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Prevalence and factors associated with COVID-19 among healthcare workers at a university hospital in Thailand

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Abstract

Globally, healthcare workers (HCWs) have a high risk of SARS-CoV-2 infection, but less is known about healthcare workers in Thailand. We estimated the prevalence and risk factors for COVID-19 among HCWs in Bangkok, Thailand. A retrospective cohort study was conducted at a large tertiary care academic hospital in Thailand from May 2020 to May 2021. HCWs that presented with fever and/or acute respiratory tract symptoms who tested with RT-PCR were identified, and their clinical data were collected. There were 1432 HCWs with fever and/or acute respiratory tract symptoms during May 2020 and May 2021. A total of 167 patients were front-line HCWs and 1265 were non-front-line HCWs. Sixty HCWs (4.2%) developed COVID-19; 2 were front-line and 58 were non-front-line HCWs. The prevalence of COVID-19 in front-line HCWs was 1.7% (2/167), and 4.6% (58/1265) in non-front-line HCWs ($P = .04$). In addition, non-front-line HCWs, non-medical staffs, history of contact with a confirmed COVID-19 case at home/family, unvaccinated status, fair compliance to personal protective equipment (PPE) standard, and initial presentation with pneumonia were significantly more common in HCWs with COVID-19 than those without COVID-19 ($P < .05$). Front-line HCWs, history of contact with a confirmed COVID-19 case at the clinical care areas in the hospital, vaccinated status, good compliance to PPE standards, and initial presentation with upper respiratory infection were significantly more common in HCWs without COVID-19 than those with COVID-19 ($P < .05$). Multivariate analysis revealed history of exposure with confirmed COVID-19 case at home or in family, unvaccinated status, non-frontline-HCWs, non-medical staffs, and fair compliance to PPE standard to be independent factors associated with COVID-19 in HCWs. COVID-19 was more common in non-front-line HCWs at this tertiary hospital. Thai guidelines on infection prevention and control for COVID-19 seem to be effective in preventing SARS-CoV-2 transmission. Therefore, the adherence to these recommendations should be encouraged.

Abbreviations: HCWs = healthcare workers, PPE = personal protective equipment, RT-PCR = real-time polymerase chain reaction.

Keywords: COVID-19, healthcare workers, prevalence, risk factors, SARS-CoV-2, Thailand

1. Introduction

Coronavirus disease 2019 (COVID-19) is caused by infection with the SARS-CoV-2 virus that was first detected in China in December 2019.[1] As of August 2022, almost 4.6 million confirmed cases and >32,000 deaths had been reported in Thailand.[2] The clinical course and severity of COVID-19 vary depending on age, underlying disease and immune status. The most common clinical presentation of COVID-19 is upper respiratory tract infection.[3] Detection of SARS-CoV-2 RNA by real-time polymerase chain reaction (RT-PCR) assay using respiratory specimens is the gold standard test to confirm the diagnosis.[3] Spread of SARS-CoV-2 occurs mainly via droplet transmissions[3,4], however, airborne transmission can occur in some situations such as in the confined space areas or presence of aerosol-generating procedures in healthcare setting (i.e., endotracheal intubation, noninvasive ventilation, tracheostomy, bronchoscopy, sputum induction, and cardiopulmonary resuscitation).[3,5]

There are several preventive measures for COVID-19 transmission. COVID-19 vaccines have good efficacy for prevention of severe disease and mortality,[6] however, efficacy against viral transmission of novel SARS-CoV-2 variants (i.e., Delta, and Omicron) is greatly reduced.[6,7] Therefore, face masking, personal protective equipment (PPE), hand hygiene, and physical distancing are required to prevent the SARS-COV-2

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All data generated or analyzed during this study are included in this published article [and its supplementary information files].

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transmission. Healthcare workers (HCWs) are at higher risk of infection with SARS-COV-2 not only while treating COVID-19 patients, but also from exposure in healthcare facilities while not treating COVID-19 patients, and from exposure in the household and community.[8] Infected HCWs reduce the healthcare system's ability to respond to the pandemic and deliver essential services. However, there are few published data on COVID-19 in Thai HCWs.

In Thailand, the first outbreak occurred during March 2020 to May 2020 with approximately 3000 confirmed cases due to the SARS-CoV-2 strain A.6. During June to November 2020, SARS-CoV-2 there were less than 1000 cases reported. However, from December 2020 to March 2021, a second wave of COVID-19 occurred with >20,000 cases caused by strain B.1.36.16. During April 2021 to May 2021, >100,000 cases of SARS-CoV-2 variant Alpha (B.1.1.7) were reported.[9] The Thailand Ministry of Public Health has issued guidelines to prevent COVID-19 transmission in community and healthcare settings.[10,11] Preventive measures in community settings include "D-M-H-T-T" (D: social distancing, M: mask wearing, H: hand washing, T: Testing for COVID-19, T: Thai Chana application scanning (it is an application for reporting the traffic of users at the public venues)).[10] In healthcare settings, the national guidelines include advice on the use of PPE for HCWs.[11]

We studied the prevalence and risk factors for contracting SARS-CoV-2 infection in HCWs in a large academic medical center in Bangkok, Thailand.

2. Materials and Methods

This was a retrospective cohort study at Siriraj Hospital, a 2300-bed tertiary care university hospital from May 2020 to May 2021. This study was approved by the Institutional Review Board of the Faculty of Medicine Siriraj Hospital, Mahidol University (COA no. *Si* 277/2020). Participants were HCWs (aged 18–75 yr) that presented with fever ≥37.5°C and/or acute respiratory tract symptoms (i.e., cough, sore throat, rhinorrhea, dyspnea, anosmia, or dysgeusia) within seven days of study enrollment. HCWs reported to the occupational health clinic and received a RT-PCR test for SARS-CoV-2 within one day of symptom onset. Their clinical data and contact history were recorded including professional responsibilities, vaccination status, and compliance with PPE standards. HCWs who did not have any symptoms and those who were not tested for SARS-CoV-2 were excluded. All HCWs were encouraged to adhere to the D-M-H-T-T measures. The front-line HCWs were requested to study the training program for infection control and PPE application before working in the clinical care areas. The importance of adhering to the PPE guidelines was emphasized to all front-line HCWs. Mask wearing and face shield application are recommended for all front-line HCWs during their working periods in the clinical care areas. Airborne precautions recommended for the front-line HCWs when caring for patients requiring aerosol-generating procedures are higher and include a N-95 respirator, long-sleeved disposable fluid-repellent gown, gloves, and eye protection. Mask wearing is suggested for all non-front-line HCWs during their working hours in the hospital.

2.1. Definitions

Front-line HCWs were defined as HCWs who had direct contact with confirmed/suspected COVID-19 patients, their clinical specimens, or their environments. Briefly, these were HCWs from inpatient departments, intensive care units, acute respiratory infection clinics, outpatient departments (OPD), and emergency departments. Non-front-line HCWs were defined as HCWs who did not have contact with confirmed/suspected COVID-19 patients and/or their clinical specimens and/or their environments. For example, there were HCWs from preclinical departments (e.g., anatomy, pathology, biochemistry, and pharmacology departments), education departments, hospital food service departments, and other departments that are dedicated to standard hospital functions. Non-medical staff were defined as HCWs who performed services that do not constitute the practice of medicine or nursing such as food service, janitorial and office workers. Pneumonia was diagnosed using the combination of one or more clinical symptoms or signs consistent with pneumonia (cough, sputum, dyspnea, fever, or pleuritic chest pain), and a new radiographic infiltrate by chest imaging. Acute bronchitis was diagnosed using the combination of one or more clinical symptoms or signs consistent with bronchitis (cough, productive sputum, or dyspnea), and no new radiographic infiltrate by chest imaging.

2.2. Statistical analysis

Data are presented as number and percentage, mean ± standard deviation (SD), or median and range, as appropriate. Fisher exact test or χ^2 test was used to compare categorical variables, and Student *t* test or Mann–Whitney *U* test was used to compare continuous variables. Variable with a P value < .05 were further analyzed for independent association with COVID-19 in HCWs using multivariate regression analysis. All statistical analyses were performed using either SPSS Statistics version 18.0 (SPSS, Inc., Chicago, IL) or Microsoft Excel version 2016 (Microsoft Corporation, Redmond, WA). A P value of ≤ .05 was considered statistically significant.

3. Results

There were 1432 HCWs with fever and/or acute respiratory tract symptoms during May 2020 to May 2021. More than half of participants were female (58.5%). Mean age was 36.1 years (standard deviation 7.0). Most of study patients had no underlying illnesses (82.1%).

One hundred and sixty-seven participants were front-line HCWs (11.7%; 167/1432) and 1265 participants (88.3%; 1265/1432) were non-front-line HCWs. Sixty HCWs had SARS-CoV-2 infection and the prevalence of COVID-19 in all HCWs was 4.2% (60/1432). Of the 60 HCWs with COVID-19, two were front-line HCWs, and 58 were non-front-line HCWs. The prevalence of COVID-19 in front-line HCWs was 1.7% (2/167), and 4.6% (58/1265) in non-front-line HCWs (P = .04). Proportion of COVID-19 among HCWs in 2020 and 2021 was 2.0% (2/100) and 4.4% (58/1332), respectively (P = .26). In 2020, 2 HCWs with COVID-19 were observed in December 2020. Whereas, in 2021, HCWs with COVID-19 were observed in April 2021 (34 HCWs), May 2021 (18 HCWs), and January 2021 (6 HCWs).

HCWs with and without COVID-19 were not significantly different in terms of baseline demographic data (age, sex, and presence of comorbidity) (Table 1). The overall vaccinated status in HCWs during the study period was 24.2% (347/1432). There were 1036 HCWs (72.3%) who self-reported good adherence in the recommended preventive measures (D-M-H-T-T and Thai guidelines on PPE).

Non-front-line HCWs, non-medical staffs, history of contact confirmed COVID-19 case at home/family, unvaccinated status, fair compliance to personal protective equipment standard, and initial presentation with pneumonia were significantly more common in HCWs with COVID-19 than those without COVID-19 (Table 1). While, front-line HCWs, history of contact confirmed COVID-19 case at the clinical care areas, vaccinated status, good compliance to PPE standard, and initial presentation with upper respiratory infection were significantly more common in HCWs without COVID-19 than those with COVID-19 (Table 1).

Table 1

Clinical characteristics of HCWs with or without COVID-19.

	COVID-19 (n = 60) n (%)	No COVID-19 (n = 1372) N (%)	*P* value
Age (mean ± SD), yr	35.0 ± 8.4	36.2 ± 6.9	.192
Male	24 (40.0)	570 (41.5)	.812
Presence of co-morbidity	12 (20.0)	245 (17.9)	.672
Types of underlying co-morbidities			
Diabetes mellitus	2 (16.7)	48 (19.6)	.803
Hypertension	5 (41.7)	111 (45.3)	.805
Chronic kidney disease	1 (8.3)	11 (4.5)	.534
Chronic liver disease	1 (8.3)	9 (3.7)	.415
Lung disease	2 (16.7)	27 (11.0)	.546
Heart disease	1 (8.3)	10 (4.1)	.477
Neurological disease	0 (0.0)	0 (0.0)	1.000
Malignancy	0 (0.0)	8 (3.3)	.525
Immunocompromised conditions	0 (0.0)	4 (1.6)	.656
Obesity (BMI ≥30 kg/m^2)	3 (25.0)	41 (16.7)	.458
Occupations			
Physicians	8 (13.3)	270 (19.7)	.224
Nurses/nurse assistants	20 (33.3)	565 (41.2)	.226
Other medical staffs	8 (13.3)	198 (14.4)	.812
Non-medical staffs	24 (40.0)	339 (24.7)	.008
Types of HCWs			
Front-line HCWs	2 (3.3)	165 (12.0)	.040
Non-front-line HCWs	58 (96.7)	1207 (88.0)	.040
Exposure areas of contact with confirmed COVID-19 case			
Home/family	25 (41.7)	384 (28.0)	.022
Workplace	18 (30.0)	331 (24.1)	.299
Crowed public area (pub/bar/market)	15 (25.0)	302 (22.0)	.585
Clinical care area (ED/OPD/Ward)	2 (3.3)	280 (20.4)	.001
No history of contact with confirmed COVID-19 case	0 (0.0)	75 (5.5)	.062
Previous SARS-CoV-2 infection	0 (0.0)	5 (0.4)	.639
Vaccination status			
Vaccinated status	5 (8.3)	342 (24.9)	.003
Unvaccinated status	55 (91.7)	1030 (75.1)	.003
Self-reported compliance to PPE standard			
Good compliance	35 (58.3)	1001 (73.0)	.013
Fair compliance	25 (41.7)	371 (27.0)	.013
Initial diagnosis at presentation			
URI	55 (91.7)	1354 (98.7)	<.001
Acute bronchitis	1 (1.7)	10 (0.7)	.415
Pneumonia	4 (6.7)	8 (0.6)	<.001

BMI = body mass index, ED = emergency department, HCWs = healthcare workers, OPD = outpatient departments, PPE = personal protective equipment, SD = standard deviation, URI = upper respiratory tract infection.

Multivariate analysis revealed history of exposure with confirmed COVID-19 case at home or in family (odds ratio (OR) 15.72, 95% confidence interval (CI) 7.34–33.65; $P < .001$), unvaccinated status (OR 9.96, 95% CI: 2.60–38.21; $P = .001$), non-frontline-HCWs (OR 8.70, 95% CI: 1.25–60.74; $P = .029$), non-medical staffs (OR 7.18, 95% CI: 3.12–16.53; $P < .001$), and fair compliance to PPE standard (OR 6.67, 95% CI: 2.80–15.91; $P < .001$) to be independent factors associated with COVID-19 in HCWs.

Clinical characteristics compared between the front-line and non-front-line HCWs are shown in Table 2. Front-line HCWs were younger and had lower prevalence of underlying co-morbidities than non-front-line HCWs. Most of the study participants in front-line HCWs were nurses/nurse assistants and physicians, while, the non-medical staffs were more observed in non-front-line HCWs. History of contact confirmed COVID-19 case at the clinical care areas was more commonly found among front-line HCWs, whereas, history of exposure with confirmed COVID-19 case at home or in family was more observed in non-front-line HCWs. History of previous SARS-CoV-2 infection were comparable between both groups. Vaccinated status was more frequently found in the participants in front-line HCWs than those in non-front-line HCWs. Good adherence with the recommended preventive measures were more often reported by front-line HCWs (100.0%; 167/167) than non-front-line HCWs (68.7%; 869/1265) ($P < .001$). COVID-19 pneumonia was observed only in non-front-line HCWs, however, all study patients were cured and discharged successfully from the hospital (Table 2).

4. Discussion

There are few published data on COVID-19 in Thai HCWs; these reports focused on the impact and outbreak of COVID-19 in healthcare facilities[12,13] and demonstrated the important of effective preventive measures for COVID-19. In Siriraj Hospital database from May 2020 to May 2021, there were 13,035 patients that met the criteria of "patient under investigation (PUI)" that underwent RT-PCR for SARS-CoV-2 and 705 (5.4%) were confirmed to have COVID-19. The prevalence of COVID-19 in Thai HCWs was comparable with the rate of COVID-19 in non-HCWs in Thailand. Most SARS-CoV-2 infection in Thai HCWs occurred in non-front-line HCWs. It is possible that front-line HCWs had increased awareness of their occupational risk and therefore more carefully and consistently practiced preventive measures.

The major risk factor was a history of contact with confirmed COVID-19 patients in their families. Good adherence to the recommended preventive measures (D-M-H-T-T and Thai guidelines on PPE) were effective in preventing COVID-19 transmission.

Table 2

Clinical characteristics compared between the front-line and non-front-line HCWs.

	Front-line HCWs (n = 167) n (%)	Non-front-line HCWs (n = 1265) n (%)	*P* value
Age (mean ± SD), yr	33.3 ± 9.5	37.8 ± 8.8	<.001
Male	71 (42.5)	523 (41.3)	.773
Presence of co-morbidity	15 (9.0)	242 (19.1)	.001
Types of underlying co-morbidities			
Diabetes mellitus	3 (20.0)	47 (19.4)	.956
Hypertension	7 (46.7)	109 (45.0)	.902
Chronic kidney disease	0 (0.0)	12 (5.0)	.377
Chronic liver disease	0 (0.0)	10 (4.1)	.422
Lung disease	2 (13.3)	27 (11.2)	.796
Heart disease	0 (0.0)	11 (4.5)	.399
Neurological disease	0 (0.0)	0 (0.0)	1.000
Malignancy	0 (0.0)	8 (3.3)	.474
Immunocompromised conditions	0 (0.0)	4 (1.7)	.616
Obesity (BMI ≥30 kg/m^2)	3 (20.0)	41 (16.9)	.760
Occupations			
Physicians	43 (25.7)	235 (18.6)	.028
Nurses/nurse assistants	102 (61.1)	483 (38.2)	<.001
Other medical staffs	22 (13.2)	184 (14.5)	.635
Non-medical staffs	0 (0.0)	363 (28.7)	<.001
Exposure areas of contact with confirmed COVID-19 case			
Home/family	15 (9.0)	394 (31.1)	<.001
Workplace	45 (26.9)	304 (24.0)	.423
Crowed public area (pub/bar/market)	39 (23.4)	278 (22.0)	.685
Clinical care area (ED/OPD/Ward)	58 (34.7)	224 (20.4)	<.001
No history of contact with confirmed COVID-19 case	10 (6.0)	65 (5.1)	.643
Previous SARS-CoV-2 infection	0 (0.0)	5 (0.4)	.415
Vaccination status			
Vaccinated status	151 (90.4)	196 (15.5)	<.001
Unvaccinated status	16 (9.6)	1069 (84.5)	<.001
Self-reported compliance to PPE standard			
Good compliance	167 (100.0)	869 (68.7)	<.001
Fair compliance	0 (0.0)	396 (31.3)	<.001
Initial diagnosis at presentation			
URI	165 (98.8)	1244 (98.3)	.655
Acute bronchitis	1 (0.6)	10 (0.8)	.789
Pneumonia	1 (0.6)	11 (0.9)	.718
Confirmed COVID-19 diagnosis	2 (1.2)	58 (4.6)	.040
Severity of COVID-19			
URI	2 (100.0)	53 (98.3)	.664
Acute bronchitis	0 (0.0)	1 (1.7)	.861
Pneumonia	0 (0.0)	4 (6.9)	.701
Outcome of COVID-19			
Cure	2 (100.0)	58 (100.0)	1.000

BMI = body mass index, ED = emergency department, HCWs = healthcare workers, OPD = outpatient departments, PPE = personal protective equipment, SD = standard deviation, URI = upper respiratory tract infection.

Our findings are similar to some international studies that reported the lower rates of COVID-19 in HCWs compared with non-HCWs.[14,15] However, other previous studies demonstrated the higher rate of SARS-CoV-2 infection among HCWs compared with non-HCWs.[16-19] For example, in a large cohort study that was done in the USA and the UK in 2020 including >2,000,000 community residents and around 100,000 front-line HCWs, it was observed the likelihood of positive testing for SARS-COV-2 was 4.0% in HCWs compared with 0.3% in community individuals.[16]

Similar to the previous studies,[19-21] the higher rate of COVID-19 was found in non-front-line HCWs than in front-line HCWs,[19] and the higher infection risk among non-medical staffs who have no direct patient care role was observed in this present study and may emphasize to the importance of community exposure.[20,21] The majority of cases of COVID-19 infection in HCWs have arisen from non-occupational exposure and a history of a family contact with COVID-19 was the main risk of SARS-CoV-2 infection among HCWs.[22] Moreover, inappropriate preventive measures is one of the factors associated with an increased risk of SARS-CoV-2 infection in the nosocomial setting, therefore, infection control training and appropriate PPE use were associated with the reduction of SARS-CoV-2 infection in HCWs.[23]

Most of HCWs with COVID-19 in this study were young and healthy, therefore they had mild illness, and favorable clinical outcome, similar to the previous studies.[18,20,24] No fatality was observed.

The proportion of COVID-19 in HCWs in our study was 4.2%, while and the rate of HCWs infected in China was 0.2% and in France was 21.0% (Table 3),[15,20,25-33] varying according to the time period measured and the COVID-19 outbreak situation in each country. A much higher incidence of infection among HCWs was observed in regions with high population incidence and prevalence, with significantly strained healthcare systems. COVID-19 vaccination rates, definition of SARS-CoV-2 infection (i.e., symptomatic infection and/or asymptomatic infection), testing policy, diagnostic method of SARS-CoV-2

infection (i.e., RT-PCR, antigen test, and/or serology test) and implemented infection control measures also influence the infection rates in HCWs.[20,23]

Our study has limitations. First, this study was conducted at a large institution, so our results may not be generalizable to other levels of healthcare facilities that may not have enough facilities to compliance with COVID-19 preventive measures. Second, the SARS-CoV-2 variant that caused outbreaks in Thailand during the study period was neither the Delta nor Omicron variants because the efficacy of COVID-19 vaccination and some preventive measures may be reduced due to the high infectivity of these variants.[7] Third, the reports of adherence to the recommended preventive guidelines among the study HCWs may be bias due to the self-reported measure. Fourth, the small cohort size of the front-line HCWs in this study may increase uncertainly in the prevalence of COVID-19 in this study group. Finally, our study targeted only symptomatic SARS-CoV-2 infection. The proportion of asymptomatic COVID-19s reported in other studies was approximately 3% to 23%.[33-35] Moreover, the patients without fever and/or respiratory symptoms but had only nonspecific symptoms (i.e. headache, myalgia, gastrointestinal symptoms, or weakness) are not included in this study.

5. Conclusions

COVID-19 was more frequently found in non-front-line HCWs. Thai guidelines on infection prevention and control for COVID-19 seem to be effective in preventing SARS-CoV-2 transmission. Therefore, the adherence to these recommendations should be encouraged.

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Author contributions

All authors participated in the drafting of the manuscript. All authors have read and agreed to the published version of the manuscript.

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Table 3

Rate of COVID-19 in HCWs across different countries.[15,20,25–33]

Country (numbers of case)	Rate of COVID-19 in HCWs
United States (n = 1958)	14.8%
Brazil (n = 775)	14.7%
United Kingdom (n = 266)	18.0%
France (n = 319)	21.0%
Portugal (n = 8037)	2.6%
Saudi Arabia (n = 16,317)	9.8%
India (n = 3711)	11.0%
China (n = 4614)	0.2%
Philippines (n = 324)	2.5%
Malaysia (n = 1174)	1.4%
Indonesia (n = 1201)	7.9%
Thailand (this study, n = 1432)	4.2%

HCWs = healthcare workers.

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