symptoms, time of symptom onset and isolation status were noted for all the HCWs included in the study.

As an outcome of the contact-tracing process, COVID-19 cumulative attack rates among contact risk groups by weeks, the distribution of the symptoms in all risk groups, and isolation status were determined.

Data was analysed using SPSS 23. Chi-square test was used to determine the "SARS-CoV-2 infection attack rate" specific to the risk groups and to examine the relationships between individual factors, demographic characteristics, health characteristics, working conditions, and contact characteristics. Multivariate analysis included factors that were significant in the chi-square test. Univariate logistic regression analysis was performed to determine the relationship of each descriptive variable with the incidence of infection. The level of significance was set at $p<0.05$.

Results

There were 138 index cases and 868 contact-based cases identified. Among the latter, 13(1.5%) were excluded because they were not contacts, 9(1%) were excluded

Table-1: Characteristics of the contact groups. (n=845).

Characteristics		Low		Medium		High		Total		Chi square
		n	% *	n	% *	n	% *	n	% *	p
Personal Characteristics (n)										
Gender (845)	Female	150	55.56%	159	60.46%	181	58.01%	490	57.99%	0.519
	Male	120	44.44%	104	39.54%	131	41.99%	355	41.01%	
Age (842)	<40	179	66.54%	181	68.82%	205	66.13%	565	67.10%	0.770
	40 and above	90	33.46%	82	31.18%	105	33.87%	277	32.90%	
Profession (844)	Healthcare professionals	186	94.82%	180	93.54%	179	90.03%	545	92.65%	0.071
	a. Doctor	75	27.78%	72	27.38%	75	24.12%	222	26.30%	
	b. Nurse	83	30.74%	98	37.26%	94	30.23%	275	32.58%	
	c. Other healthcare worker	28	10.37%	10	3.80%	10	3.22%	48	5.69%	
	d. Healthcare support service	70	25.93%	66	25.10%	101	32.48%	237	28.08%	
	Technical and administrative staff	14	5.19%	17	6.46%	31	9.97%	62	7.35%	
	a. Technical personnel	12	4.44%	16	6.08%	30	9.64%	58	6.87%	
	b. Director	2	0.74%	1	0.38%	1	0.32%	4	0.47%	
Health Status										
Chronic disease (778)	No	132	55.46%	137	57.08%	165	55.00%	434	55.78%	0.855
	Yes	106	44.54%	103	42.92%	135	45.00%	344	44.22%	
Characteristics of Contact										
Mask use (845)	No	40	14.82%	42	15.97%	291	93.27%	373	44.14%	<0.001
	Yes	230	85.19%	221	84.03%	21	6.73%	472	55.86%	
Place of contact (833)	COVID-19 clinics	73	27.65%	68	25.95%	103	33.33%	246	29.22%	0.107
	Other areas	191	72.35%	194	74.05%	206	66.67%	587	70.78%	
Source of contact (842)	Healthcare worker	127	47.04%	83	31.56%	230	73.72%	440	52.26%	<0.001
	Patient	137	51.12%	178	67.68%	60	16.29%	375	44.54%	
	Out of hospital	4	1.49%	3	0.76%	21	6.75%	27	3.21%	
Number of contacts (844)	First contact	260	96.30%	237	90.11%	281	90.35%	778	92.18%	0.009
	Multiple contacts	10	3.70%	26	9.89%	30	9.65%	66	7.82%	
During Follow-Up										
Symptoms (841)	Do not exist	234	86.67%	218	82.89%	218	70.78%	670	79.67%	<0.001
	Exist	36	13.33%	45	17.11%	90	29.22%	171	20.33%	
Isolation** (827)	Isolated	16	5.93%	48	18.90%	276	91.09%	340	41.11%	<0.001
	Not isolated	254	94.07%	206	81.10%	27	8.91%	487	58.89%	

* Column percentage was taken. ** The cases that were not isolated despite the high risk are due to the differences in isolation practices in the first period of the pandemic.

because, after a correction of initial test finding by the laboratory, they had been in contact with false-positive (FP) cases, and 1(0.1%) was excluded owing to lack of data. The final sample, as such, stood at 845(97.4%) cases; 312(37%) in the high-risk group, 263(31%) in the medium-risk group, and 270(32%) in the low-risk group (p=0.037). Of the total, 27(3.20%) HCWs tested COVID-19-positive (Figure).

The mean age of the study group was 36.20±8.382 years. Overall, there were 490(58%) females, 355(41%) males, 565(67%) aged <40 years, and 277(33%) aged >40 years (Table-1).

Symptoms consistent with COVID-19 were found in 171(20.33%) subjects and 90(29.22%) in the high-risk in group, while isolation was done in 340(41.11%) subjects and 276(91.09%) in the high-risk group (Table-1).

While 7(26%) of the positive cases were symptomatic at the beginning, 24(89%) overall were diagnosed as symptomatic and 3(11%) as asymptomatic. Symptoms in order of frequency were fatigue 12(50.0%), cough 10 (41.7%), sore throat 9(37.3%), generalised muscle pain 8(33.3%), fever 6(25%), and headache 6(25%). Only 1(3. 7%) HCWs with patient contact developed the infection, 22(81.4%) HCWs had contact with each other, and 4(14.8%) had exposure at home or through external sources. No deaths occurred among the cases.

HCWs who engaged in risky contact without a mask were at a risk of COVID-19 3.76 (95% CI: 1.57-9.00) times more than those who wore a mask (p=0.003). Those whose source of contact was an HCW had a 4.21 (95% CI: 1.58-11.23) times higher risk than those with a patient or external source (p=0.004), and those with more than one contact had a 2.82 (95% CI: 1.03-7.70) times higher COVID-19 risk than those with the first contact (p=0.044). Healthcare service staff were reported to have

Table-2: Group-specific Severe acute respiratory syndrome-coronovirus-2 (SARS-CoV-2) infection attack rate and risk factors in healthcare workers having had contact with infectious individuals.

RISK GROUPS		Number of contacts N	Number infected n	Attack rate (95% CI)* %	OR**	OR (95% CI) Lower	Upper	p
Contact risk groups	High	312	16	5.13% (2.89-7.69)	3.60	1.19	10.89	0.024
	Medium	263	7	2.66% (0.76-4.56)	1.82	0.53	6.29	0.345
	Low (ref)	270	4	1.48% (0.37-2.96)				
PERSONAL CHARACTERISTICS								
Gender	Male	355	12	3.36% (1.69-5.35)	1.11	0.51	2.4	0.795
	Female (ref)	490	15	3.06% (1.63-4.69)				
Age	<40	565	19	3.36% (1.95-4.96)	1.17	0.51	2.71	0.714
	40 and above (ref)	277	8	2.89% (1.08-5.05)				
Method of Service Provision (Profession)	Healthcare professionals (HCP)	782	26	3.33% (2.17-4.73)	2.10	0.28	15.72	0.471
	Technical and administrative (ref)	62	1	1.61% (0.01-4.84)				
HEALTH AND TREATMENT STATUS								
Chronic disease	No	434	19	4.38% (2.54-6.45)	1.92	0.83	4.45	0.126
	Yes (ref)	344	8	2.33% (0.87-4.07)				
CHARACTERISTICS OF CONTACT								
Mask Use	No	353	20	5.14% (3.18-7.67)	3.76	1.57	9.00	0.003
	Yes (ref)	465	7	1.48% (0.43-2.65)				
Place of Contact	COVID-19 clinics	244	11	4.51% (2.05-7.38)	1.70	0.78	3.71	0.186
	Other areas (ref)	591	16	2.71% (1.52-4.06)				
Source of Contact	From a healthcare worker	440	22	5.00% (3.18-7.05)	4.21	1.58	11.23	0.004
	Patient or external contact (ref)	405	5	1.24% (0.25-2.47)				
	a. Patient	375	1	0.27% (0.00-0.80)				
	b. Home / external contact	27	4	14.81% (3.70-29.63)				
Number of contacts	Repeated	66	5	7.58% (1.52-13.64)	2.82	1.03	7.7	0.044
	First contact (ref)	778	22	2.83% (1.67-4.11)				
DURING FOLLOW-UP								
Isolation	Isolated	316	16	5.00% (2.94-7.35)	2.51	1.14	5.55	0.023
	Not isolated (ref)	428	10	2.05% (0.82-3.29)				

* bootstrap results are based on 1000 bootstrap samples. ** Univariate regression. CI: Confidence interval, OR: Odds ratio, COVID-19: Coronovirus diseases-2019.

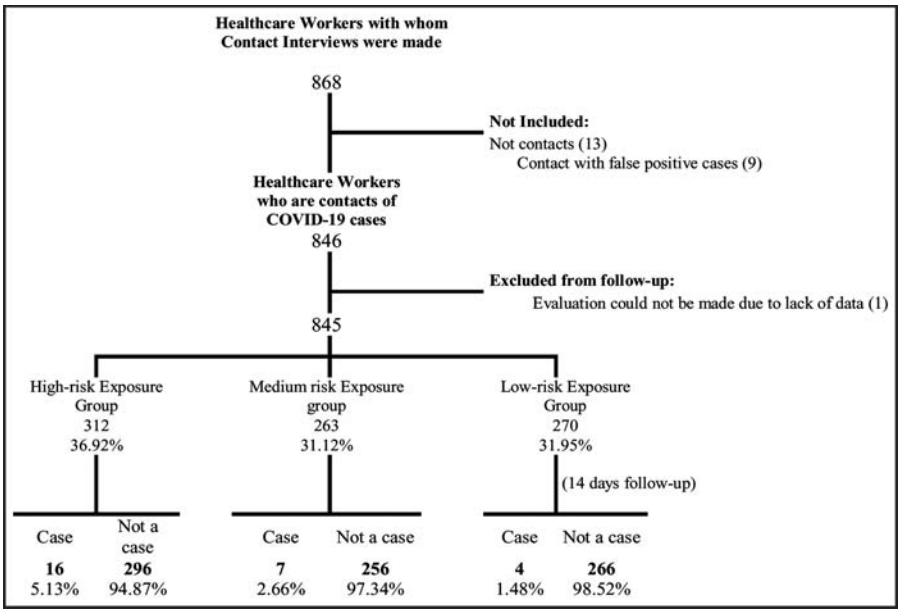

Figure: Strengthening the Reporting of Observational studies in Epidemiology (STROBE) flow diagram.

a 2.10 (95% CI: 0.28-15.72) times higher risk compared to those involved in technical services (p=0.471). Contacts that took place in areas where services were provided for COVID-19 patients carried a 1.70 (95% CI: 0.78-3.71) times higher risk of infection than those in other hospital areas or social areas (p=0.186).

At the end of the follow-up, the attack rate was 27(3.20%) (95% CI: 2.13-4.38) in all contacts, 16(5.13%) (95% CI: 2.89-7.69) in high-risk contacts, 7(2.66%) (95% CI: 0.76-4.56) in medium-risk contacts, and 4(1.48%) (95% CI: 0.37-2.96) among low-risk contacts (p=0.012). For HCWs, being in the high-risk group entailed a 3.60 (95% CI: 1.19-10.89) times higher risk

of turning into a COVID-19 case compared to the to the low-risk group (p=0.024) (Table-2).

The mean incubation period of contacts who developed the infection was 5.00±3.07 (95% CI: 1.88-6.29) days and their median incubation period was 4.5 (interquartile range [IQR]: 2.0-6.0) days. Mean incubation period in low-risk contacts was 6.25±2.63 (95% CI: 4.50-8.75) days and median was 5.5 (IQR: 4.0-6.0) days. It was 4.75±1.71 (95% CI: 3.50-6.25) days and 4.5 (IQR: 3.0-5.0) days in medium-risk contacts, and 4.75±3.45 (95% CI: 3.19-6.50) along with median 4.0 (IQR: 1.5-6.0) days in high-risk contacts (p=0.378).

The mean serial interval times of overall contacts was 5.14±4.72 (95% CI: 3.19-7.18) days or median 4.0 (IQR: 1.5-5.5) days. In groups carrying low, medium and high risks, the respective values were 5.00±4.97 (95% CI: 1.29-9.50) days and 3.5 (IQR: 1.0-5.0) days; 3.33±0.58 (95% CI: 3.00-4.00) days and 3.0 (IQR: 3.0-4.0) days; and 5.53±5.22 (95% CI: 2.48-6.87) days and 5.0 (IQR: 1.5-6.5) days (p=0.690).

Discussion

The current study was conducted following the first peak of the COVID-19 pandemic in Turkey, and 27 of the 845 HCWs became RT-PCR positive until the end of the follow-up.

There were 58% women, 33% nurses, 28% support staff, and 26% doctors in the sample which had an overall mean age of 36 years. Of the participants, 37% were in the high-risk, 31% in the medium-risk, and 32% in the low-risk contact groups. The scope of the few studies conducted in this area included predominantly women and nurses aged 39-44.5 years.[14-16] Differences between countries in healthcare organisations are reflected in the differences in age, gender, and occupational distribution in the study groups. The important place of nurses among HCWs and the fact that nurses are mostly women turned the gender distribution more in the favour of females. Early isolation of HCWs in the advanced age group within the scope of precautions might have reduced the mean age in the study groups.

As a result of contact follow-up, the overall SARS-COV-2 infection attack rate was 3.20%, and 5.13% in the high-risk group. For HCWs, being in the high-risk contact group entailed a 3.60 times higher risk of developing COVID-19 than being in the low-risk group. In a retrospective cohort study conducted in Greece with 3,398 HCWs exposed to a patient or colleague with COVID-19 around the same time as the current study, the total incidence of SARS-CoV-2 infection on RT-PCR was 2.2% while the incidence was reported to be 5% in high-risk exposure. High- vs. low-risk exposure was 5.26 (2.98-9.26).[15] However, in a different study conducted among hospital-based HCWs in Wuhan, where risk groups were evaluated according to the environment in which they worked, high-risk departments had 2.13 (1.45-3.95) times higher risk than the general departments.[9] In our findings, contacts taking place in the service areas for COVID-19 patients carried a 1.70 times higher risk of infection compared with other hospital areas or social areas, although it did not constitute a significant difference. However, some researchers reported no relationship with the so-called "high risk" areas of the hospital and associated the dynamics of transmission in their hospitals with the dynamics of the general population.[17] HCWs who had contact without a mask were at a 3.60 times higher risk of COVID-19 than those who wore masks, which is often included in risky contact assessments. This finding is very similar to the high-risk contact group. Many studies have reported a correlation between the lack of mask use and SARS-CoV-2 positivity.[8,18] Furthermore, repeated contacts have been defined as a factor that increases the risk of infection in publications that contribute to procedures for early identification and isolation of patients,[19] as was the case in the current study. As seen in different evaluations, algorithms defining high-risk contact more clearly for HCWs are required. The findings of the current study support the use of variables such as contact time, contact distance, and mask use, which are used to define risky contacts. It also provides evidence for the appropriateness of isolation of HCWs with high-risk contact. Those whose source of contact is an HCW carried a 4.21 times greater risk of COVID-19 than those with a sick or external source. Moreover, there is an example of HCWs representing the source of infection in healthcare institutions.[16] Depending on the stage of the pandemic, patients diagnosed with SARS-CoV-2 may no longer be the usual suspects of transmission, and HCWs may engage in high-risk contact with infected colleagues and family members.[7]

In the current study, the mean incubation period of the contacts who developed the infection was 5.00 days and the median was 4.5 days, while the mean serial interval time was 5.14 and the median was 4 days. The incubation period of COVID-19 is 5-6 days on an average, but it can take up to 14 days.[20,21] However, in the current cohort, the majority of HCWs with COVID-19 became symptomatic in the first five days post-exposure. Based on confirmed cases from 86 Chinese cities, the serial interval for COVID-19 was 5.29 days (95% CI: 4.72-5.86), and the serial interval

for COVID-19 in western Iran was estimated to be 5.71 days. As in these two examples, there are studies that have revealed mean serial intervals that may be very close to our findings.[22-25] The median serial interval estimate of 4.0 days and the mean serial interval estimate of 5 days suggest that COVID-19 infection leads to rapid cycles of transmission from one generation of cases to the next.[26] Contact-based surveillance provides the opportunity to act earlier for ensuring isolation compared with symptom-based surveillance.[27] The current findings strongly support seven-day isolation and seventh-day RT-PCR testing policy for HCWs exposed to high risk. A 14-day symptom follow-up can be considered as a meaningful practice in this context.

The main advantage of the current study is the management of a large number of HCWs with contact based on a standardised risk assessment protocol. It provides a good insight into the protective role of contact-based surveillance studies and contact management for HCWs. The isolation policy implemented for HCWs may apply to other branches of the health facility as well. Avoiding repeated contacts, enforcing mask use and protecting oneself not only from the patients but also from colleagues could be important in prevention.

The current also has limitations as contact classification may vary depending on the statements of HCWs. Rapid isolation of patients with contact-tracing may have prevented longer serial intervals and incubation periods. Moreover, serial intervals and incubation periods may vary during a pandemic, and the current study was conducted in the first three months of the pandemic.

Conclusion

The detection of high-risk contacts was found to be important for controlling COVID-19 infection in a hospital setting.

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