Objectives: It is crucial for healthcare workers (HCWs) to comply with infection prevention and control precautions such as the appropriate use of personal protective equipment (PPE) for their safety and the safety of patients. In this study, we aimed to assess HCWs’ compliance with the appropriate use of PPE in primary healthcare settings in Qatar along with its associated factors and explore their perceived effectiveness of different PPE items in protecting against COVID-19 infection.

Methods: A Web-based survey was conducted between November 2020 and January 2021 targeting all clinical HCWs under the umbrella of Primary Health Care Corporation.

Results: A total of 757 HCWs completed the survey, and most were between 30 and 39 years of age (50.2%), females (62.7%), and nurses (35.3%). Eighty-eight percent of participants believed that PPE could provide high or very high protection against COVID-19. About one-half (53%) were found to be fully compliant with PPE use during patient interactions with suspected or confirmed COVID-19 cases, whereas three-quarters (76.3%) were fully compliant while performing aerosol-generating procedures. Healthcare workers’ age, nationality, health center region, area of work, clinical experience, frequency of interaction with suspected or confirmed COVID-19 cases, and the perceived effectiveness of PPE were significant predictors of full compliance with PPE. Shortage of PPE was the commonest reported barrier to appropriate use.

Conclusions: Despite HCWs’ high perceived effectiveness for PPE in protecting against COVID-19 infection, their full compliance rate with using PPE was moderate and needs further improvement.

Key Words: healthcare workers, compliance, personal protective equipment, COVID-19, primary health care, perceived effectiveness

Infectious outbreaks can overwhelm health systems and put healthcare workers (HCWs) at increased risk of infection while dealing with increasing numbers of infected cases. The current severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has infected more than 50% of HCWs in several countries. Besides the importance of practicing hand hygiene, HCWs need to strictly follow the World Health Organization (WHO) recommendations by using droplet and contact precautions (including the use of a medical mask; eye protection [goggles] or facial protection [face shield]; a clean, nonsterile, long-sleeved gown; and gloves) during regular patient interactions with suspected or confirmed COVID-19 cases, and airborne precautions using N95 respirator or equivalent along with contact precautions while performing aerosol-generating procedures (AGPs). The evolving literature has shown variable rates of compliance with personal protective equipment (PPE) among HCWs during the current COVID-19 pandemic. Where only 31.5%, 46.8%, and 54.9% of HCWs were consistently compliant with PPE in Brazil, Egypt, and Congo, respectively, compliance rates exceeded 80% in each of Germany and Ghana. Healthcare-associated infections resulting from low compliance with infection prevention and control precautions can have negative repercussions on HCWs, patients, and health systems resulting in prolonged hospital stays and adverse health and economic consequences. Several factors affect HCWs’ compliance with PPE such as the availability of PPE, seniors compliance, past experience, training on the appropriate use of PPE, discomfort caused by certain types of PPE, performing high COVID-19 risk procedures, and the perceived effectiveness of PPE. Evidence has shown that the high perceived effectiveness of PPE is a strong predictor for high compliance.

In Qatar, among HCWs who were tested for COVID-19, 10.6% and 16.2% tested positive in secondary and primary healthcare settings, respectively. Primary Health Care Corporation (PHCC)—the main provider of primary healthcare services in Qatar—has played a crucial and proactive role in mitigating the spread of COVID-19 infection by converting some of the health centers into COVID-19 facilities, assisting in contact tracing, and early detection of cases by dedicating some of their healthcare staff for the provision of drive-through swabbing. In fact, starting in March 2020, PHCC dedicated a number of health centers as testing and holding facilities for COVID-19, whereas some rearrangements were made to other health centers to separate suspected cases of COVID-19 from other patients. At the time of conducting this study, PHCC was providing its services through 27 health centers distributed all over Qatar (7 health centers in the central region and 10 in each of the western and northern regions). Although telephone consultations have replaced face-to-face consultations in many routine clinical settings, some primary healthcare services continued operating regularly with face-to-face consultations such as childhood immunization services (Well Baby clinic); antenatal clinics for pregnant women, which provided both types of consultations according to trimesters; emergency department; and laboratory and diagnostic radiology services. In this study, we aimed to assess the compliance with the appropriate use of PPE among HCWs in primary healthcare settings in Qatar along with its associated factors and explore HCWs’ perceived
effectiveness of different PPE items in protecting against COVID-19 infection.

METHODS

Study Design, Setting, and the Target Population

We conducted a Web-based cross-sectional study between November 2020 and January 2021 targeting all clinical staff (physicians, nurses, and allied health professionals) working under the umbrella of PHCC. Primary Health Care Corporation is the state-owned primary healthcare provider in Qatar that provides primary healthcare services through a large number of healthcare centers distributed all over the country. According to the annual statistical report by PHCC, the total staff amounted to 6631 employees in 2019, with 4429 (67%) of them being clinical staff.\(^1\,\)\(^8\)

Study Procedure

We developed an online self-administered survey using Google Forms. Because the response rate in Web-based surveys is generally low, we invited all eligible HCWs in clinical positions in PHCC. We contacted HCWs via email with a link to the online survey. We started the survey with an introductory letter that explained the objectives of the study and ensured the voluntary participation, the anonymity, and the confidentiality of the collected data. Taking the survey implied informed consent, and the participants had the option to quit the survey at any time. Reminders were sent regularly. We obtained the ethical approval from the institutional review board of PHCC (PHCC/DCR/2020/07/073). This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for cross-sectional studies.

Study Questionnaire

The questionnaire was adopted from different surveys.\(^1\,\)\(^9\,\,\)\(^2\,\)\(^3\) It consisted of 3 sections. The first one explored the sociodemographic characteristics of the participants (age, sex, nationality, profession, clinical experience, healthcare facility [whether a COVID-19 facility or not], area of work, the name of the health center) and some background information such as having a friend or a relative infected with COVID-19. The frequency of interaction with suspected or confirmed COVID-19 cases, and training on PPE. The second and third sections assessed the perceived effectiveness of different PPE items in protecting against COVID-19 infection and compliance with the appropriate use of PPE using the WHO risk assessment tool for HCWs in the context of COVID-19,\(^2\,\)\(^3\) along with the barriers to the appropriate use, respectively.

Study Variables

We assessed HCWs’ perceived effectiveness of different PPE items in protecting against COVID-19 by asking them to indicate their degree of agreement with a set of statements on a 4-point Likert scale. The 4 points on the scale were as follows: 1 (strongly disagree), 2 (disagree), 3 (agree), and 4 (strongly agree). Examples of such statements were as follows: “I believe that regular face mask (medical or surgical) is effective and can help against contracting COVID-19 infection.” “I believe that gloves are effective and can help against contracting COVID-19 infection,” and so on. Also, we asked HCWs to indicate the degree of protection PPE generally can provide on a 5-point Likert scale. The points on the scale were 1 (no or very low protection), 2 (low protection), 3 (moderate protection), 4 (high protection), and 5 (very high protection). We calculated a perceived effectiveness score by summing the points for all statements with a maximum score of 25.

Higher scores indicated higher perceived effectiveness of PPE in protecting against contracting COVID-19. We assessed HCWs’ compliance with PPE by asking them to state the frequency of using different PPE items during regular interactions with suspected or confirmed cases or while performing an AGP for them using a 5-point Likert scale (always as recommended, often, sometimes, seldom, never). We considered those who answered all the questions as “always as recommended” as fully compliant, and they were counted in the calculation of the proportions of HCWs who were fully compliant with PPE in different settings (whether during regular patient interactions, while performing AGPs, or during both situations). We asked HCWs to select the barriers to the appropriate PPE use from a list, and they had the option to disclose other barriers that were not listed.

Statistical Analysis

We carried out the data analysis using IBM SPSS Statistics for Windows, version 26.0 (IBM, Armonk, NY). We presented descriptive statistics as frequencies and percentages for categorical variables, and as medians and interquartile ranges for continuous not normally distributed variables. We used the \(\chi^2\) test to determine the differences in compliance rates between different groups. After testing for normality using the Shapiro-Wilk test, we used Mann-Whitney \(U\) and Kruskal-Wallis tests to compare perceived effectiveness scores among different groups. We carried out a multivariable logistic regression model to determine the predictors of full compliance with PPE in different settings (during both regular patient interactions with suspected or confirmed COVID-19 cases, and while performing an AGP). The associations between predictors and outcomes were presented as adjusted odds ratios (ORs) and 95% confidence intervals (95% CIs). We assessed the goodness of fit using the Hosmer-Lemeshow test. \(P\) values of less than 0.05 were considered significant.

Ethical Approval

This study was performed in line with the principals of Declaration of Helsinki. Ethical approval was obtained from PHCC under protocol ID PHCC/DCR/2020/07/073.

RESULTS

Sociodemographic Characteristics and Background Information

A total of 757 HCWs completed the survey. Most, 380 (50.2%), were between 30 and 39 years of age, and 475 (62.7%) were females. With more than 60 nationalities reported, the top 3 were Filipino (26.9%), Indian (25.1%), and Egyptian (11.9%). Of all HCWs, 267 (35.3%) were nurses, 150 (19.8%) were physicians, and the remaining were other health professionals like dentists, allied HCWs, pharmacists, and others. Most HCWs, 302 (39.9%), were from health centers in the western region, and 368 (48.6%) had a clinical experience of 5 years or more. About one-fifth (19.9%) of participants were deployed to a COVID-19 facility. More than half of the participants (58.8%) reported frequent dealing with suspected or confirmed COVID-19 cases in most of the shifts or every shift, and most of HCWs (81.2%) were aware of a relative or a friend diagnosed with COVID-19. Upon assessing the status of training on appropriate PPE use in the previous year, 88.2% admitted receiving such training (Table 1).

\(^1\) Abed Alah et al. J Patient Saf. 2022;18(8), 748.

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Of all HCWs, 83%, 97.8%, 95.4%, 94.7%, and 92.4% agreed or strongly agreed that regular face mask (medical or surgical), respirator, eye protection (using goggles or a face shield), long-sleeved gown, and gloves are effective in protecting against contracting COVID-19 infection, respectively. Most participants, 666 (88%), believed that PPE could provide high or very high protection against COVID-19. The calculated median of the perceived effectiveness score was 22, with 406 (53.6%) scored ≥22. The univariate analysis showed a statistically significant difference in the perceived effectiveness scores between HCWs of different nationalities and different areas of work. Healthcare workers of Filipino nationality reported significantly higher perceived effectiveness scores compared with all other nationalities (P < 0.001). Similarly, higher proportions of HCWs with higher perceived effectiveness scores were found in COVID-19 facilities compared with non–COVID-19 facilities.

### TABLE 1. Sociodemographic Characteristics and Related Background Information of the Participants by the Type of Profession

| Characteristic                        | Nurse (n = 267), No. (%) | Physician (n = 150), No. (%) | Others (n = 340), No. (%) | Total (N = 757), No. (%) | χ² Test, P Value |
|---------------------------------------|--------------------------|------------------------------|----------------------------|--------------------------|-----------------|
| Age category, y                       |                          |                              |                            |                          |                 |
| 18–29                                 | 28 (10.5)                | 0 (0.0)                      | 38 (11.2)                  | 66 (8.7)                 | <0.001          |
| 30–39                                 | 179 (67.0)               | 39 (26.0)                    | 162 (47.6)                 | 380 (50.2)               |                 |
| 40–49                                 | 43 (16.1)                | 64 (42.7)                    | 105 (30.9)                 | 212 (28.0)               |                 |
| ≥50                                   | 17 (6.4)                 | 47 (31.3)                    | 35 (10.3)                  | 99 (13.1)                |                 |
| Sex                                   |                          |                              |                            |                          |                 |
| Female                                | 234 (87.6)               | 60 (40.0)                    | 181 (53.2)                 | 475 (62.7)               | <0.001          |
| Male                                  | 33 (12.4)                | 90 (60.0)                    | 159 (46.8)                 | 282 (37.3)               |                 |
| Nationality*                          |                          |                              |                            |                          |                 |
| Indian                                | 112 (41.9)               | 10 (6.7)                     | 68 (20.0)                  | 190 (25.1)               | <0.001          |
| Filipino                              | 96 (36.0)                | 2 (1.3)                      | 106 (31.2)                 | 204 (26.9)               |                 |
| Egyptian                              | 20 (7.5)                 | 29 (19.3)                    | 41 (12.0)                  | 90 (11.9)                |                 |
| Jordanian                             | 11 (4.1)                 | 17 (11.3)                    | 34 (10.0)                  | 62 (8.2)                 |                 |
| Sudanese                              | 1 (0.4)                  | 7 (4.7)                      | 45 (13.2)                  | 53 (7.0)                 |                 |
| Others                                | 27 (10.1)                | 85 (56.7)                    | 46 (13.5)                  | 158 (20.9)               |                 |
| PHCC region                           |                          |                              |                            |                          |                 |
| Northern                              | 99 (37.1)                | 52 (34.7)                    | 142 (51.8)                 | 293 (38.7)               | 0.520           |
| Central                               | 62 (23.2)                | 32 (21.3)                    | 68 (20.0)                  | 162 (21.4)               |                 |
| Western                               | 106 (39.7)               | 66 (44.0)                    | 130 (38.2)                 | 302 (39.9)               |                 |
| Area of work                          |                          |                              |                            |                          |                 |
| Non–COVID-19 facility                 |                          |                              |                            |                          |                 |
| Clinic                                | 136 (50.9)               | 108 (72.0)                   | 145 (42.6)                 | 389 (51.4)               | <0.001          |
| Emergency                             | 17 (6.4)                 | 7 (4.7)                      | 2 (0.6)                    | 26 (3.4)                 |                 |
| Others                                | 47 (17.6)                | 6 (4.0)                      | 138 (40.6)                 | 191 (25.2)               |                 |
| COVID-19 facility                     | 67 (25.1)                | 29 (19.3)                    | 55 (16.2)                  | 151 (19.9)               |                 |
| Clinical experience (in PHCC), y      |                          |                              |                            |                          |                 |
| <1                                    | 50 (18.7)                | 24 (16.0)                    | 36 (10.6)                  | 110 (14.5)               | 0.004           |
| 1–2                                   | 47 (17.6)                | 30 (20.0)                    | 57 (16.8)                  | 134 (17.7)               |                 |
| 3–4                                   | 45 (16.9)                | 17 (11.3)                    | 83 (24.4)                  | 145 (19.2)               |                 |
| ≥5                                    | 125 (46.8)               | 79 (52.7)                    | 164 (48.2)                 | 368 (48.6)               |                 |
| Frequency of dealing with COVID-19 suspected or confirmed cases during clinical practice | | | | | |
| Never                                 | 9 (3.4)                  | 22 (14.7)                    | 55 (16.2)                  | 86 (11.4)                | <0.001          |
| Some of my shifts                    | 47 (17.6)                | 51 (34.0)                    | 128 (37.6)                 | 226 (29.9)               |                 |
| Most of my shifts                    | 40 (15.0)                | 17 (11.3)                    | 42 (12.4)                  | 99 (13.1)                |                 |
| Every shift                          | 171 (64.0)               | 60 (40.0)                    | 115 (33.8)                 | 346 (45.7)               |                 |
| Having a relative or friend diagnosed with COVID-19 | | | | | |
| No                                    | 43 (16.1)                | 28 (18.7)                    | 71 (20.9)                  | 142 (18.8)               | 0.326           |
| Yes                                   | 224 (83.9)               | 122 (81.3)                   | 269 (79.1)                 | 615 (81.2)               |                 |
| Training on proper use of PPE in the past year | | | | | |
| No                                    | 9 (3.4)                  | 16 (10.7)                    | 64 (18.8)                  | 89 (11.8)                | <0.001          |
| Yes                                   | 258 (96.6)               | 134 (89.3)                   | 276 (81.2)                 | 668 (88.2)               |                 |

Significant P values of <0.05 are shown in bold.
*More than 60 nationalities were reported.

**HCWs’ Perceived Effectiveness of Different PPE Items Against COVID-19 Infection**

Of all HCWs, 83%, 97.8%, 95.4%, 94.7%, and 92.4% agreed or strongly agreed that regular face mask (medical or surgical), respirator, eye protection (using goggles or a face shield), long-sleeved gown, and gloves are effective in protecting against contracting COVID-19 infection, respectively. Most participants, 666 (88%), believed that PPE could provide high or very high protection against COVID-19. The calculated median of the perceived effectiveness score was 22, with 406 (53.6%) scored ≥22. The univariate analysis showed a statistically significant difference in the perceived effectiveness scores between HCWs of different nationalities and different areas of work. Healthcare workers of Filipino nationality reported significantly higher perceived effectiveness scores compared with all other nationalities (P < 0.001). Similarly, higher proportions of HCWs with higher perceived effectiveness scores were found in COVID-19 facilities compared with non–COVID-19 facilities.
We assessed the compliance of HCWs with PPE using the WHO risk assessment tool for HCWs in the context of COVID-19. Using this tool, 328 of 619 (53%; 95% CI, 49.0–57.0; who deal with suspected or confirmed COVID-19 cases) were found to be fully compliant with PPE use during patient interactions with suspected or confirmed COVID-19 cases, 384 of 503 (76.3%; 95% CI, 72.4–80.0; who perform AGPs for suspected or confirmed COVID-19 cases) were fully compliant with PPE use while performing such procedures, and 257 (51.1%; 95% CI, 46.6–55.5) were fully compliant during both situations. During routine patient interactions with suspected or confirmed cases, full compliance rates were found to be highest with face mask (90.6%) and lowest with eye protection (using goggles) or facial protection (using a face shield; 55.4%). On the other hand, we could not detect such a gap in the full compliance rates between different PPE items while performing AGPs for suspected or confirmed COVID-19 cases (Fig. 1).

The univariable analysis showed that nationality, area of work, profession, frequency of dealing with suspected or confirmed COVID-19 cases, and the perceived effectiveness of PPE were significantly associated with full compliance (Table 3).

### Predictors of HCWs’ Compliance With PPE

As shown in Table 3, we carried out a multivariable logistic regression analysis to determine the predictors of full compliance with PPE in different settings (during both regular patient interactions with suspected or confirmed COVID-19 cases, and while performing an AGP for a suspected or confirmed case). The model was of good fit and statistically significant ($\chi^2_{5,968} = 76.607$, $P < 0.001$) when compared with the null model. As shown in Table 3, age, nationality, PHCC region, area of work, clinical experience, frequency of interaction with suspected or confirmed COVID-19 cases, and the perceived effectiveness of PPE were found to be significantly and independently associated with full compliance with PPE. Healthcare workers 18 to 29 years of age (OR, 0.21; 95% CI, 0.07–0.61; $P = 0.004$) and those 30 to 39 years of age (OR, 0.39; 95% CI, 0.18–0.82; $P = 0.013$) were less likely to be fully compliant with PPE compared with those 50 years or older. Sudanese HCWs were less likely to be fully compliant compared with those 50 years or older. It was found that the participants who were working in COVID-19 facilities were less likely to be fully compliant compared with those running primary healthcare clinics at non-COVID-19 facilities (OR, 0.54; 95% CI, 0.32–0.90; $P = 0.018$) or most of shifts (OR, 0.52; 95% CI, 0.30–0.92; $P = 0.025$) were less likely to be fully compliant compared with those who deal with such cases on every shift. On the other hand, HCWs with less than 1 year of experience and those who worked in COVID-19 facilities ($P = 0.013$). Moreover, participants who received a training on appropriate PPE use in the previous year had higher scores compared with those who did not ($P = 0.010$; Table 2).

### HCs’ Compliance With PPE

The univariable analysis showed that nationality, area of work, profession, frequency of dealing with suspected or confirmed COVID-19 cases, and the perceived effectiveness of PPE were significantly associated with full compliance (Table 3).

#### TABLE 2. Differences in the Perceived Effectiveness Score for PPE Among Different Subgroups

| Variable                        | Perceived Effectiveness Score, Median (IQR) | $P^*$  |
|---------------------------------|--------------------------------------------|-------|
| Age category, y                 |                                            |       |
| 18–29                           | 21 (19–23)                                 | 0.343 |
| 30–39                           | 22 (19–24)                                 |       |
| 40–49                           | 22 (19–24)                                 |       |
| ≥50                             | 22 (19–24)                                 |       |
| Sex                             |                                            |       |
| Female                          | 22 (19–24)                                 | 0.088 |
| Male                            | 22 (19–24)                                 |       |
| Nationality$^1$                 |                                            |       |
| Filipino                        | 23 (21–24)                                 | <0.001|
| Indian                          | 22 (19–24)                                 |       |
| Egyptian                       | 21 (19–23)                                 |       |
| Jordanian                      | 20 (19–23)                                 |       |
| Sudanese                       | 21 (19–23)                                 |       |
| Others                          | 21 (19–24)                                 |       |
| PHCC region                     |                                            |       |
| Northern                       | 22 (19–24)                                 | 0.136 |
| Central                        | 21 (19–24)                                 |       |
| Western                        | 22 (19–24)                                 |       |
| Area of work$^2$                |                                            |       |
| Non–COVID-19 facility          |                                            |       |
| Clinic                          | 22 (19–24)                                 | 0.013 |
| Emergency                      | 23 (20–24)                                 |       |
| Others                          | 21 (19–24)                                 |       |
| COVID-19 facility              | 23 (20–24)                                 |       |
| Clinical experience (in PHCC), y|                                            |       |
| <1                              | 22 (19–24)                                 | 0.706 |
| 1–2                            | 22 (19–24)                                 |       |
| 3–4                            | 22 (19–24)                                 |       |
| ≥5                             | 22 (19–24)                                 |       |
| Profession                      |                                            |       |
| Physician                      | 22 (19–24)                                 | 0.539 |
| Nurse                          | 22 (19–24)                                 |       |
| Others                          | 22 (19–24)                                 |       |
| Having a relative or friend diagnosed with COVID-19 | |       |
| No                              | 22 (19–24)                                 | 0.500 |
| Yes                             | 22 (19–24)                                 |       |
| Training on the proper use of PPE in the past year | |       |
| No                              | 19 (18–21)                                 | 0.010 |
| Yes                             | 22 (19–24)                                 |       |

*Significant $P$ values of $<0.05$ are shown in bold.

$^1$Using the Mann-Whitney test for 2 independent samples and the Kruskal-Wallis test for 3 or more independent samples.

$^2$Pairwise comparisons showed statistically significant differences between each of Indian, Egyptian, Jordanian, Sudanese, and other nationalities compared with Filipino nationality ($P = 0.002$, 0.001, 0.005, 0.002, and $<0.001$, respectively).

$^3$Pairwise comparisons showed statistically significant differences between each of those who worked in clinic or other non-COVID-19 facilities compared with those who worked in COVID-19 facility ($P = 0.038$ and 0.009, respectively).

IQR, interquartile range.
Barriers to the Appropriate Use of PPE

Upon assessing the barriers to the appropriate use of PPE, the top 3 barriers were shortage of PPE (42.3%), discomfort caused by certain types of PPE such as face mask or face shield (31.4%), and work overload and lack of time (29.3%). On the other hand, 29.5% of participants did not report any barriers for the appropriate use of PPE, whereas shortage of PPE was the most common reported barrier among all HCWs in different areas of work, professions, and health centers regions (Table 4).

**DISCUSSION**

Healthcare workers are among the frontliners in the fight against COVID-19, and thus, they are at a high risk of contracting the infection. The nature of their work, which involves direct, close, and prolonged contact with patients, has placed them among the high-risk groups for acquiring the infection during the COVID-19 pandemic. In this study, we assessed HCWs’ compliance with PPE and their perceived effectiveness of different PPE items. We found that more than 80% of HCWs believed in the effectiveness of PPE in protecting them against contracting COVID-19 infection. However, they perceived that certain types of PPE are superior to others in preventing the spread of the infection, particularly when it comes to face masks and respirators, where 83%, and 97.8% of HCWs found them effective, respectively. Consisting with a finding reported in a study conducted in Egypt, this might be attributed to the discomfort caused by different types of PPE during COVID-19 pandemic demonstrated a comparatively high occurrence of all the types of discomfort, which were reported by more than 40% of HCWs, with the top complaints being retroauricular pain (mask pressure related), chest distress or dyspnea, and inconvenience at work, followed by thirst or dry throat. Moreover, in our study, we found that the discomfort caused by certain types of PPE like face mask, goggles, or face shield is among the top barriers to the compliance with PPE. Several measures can be followed to minimize the discomfort caused by PPE and improve compliance. For example, the use of a dressing can decrease the chance of incurring pressure injuries that can be caused by certain types of PPE in certain areas such as the bridge of the nose and behind the ears, using a headband with buttons that attach to the straps of a surgical mask, wearing appropriate size of PPE, and removing PPE as soon as possible after leaving the work environment. Having younger age groups less compliant with PPE might be attributed to their knowledge of the fact that the risk and severity of COVID-19 increase in older adults starting in their 50s and in those with chronic medical conditions who are usually of older age. Surprisingly, despite having higher perceived effectiveness, participants who were working in COVID-19 facilities were less likely to be fully complaint compared with those running primary healthcare clinics at non-COVID-19 facilities, which might be attributed to the shortage of PPE as reported by more HCWs among COVID-19 facilities compared with non-COVID-19 facilities, which is expected in light of the large number of suspected COVID-19 cases dealt with in COVID-19 facilities. Moreover, more HCWs in COVID-19 facilities reported other barriers to the use of PPE such as lower perceived risk of getting COVID-19, discomfort caused by some types of PPE, and that PPE interfere with patient-provider relationship, among others. Expectedly, we found that participants with high perceived effectiveness and those who received training on the appropriate use of PPE were more than 2 times more likely to be fully compliant with PPE. This result came to support the available evidence that higher perceived effectiveness of PPE and previous training predicted higher compliance. The most common barrier for appropriate use of PPE was the shortage of PPE, which is a global problem. The WHO has warned that shortage of PPE caused by increasing demand and misuse is putting the lives of HCWs at risk from SARS-CoV-2 infection and other infectious diseases. Therefore, to help countries in optimizing the rational use of PPE, the WHO issued a guidance for the rational use of PPE in healthcare settings and the effective management of supply chains. It is evident from previous outbreaks that PPEs are crucial to protect HCWs’ health and well-being and maintain a sustainable health workforce that can help in mitigating infectious outbreaks. We believe that adequate provision, clear guidance, and training on the appropriate use of PPE will

![FIGURE 1. Proportions of fully compliant HCWs with different types of PPEs](https://www.journalpatientsafety.com)
### TABLE 3. Determinants and Predictors of Full Compliance With PPE Measures Using χ² Test and Multiple Logistic Regression Analysis

| Variable                          | Fully Compliant, No. (%) | χ² Test, P Value | Multivariable Regression Analysis |
|-----------------------------------|--------------------------|-----------------|-----------------------------------|
|                                   |                          |                 | AOR (95% CI)                      | P       |
| Age category, y                   |                          |                 |                                   |         |
| 18–29                             | 18 (7.0)                 | 0.138           | 0.21 (0.07–0.61)                  | 0.004   |
| 30–39                             | 135 (52.5)               |                 | 0.39 (0.18–0.82)                 | 0.013   |
| 40–49                             | 70 (27.2)                |                 | 0.49 (0.24–1.01)                 | 0.054   |
| ≥50                               | 34 (13.2)                |                 | 1 (reference)                    |         |
| Sex                               |                          |                 |                                   |         |
| Female                            | 160 (62.3)               | 0.914           | 0.997 (0.63–1.58)                 | 0.991   |
| Male                              | 97 (37.7)                |                 | 1 (reference)                    |         |
| Nationality                       |                          |                 |                                   |         |
| Filipino                          | 85 (33.1)                | **0.032**       | 1 (reference)                    |         |
| Indian                            | 68 (26.5)                |                 | 0.65 (0.38–1.12)                 | 0.121   |
| Egyptian                          | 23 (8.9)                 |                 | 0.51 (0.24–1.11)                 | 0.089   |
| Jordanian                         | 16 (6.2)                 |                 | 0.47 (0.20–1.11)                 | 0.085   |
| Sudanese                          | 8 (3.1)                  |                 | 0.31 (0.11–0.84)                 | **0.021**|
| Others                            | 57 (22.2)                |                 | 0.50 (0.25–1.01)                 | 0.052   |
| PHCC region                       |                          |                 |                                   |         |
| Northern                          | 97 (37.7)                | 0.464           | 0.88 (0.57–1.37)                 | 0.576   |
| Central                           | 48 (18.7)                |                 | 0.55 (0.32–0.93)                 | **0.026**|
| Western                           | 112 (43.6)               |                 | 1 (reference)                    |         |
| Area of work                      |                          |                 |                                   |         |
| Non–COVID-19 facility             |                          |                 |                                   |         |
| Clinic                            | 149 (58.0)               | **0.039**       | 1 (reference)                    |         |
| Emergency                         | 12 (4.7)                 |                 | 0.76 (0.28–2.06)                 | 0.588   |
| Others                            | 38 (14.8)                |                 | 0.60 (0.34–1.04)                 | 0.069   |
| COVID-19 facility                 | 58 (22.6)                |                 | 0.47 (0.28–0.79)                 | **0.004**|
| Profession                        |                          |                 |                                   |         |
| Nurse                             | 115 (44.7)               | **0.025**       | 1 (reference)                    |         |
| Physician                         | 63 (24.5)                |                 | 1.25 (0.62–2.52)                 | 0.542   |
| Others                            | 79 (30.7)                |                 | 0.80 (0.47–1.35)                 | 0.400   |
| Clinical experience (in PHCC), y  |                          |                 |                                   |         |
| <1                                | 49 (19.1)                | 0.446           | 2.45 (1.25–4.79)                 | **0.009**|
| 1–2                               | 42 (16.3)                |                 | 1.22 (0.65–2.26)                 | 0.535   |
| 3–4                               | 50 (19.5)                |                 | 1.23 (0.70–2.16)                 | 0.470   |
| ≥5                                | 116 (45.1)               |                 | 1 (reference)                    |         |
| Having a relative or friend diagnosed with COVID-19 | | | | |
| No                                | 49 (19.1)                | 0.483           | 1.41 (0.84–2.36)                 | 0.189   |
| Yes                               | 208 (81.9)               |                 | 1 (reference)                    |         |
| Frequency of interaction with COVID-19 suspected or confirmed patients | | | | |
| Never                             | 17 (6.6)                 | **0.030**       | 1.20 (0.47–3.05)                 | 0.697   |
| Some of the shifts                | 56 (21.8)                |                 | 0.54 (0.32–0.90)                 | **0.018**|
| Most of the shifts                | 33 (12.8)                |                 | 0.52 (0.30–0.92)                 | **0.025**|
| Every shift                       | 151 (58.8)               |                 | 1 (reference)                    |         |
| Training on the proper use of PPE in the past year | | | | |
| No                                | 19 (7.4)                 | 0.124           | 0.84 (0.41–1.72)                 | 0.639   |
| Yes                               | 238 (92.6)               |                 | 1 (reference)                    |         |
| Perceived effectiveness category  |                          |                 |                                   |         |
| Low perception                    | 84 (32.7)                | <0.001          | 1 (reference)                    |         |
| High perception                   | 173 (67.3)               |                 | 2.48 (1.66–3.70)                 | <0.001   |

*Significant P values of <0.05 are shown in bold.

*The outcome of the regression model is compliance with PPE (N = 503) including compliance during interaction with suspected or confirmed COVID-19 cases and while performing an AGP for suspected or confirmed COVID-19 case.

1Because of rounding, percentages may not always appear to add up to 100%.

AOR, adjusted OR.
| PPE Barriers                                      | PHCC Regions                      | Profession       | Area of Work       |
|--------------------------------------------------|-----------------------------------|------------------|-------------------|
|                                                  | Northern, No. (%) | Central, No. (%) | Western, No. (%) | Nurse, No. (%) | Physician, No. (%) | Others, No. (%) | COVID19 Facility, No. (%) | Clinic, No. (%) | Emergency, No. (%) | Others, No. (%) | Total, No. (%) |
| Shortage of PPE                                  | 118 (40.3)         | 70 (43.2)        | 132 (43.7)       | 117 (43.8)     | 64 (42.7)          | 139 (40.9)      | 70 (46.4)          | 169 (43.4)      | 8 (30.8)         | 73 (38.2)       | 320 (42.3)     |
| Work overload and lack of time                   | 84 (28.7)          | 41 (25.3)        | 97 (32.1)        | 82 (30.7)      | 46 (30.7)          | 94 (27.6)       | 30 (19.9)          | 126 (32.4)      | 11 (42.3)        | 55 (28.8)       | 222 (29.3)     |
| Forgetfulness                                    | 22 (7.5)           | 12 (7.4)         | 23 (7.6)         | 14 (5.2)       | 13 (8.7)           | 30 (8.8)        | 5 (3.3)            | 25 (6.4)        | 5 (19.2)         | 22 (11.5)       | 57 (7.5)       |
| Lack of knowledge of proper use of PPE           | 19 (6.5)           | 14 (8.6)         | 34 (11.3)        | 20 (7.5)       | 7 (4.7)            | 40 (11.8)       | 11 (7.3)           | 37 (9.5)        | 1 (3.8)          | 18 (9.4)        | 67 (8.9)       |
| Low COVID-19 risk perception                     | 18 (6.1)           | 9 (5.6)          | 14 (4.6)         | 11 (4.1)       | 3 (2.0)            | 27 (7.9)        | 9 (6.0)            | 19 (4.9)        | 0 (0.0)          | 13 (6.8)        | 41 (5.4)       |
| Low perceived effectiveness of PPE               | 14 (4.8)           | 11 (6.8)         | 14 (4.6)         | 10 (3.7)       | 4 (2.7)            | 25 (7.4)        | 8 (5.3)            | 22 (5.7)        | 1 (3.8)          | 8 (4.2)         | 39 (5.2)       |
| Discomfort caused by PPE                         | 81 (27.8)          | 52 (32.1)        | 105 (34.8)       | 80 (30.0)      | 49 (32.7)          | 109 (32.1)      | 51 (33.8)          | 116 (29.8)      | 7 (26.9)         | 64 (33.5)       | 238 (31.4)     |
| Interference of patient-provider relationship    | 31 (10.6)          | 17 (10.5)        | 27 (8.9)         | 28 (10.5)      | 8 (5.3)            | 39 (11.5)       | 14 (9.3)           | 35 (9.0)        | 1 (3.8)          | 25 (13.1)       | 75 (9.9)       |
| Lack of policies/sanctions/penalties for noncompliers | 12 (4.1)         | 9 (5.6)          | 18 (6.0)         | 15 (5.6)       | 5 (3.3)            | 19 (5.6)        | 10 (6.6)           | 19 (4.9)        | 1 (3.8)          | 9 (4.7)         | 39 (5.2)       |
| Lack of PPE training                             | 22 (7.5)           | 14 (8.6)         | 28 (9.8)         | 18 (6.7)       | 10 (6.7)           | 36 (10.6)       | 15 (9.9)           | 30 (7.7)        | 1 (3.8)          | 18 (9.4)        | 64 (8.5)       |
| Noncompliance of colleagues and supervisors (peer effect) | 17 (5.8)       | 12 (7.4)         | 10 (3.3)         | 11 (4.1)       | 7 (4.7)            | 21 (6.2)        | 8 (5.3)            | 22 (5.7)        | 0 (0.0)          | 9 (4.7)         | 39 (5.2)       |
Strengths and Limitations

This study has several strengths. First, it is one of the few studies in the Middle East to explore HCWs’ compliance with PPE during the current COVID-19 pandemic. Second, we managed to include an acceptable number of HCWs from the primary healthcare setting, which might increase our confidence in generalizing the results to the primary HCW population in Qatar. Although we provided some insights into the compliance of HCWs with PPE during this unprecedented crisis of COVID-19, we do acknowledge some limitations. First, the main limitation of this study that might introduce reflections in the practices. Hence, the detected compliance rates should be viewed cautiously. However, the only means for collecting data during COVID-19 in line with the national recommendations of maintaining physical distancing was using Web-based surveys. Second, institutional recommendations and instructions regarding the use of PPE might influence HCWs’ compliance and affect our results. Lastly, using the cross-sectional design of this study hindered us from establishing how compliance with PPE translates into lower incidence of COVID-19 infection among HCWs on the ground, which requires an alternative study design.

CONCLUSIONS

Despite the high perceived effectiveness HCWs in primary healthcare settings had for PPE in protecting against COVID-19 infection, their full compliance rate with using PPE was moderate and needs further improvement. Healthcare workers’ age, nationality, health center region, area of work, clinical experience, frequency of interaction with suspected or confirmed COVID-19 cases, and the perceived effectiveness of PPE were significant predictors of full compliance with PPE. Shortage of PPE was the most commonly reported barrier. Continuous monitoring and conducting clinical audits and provision of adequate supplies of PPE are among the most important strategies to be followed by policy makers and managers of health centers to improve compliance rates among HCWs. Further research that involves direct observation of HCWs’ compliance with PPE is recommended, and investigating the impact of noncompliance on delivery of care and patient safety is needed.

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