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-front-line 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, tracheoscopy, bronchoscopy, sputum induction, and cardiopulmonary resuscitation).[3,4]

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 transmission.

Received: 11 June 2022 / Accepted: 30 August 2022
http://dx.doi.org/10.1097/MD.0000000000030837

This work was supported by the Health Systems Research Institute (Thailand), Nonthaburi, Thailand, and by the Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand.

The authors have no conflicts of interest to disclose.

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

This study was approved by the Institutional Review Board of the Faculty of Medicine Siriraj Hospital, Mahidol University (COA no. Si 277/2020).

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How to cite this article: Sirijatuphat R, Leelarasamee A, Horthongkham N. Prevalence and factors associated with COVID-19 among healthcare workers at a university hospital in Thailand. Medicine 2022;101:38(e30837).
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. 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. The Thailand Ministry of Public Health has issued guidelines to prevent COVID-19 transmission in community and healthcare settings. 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)). In healthcare settings, the national guidelines include advice on the use of PPE for HCWs.

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, rhinitis, 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 advised 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 χ² 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).
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).

### Table 1

|            | COVID-19 (n = 60) | No COVID-19 (n = 1372) | \( P \) 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) | .806 |
| 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/m²) | 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 |
| Crowded 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.
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.\[16\]

Table 2

| Clinical characteristics compared between the front-line and non-front-line HCWs. | Front-line HCWs (n = 167) | Non-front-line HCWs (n = 1265) | 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 (46.0) | .902 |
| Chronic kidney disease | 0 (0.0) | 12 (5.3) | .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/m²) | 3 (20.0) | 41 (16.9) | .760 |
| Occupations | | | |
| Physicians | 43 (25.7) | 235 (18.6) | <.001 |
| 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 | 46 (27.6) | 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.

The proportion of COVID-19 in HCWs in our study was 4.2%, while the rate of HCWs infected in China was 0.2% and in France was 21.0% (Table 3),\[15,20,24-33\] 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.[10,20,21] 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 comply 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.[22] 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 uncertainty 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-19 patients reported in other studies was approximately 3%.[23,24] 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.

Acknowledgements
The authors gratefully acknowledge Mrs. Sukanya Chanboonchuay for her assistance with data collection and management. The authors also thank the microbiology team and COVID-19 care team of Siriraj Hospital for providing patient information and laboratory results.

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

| 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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