

# Understanding of Coronavirus Disease 2019 (COVID-19) and the practice of preventive measures among doctors and nurses in a university teaching hospital- A cross-sectional study

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## ABSTRACT

**Introduction:** Knowledge and adequate practice of preventive measures among health care workers (HCWs) are important to reduce the risk of COVID-19 transmission.

**Methods:** A cross-sectional study was conducted among doctors and nurses in the medical department in Pusat Perubatan Universiti Kebangsaan Malaysia between November 18, 2020 and December 18, 2020 during the third wave of COVID-19 epidemic in Malaysia. We studied the knowledge and practice of preventive measures of COVID-19 among doctors and nurses in the COVID-19 or sudden acute respiratory infection (SARI) wards and general medical wards. Data was collected using a validated self-designed google form online-questionnaire.

**Results:** A total of 407 subjects completed the study and 80.8% were females; 55.8% were aged between 30-39 years; 46.4% were medical doctors. The main source of COVID-19 knowledge was the Ministry of Health Malaysia (MOH) website (35.1%). Majority (97%) had sufficient knowledge and 82% practiced proper preventive measures. Doctors had a higher mean knowledge score compared to nurses ( $p < 0.001$ ). HCWs working in COVID-19 or SARI wards scored higher in knowledge questions compared to those in the general medical wards ( $p = 0.020$ ). Nurses practiced better preventive measures ( $p < 0.001$ ). Good knowledge could not be predicted based on professions (OR: 0.222, 95% CI: 0.048 – 1.028,  $p = 0.054$ ). Majority were unable to recall the proper steps of donning (85.8%) and doffing (98.5%).

**Conclusions:** Although majority had good knowledge and practiced proper preventive measures, there was a poor recall in donning and doffing steps regardless of place of practice. The MOH website is a useful platform for tailored continuous medical education and regular updates on COVID-19. Regular training and retraining on donning and doffing of PPE is needed to bridge this gap.

## KEYWORDS:

COVID-19, novel coronavirus, knowledge, preventive measures, health care workers

## INTRODUCTION

The COVID-19 pandemic started in December 2019, and has since caused multiple health related complications and death worldwide. The first COVID-19 outbreak in Malaysia was reported on the 25th of January 2020, originating from 3 tourists travelling from China arriving through Singapore. The second wave occurred in early March 2020, following an international religious assembly in Kuala Lumpur. This study was conducted in October 2020 during the third wave of COVID-19 in Malaysia.

Health care workers (HCWs) are frontliners of COVID-19 pandemic and have a higher risk of contracting and transmitting the virus to colleagues, family members and patients. The risk of transmission can be caused by lack of proper isolation facilities, insufficient knowledge on COVID-19 and inadequate practice of preventive measures.<sup>1-3</sup>

The standard preventive measures are appropriate use of PPE, hand hygiene, implementation of mask policy and training and education on prevention of infection. Whilst these have been shown to be effective in reducing risk of cross-infection among HCWs, hospital-acquired COVID-19 infection has been reported.<sup>4</sup> Hospital acquired COVID-19 infection further increases the cost of treatment and delays discharges of cured patients. Exploring the extent of knowledge, compliance of HCWs to the steps of PPE and practice of preventive measures are important steps to address the potential missing link.

The advent of COVID-19 vaccination brings hope to the potential end to this pandemic. To date there are 3 main vaccines in the market with varying efficacy.<sup>5-8</sup> The vaccine confers immunity, reduces the severity of infection and potentially decreases transmission rates. There is no evidence that any of the current Covid-19 vaccines can completely stop people from being infected and this has implications for achieving herd immunity. The most effective way to curb this pandemic remains a good knowledge and practice of preventive measures against Covid-19.

## MATERIALS AND METHODS

A cross-sectional survey study was conducted among 410 doctors and nurses between November 18th, 2020 to December 18th, 2020 in Pusat Perubatan Universiti Kebangsaan Malaysia (PPUKM) during the third wave of the COVID-19 epidemic in Malaysia in the medical department. This study explored the knowledge and routine practices of preventive measures and appropriate PPE steps in HCWs in the medical wards. This was a quantitative analysis investigating the knowledge and practice of preventive measures among doctors and nurses. A google form questionnaire link was sent out through WhatsApp messenger groups to HCWs in the medical department. The link was also shared personally to HCWs who were in the contact list of the investigators. This study included all 420 HCWs in the medical department. Only those who completed the questionnaire were recruited and data analysed. Subjects with incomplete answers in the questionnaire and who did not consent were excluded.

A self-administered questionnaire in the English language was developed based on existing published COVID-19 research and data from WHO websites and our clinical experience of treating COVID-19 patients in PPUKM.<sup>5</sup> The content and relevance of the questionnaire were checked and validated by the authors and two external infectious disease physicians. The questionnaire was subsequently validated in a pilot study involving 20 participants using an online platform.

There were 3 sections in the questionnaire which were demographic characteristics (gender, age, working experience, profession, location of practice and main source of knowledge on COVID-19), COVID-19 knowledge (which comprised 14 questions on general knowledge, symptoms, mode of transmission and treatment) and practice of preventive measures (which comprised 13 questions assessing practice of mask wearing, hand hygiene, adherence to safety practice and workplace protocols as well as knowledge of donning and doffing Personal Protection Equipment (PPE)). Questions were answered by either yes or no. The participants were asked to list the correct sequence of donning and doffing PPE in the theme of practice of donning and doffing. The options given were gown, gloves, eye protection, hand hygiene and mask. Only the correct sequence was given a score of 1. Each correct answer was given a score of 1 and an incorrect answer was given a score of zero. A high level of knowledge was defined by a score > 11 on the knowledge scale. Those who scored > 10 on the practice of preventive measure scale were considered to have an adequate adherence to COVID-19 prevention. A score of 75% and above was considered a good score.

All the researchers reviewed the interview materials, summarised and formulated the meaningful statements. Data was collected using google form online-questionnaire method. The subjects were informed about the study objectives and informed consent was obtained from each participant. The data were analysed using Statistical Package for Social Science (SPSS) software version 16. Demographic characteristics were analysed by descriptive statistics. Normally distributed continuous data were described as

means and standard deviations (SD). The qualitative data was described in frequencies (n) and percentages (%) of total subjects. Chi-square-test was used to compare qualitative variables and association between doctors and nurses. Data were analysed using independent simple t-test and one-way analysis of variance (ANOVA) test. At 95% Confidence Interval, p value <0.05 was considered to be statistically significant.

## RESULTS

### *Demographic characteristics*

In all 410 HCWs participated and nearly all (n=407) completed the questionnaire (response rate=99.3%). Table I summarises the demographics of the subjects. Majority were females (n=329, 80.8%). Most subjects were aged below 40 years (n=335, 82.3%) and 310 (76.2%) had more than 5 years of work experience. A total of 189 (46.4%) subjects were medical doctors and one-third (n=132, 32.4%) of participants were directly involved in the management of COVID-19 or SARI patients.

### *Source of COVID-19 information*

MOH website was the most common source 143 (35.1%), followed by social media (Facebook, WhatsApp messenger) 116 (28.5%). Continuous medical education accounted for only 77 (18.9%).

### *Knowledge about COVID-19*

The least correct answers were related to vaccine development for COVID-19 where only 79 (19.4%) answered correctly (Table II). There was a difference detected between doctors and nurses in the following; COVID-19 is a viral disease (p < 0.001), COVID-19 is transmitted through close contact (p = 0.005), COVID-19 always causes death (p < 0.001) and antibiotics are effective in treating COVID-19 (p < 0.001).

Thirty-two participants (7.9%) scored 14, 207 (50.9%) scored 13, 129 (31.7%) scored 12, 27 (6.6%) scored 11 and 12 (2.9%) had a knowledge score of less than 11. A total of 393 (97%) subjects were considered to have sufficient knowledge (score > 11). The mean knowledge score was 12.52 (SD 1.00). Doctors had higher mean knowledge scores compared to nurses [12.77 (1.0) vs 12.29 (0.95), p = 0.001]. HCWs working in COVID-19/SARI wards scored higher than those in non-COVID-19/non-SARI wards [12.67 (0.79) vs 12.44 (1.08), p=0.020]. There was a significant association between knowledge scores and males (p = 0.013), doctors (p < 0.001) and practicing in COVID/SARI wards (p = 0.020).

### *Practice of preventive measures towards COVID-19*

More than 75% of HCWs adhered strictly to the COVID-19 safety protocol, hand hygiene and proper PPE (Table III). In all 336(82%) subjects practiced adequate preventive measures (score > 10). Nurses practiced better preventive measures (OR 0.231, p < 0.001).

HCWs working in the COVID-19/SARI wards had lower mean practice scores [10.41 (SD 1.03)] compared to those working in the non-COVID-19/non-SARI wards [10.43 (SD 1.09)]; p=0.886. There was a significant association between length of

**Table I: Demographics, location of practice and main source of knowledge of study participants**

Variables	Frequency (n = 407)	Percentage
<b>Gender</b>		
Male	78	19.2
Female	329	80.8
<b>Age (years)</b>		
20-29	108	26.5
30-39	227	55.8
40-49	68	16.7
>50	4	1
<b>Working experience (years)</b>		
<5	97	23.8
5-10	168	41.3
>10	142	34.9
<b>Designation</b>		
Nurses	218	53.6
Doctors	189	46.4
House officer	54	13.3
Medical officer	102	25
Specialist	8.1	33
<b>Location of practice</b>		
COVID-19/SARI ward	132	32.4
Non-COVID-19/Non-SARI ward	275	67.6
<b>Main source of knowledge on COVID-19</b>		
CME	77	18.9
MOH website	143	35.1
WHO website	24	6
Social media	116	28.5
Newspaper	3	0.7
Television	44	10.8

**Table II: Knowledge of health care workers toward COVID-19 (n = 407)**

Theme: Knowledge Questions	Correct Responses, n (%)			p value	95% CI
	Doctors (n=189)	Nurses (n=199)	Overall (n=407)		
<b>1: General knowledge on COVID-19 disease</b>					
COVID-19 is a viral disease.	188 (99.5)	204 (93.6)	392 (96.31)	<0.001	0.078 (0.010 - 0.595)
COVID-19 is transmitted through close contact.	170 (89.9)	211 (96.8)	381 (93.61)	0.005	3.369 (1.384 - 8.202)
COVID-19 is transmitted by respiratory droplets.	183 (96.8)	212 (97.2)	395 (97.05)	0.802	1.158 (0.367 - 3.654)
COVID-19 always causes death.	180 (95.2)	136 (63.4)	316 (77.64)	<0.001	0.083 (0.04 - 0.171)
The virus may be more dangerous for the elderly and patients with chronic diseases.	188 (99.5)	218 (100)	406 (99.75)	0.464	2.16 (1.945 - 2.398)
COVID-19 may lead to pneumonia and respiratory failure.	185 (97.9)	215 (98.6)	400 (98.28)	0.709	1.55 (0.342 - 7.013)
<b>2: Symptoms of COVID-19</b>					
Headache, fever, cough, sore throat, and flu are common symptoms of COVID-19.	187 (98.9)	214 (98.2)	401 (98.53)	0.690	0.572 (0.104 - 3.159)
The incubation period is from 2 to 14 days.	186 (98.4)	214 (98.2)	400 (98.28)	1.000	0.863 (0.191 - 3.905)
<b>3: Mode of Transmission</b>					
Asymptomatic patient can transmit COVID-19 to other people during the incubation period.	179 (94.7)	209 (95.9)	388 (95.33)	0.579	1.297 (0.516 - 3.263)
Wearing surgical or N95 masks can help prevent one from contracting COVID-19.	182 (96.3)	203 (93.1)	385 (94.59)	0.157	0.521 (0.208 - 1.305)
Social distancing of one-meter distance can help prevent one from contracting COVID-19.	188 (99.5)	217 (99.5)	405 (99.51)	1.000	1.154 (0.072 - 18.581)
Isolation of COVID-19 patient is effective in reducing the transmission of COVID-19	188 (99.5)	217 (99.5)	405 (99.51)	1.000	1.154 (0.072 - 18.581)
<b>4: Treatment of COVID-19</b>					
There is a vaccine for COVID-19 in development	34 (18)	45 (20.6)	79 (19.4)	0.531	1.186 (0.723 - 1.946)
Antibiotics are effective in treating COVID-19.	176 (93.1)	163 (74.8)	339 (83.29)	<0.001	0.219 (0.115 - 0.416)

Table III: Practice of preventive measure towards COVID-19 among HCWs

Statement	Yes, n(%)	No, n(%)
<b>Theme 1: Wearing of surgical or N95 mask</b>		
Do you use a surgical or N95 mask in the workplace?	365 (89.68)	42 (10.32)
Are you confident with the steps of wearing surgical or N95 masks the right way?	391 (96.07)	16 (3.93)
<b>Theme 2: Hand hygiene</b>		
Do you wash and disinfect your hands before contact with each patient?	400 (98.28)	7 (1.72)
Do you wash and disinfect your hands after contact with each patient?	405 (99.51)	2 (0.49)
Do you frequently clean and disinfect surfaces?	341 (83.78)	66 (16.22)
Do you carry a hand sanitiser?	318 (78.13)	89 (21.87)
<b>Theme 3: Adherence to safety practice and workplace protocols</b>		
Would you perform a COVID-19 screening test ordered before certain high risk procedure?	369 (90.66)	38 (9.34)
Do you adhere to your hospital COVID-19 safety protocol?	401 (98.53)	6 (1.47)
Do you keep yourself updated on the hospital COVID-19 safety protocol?	387 (95.09)	20 (4.91)
Do you wear proper personal protective equipment (PPE) when dealing with suspected or confirmed COVID-19 cases?	401 (98.53)	6 (1.47)
Would you report to your superior after attending a suspected or confirmed COVID-19 cases without wearing proper PPE?	394 (96.81)	13 (3.19)
<b>Theme 4: Practice of donning and doffing</b>		
Answered the donning sequence correctly.	58 (14.25)	349 (85.75)
Answered the doffing sequence correctly.	6 (1.47)	401 (98.53)

Table IV: Predictor of HCWs good knowledge on COVID-19

Variable	Good knowledge (score > 11)	Poor knowledge (score < 11)	OR (95% CI)	p value
<b>Gender</b>				0.35
Male	77 (19.5%)	1 (8.3%)	1	
Female	318 (80.5%)	11 (91.7%)	0.375 (0.048 - 2.952)	
<b>Age (years)</b>				0.644
20-29	106 (26.8%)	2 (16.7%)	1	
30-39	218 (55.2%)	9 (75%)	0.457 (0.097 - 2.153)	
40-49	67 (17%)	1 (8.3%)	1.264 (0.112 - 14.215)	
>50	4 (1%)	0 (0%)	INFINITE	
<b>Designation</b>				0.054
Doctor	187 (47.3%)	2 (16.7%)	1	
Nurse	208 (52.7%)	10 (83.3%)	0.222 (0.048 - 1.028)	
<b>Length of years in service</b>				0.211
< 5	96 (24.3%)	1 (8.3%)	1	
5-10	160 (40.5%)	8 (66.7%)	0.208 (0.026 - 1.691)	
> 10	139 (35.2%)	3 (25%)	0.483 (0.049 - 4.710)	
<b>Location of practice</b>				0.579
Non COVID-19/Non SARI ward	266 (67.3%)	9 (75%)	1	
COVID-19/SARI ward	129 (32.7%)	3 (25%)	1.455 (0.387 - 5.465)	
<b>Main source of knowledge on COVID-19</b>				0.444
CME	73 (18.5%)	4 (33.3%)	1	
Social media	112 (28.4%)	4 (33.3%)	1.534 (0.372 - 6.328)	
WHO website	24 (6.1%)	0 (0%)	INFINITE	
Newspaper	3 (0.8%)	0 (0%)	INFINITE	
MOH website	141 (35.7%)	2 (16.7%)	3.863 (0.691 - 21.589)	
Television	42 (10.6%)	2 (16.7%)	1.151 (0.202 - 6.551)	

service > 10 years ( $p=0.037$ ), nursing profession ( $p < 0.001$ ) and female gender ( $p < 0.01$ ) and better preventive measures practice. The correct sequence of donning and doffing PPE was low; 58 (14.3%) donning and 6 (1.5%) doffing.

Predictors associated with good knowledge and adequate practice of preventive measures on COVID-19 Logistic regression was performed to determine the factors associated with good knowledge and adequate practice regarding COVID-19 (Tables IV-V). Good knowledge of COVID-19 could not be predicted based on profession (OR: 0.222, 95% CI: 0.048 – 1.028,  $p = 0.054$ ). While predictors of

adequate practices were being a nurse (OR: 0.231, 95% CI: 0.130 – 0.411,  $p < 0.001$ ) and female gender (OR: 0.317, 95% CI 0.180 – 0.558,  $p < 0.001$ ).

## DISCUSSION

The COVID-19 pandemic is an on-going global health emergency which continues to impact our lives and world economy. To date more than 2 million people have succumbed to the disease.<sup>9</sup> HCWs have a reported higher risk of infection with outbreaks in hospitals in Germany and Malaysia.<sup>10</sup> Knowledge of COVID-19 and good preventive

**Table V: Predictor of HCWs good practice on COVID-19**

Variable	Good practice (score > 10)	Poor practice (score < 10)	OR (95% CI)	p value
<b>Gender</b>				< 0.001
Female	284 (84.5%)	45 (63.4%)	1	
Male	52 (15.5%)	26 (36.6%)	0.317 (0.180 - 0.558)	
<b>Age (years)</b>				0.592
20-29	88 (26.2%)	20 (28.2%)	1	
30-39	185 (55.1%)	42 (59.2%)	0.999 (0.554 - 1.802)	
40-49	60 (17.9%)	8 (11.3%)	0.587 (0.243 - 1.419)	
>50	3 (0.9%)	1 (1.4%)	1.467 (0.145 - 14.845)	
<b>Designation</b>				< 0.001
Doctor	136 (40.5%)	53 (74.6%)	1	
Nurse	200 (59.5%)	18 (25.4%)	0.231 (0.130 - 0.411)	
<b>Length of years in service</b>				0.127
< 5	75 (22.3%)	22 (31%)	1	
5-10	137 (40.8%)	31 (43.7%)	0.771 (0.417 - 1.426)	
> 10	124 (36.9%)	18 (25.4%)	0.495 (0.249 - 0.982)	
<b>Location of practice</b>				0.269
Non-COVID-19/Non- SARI ward	231 (68.8%)	44 (62%)	1	
COVID-19/SARI ward	105 (31.3%)	27 (38%)	1.350 (0.793 - 2.298)	
<b>Main source of knowledge on COVID-19</b>				< 0.001
CME	55 (16.4%)	22 (31%)	1	
Social media	92 (27.4%)	24 (33.8%)	0.652 (0.334 - 1.272)	
WHO website	16 (4.8%)	8 (11.3%)	1.250 (0.468 - 3.338)	
Newspaper	2 (0.6%)	1 (1.4%)	1.250 (0.108 - 14.498)	
MOH website	131 (39%)	12 (16.9%)	0.229 (0.106 - 0.495)	
Television	40 (11.9%)	4 (5.6%)	0.250 (0.08 - 0.782)	

practices by HCWs are both important to protect and prevent cross-infection in the hospital setting. There is limited published data on the knowledge and practice of preventive measures among HCWs about the COVID-19.<sup>11</sup>

There were more females than males (80% versus 19.2%) in this study. The majority of participants were nurses, and in Malaysia nurses are mainly females. This is similar to reports from two other Asian studies where females were nurses.<sup>12,13</sup> There was a higher percentage of subjects with working experience more than 5 years (76.2%) compared to 28% to 70% reported in other studies.<sup>13,15</sup> One third of the HCWs in this study were in charge of the COVID-19/SARI wards. This is comparable to a study done in China where 42.6% of subjects were directly involved in COVID-19 prevention and treatment.<sup>15</sup>

The MOH website was the primary source of information on COVID-19 in our cohort. This is similar to a study in Vietnam where MOH website was one of the main sources of COVID-19 information.<sup>13</sup> This underlines the importance of regular updates on COVID-19 related information on MOH website. In our study approximately one-third of the HCWs used social media as their main source of information. This is similar to studies in Vietnam, United Arab Emirates and Pakistan.<sup>13,16,17</sup> This highlights the role that technology plays in dissemination of COVID-19 information. The majority of our subjects were millennials and their age coincides with the peak usage of many social media platforms such as Facebook and Instagram. It is logical to assume that they turn to social media as their main source of information during the COVID-19 pandemic. It also shows the importance of evaluating and vetting the information available as the large amount of information flooding the internet may cause

confusion amongst HCWs. Providing a link of various approved websites on the MOH website is a logical solution. Despite the fact that the continuous medical education is an obvious platform for dissemination and improvement of COVID-19 knowledge, it was not the main source of knowledge in the majority of our subjects. In PPUKM the CME sessions are pre-planned to cover a wide array of medical diseases. What could have been done was to use the CME platform to update the COVID-19 disease regularly.

There were essential elements of variation between doctors and nurses. Overall our study cohort showed a high level of COVID-19 knowledge. This may be explained by the fact that for all of participants this is the first pandemic that they have experienced. The devastating consequence of this pandemic ranges from a change in lifestyle of mask wearing and social distancing became the norm to the increasing number of COVID-19 deaths reported on a daily basis. This fear is likely the driving force to know more about the disease. This is similar to studies conducted among HCWs in Italy, China and Vietnam.<sup>13,18,19</sup> Other studies showed conflicting results with a lower percentage of HCWs with sufficient knowledge.<sup>15,20</sup> When asked to indicate whether the statement “COVID-19 always causes death” was true or false, 95.2% of doctors and 63.4% of nurses answered correctly. This difference in risk perception may contribute to behavioural responses in the workforce and affect the efficiency of HCWs in dealing with this COVID-19. The nurses scored lower for two statements; “COVID-19 is a viral disease” and “antibiotics are effective in treating COVID-19”. One possible explanation is doctors were invited to participate in online webinars on COVID-19 updates regularly and this was not extended to the nursing staff.

Hesitancy to get vaccinated is a threat to the fight against the spread of COVID-19. Many studies have shown different ranges of willingness to vaccinate ranging from 28.7% to 93.3%.<sup>21,22</sup> Our study explored the awareness of HCWs to the development of the COVID-19 vaccine. Only 20% of subjects were aware of the vaccine development with both nurses and doctors showing equally poor awareness. This lack of awareness could indirectly affect the willingness to vaccinate. There is a lot of misinformation that circulates in the media on vaccination. It is important to stress that vaccines in general are effective in limiting the spread of COVID-19 by providing herd immunity.

Most subjects practiced good preventive measures and adhered to safety practice of the workplace protocols when dealing with COVID-19 or SARI cases as recommended by MOH Malaysia and WHO. Handwashing practice was good in our cohort. These findings were consistent with studies conducted in Saudi Arabia and Pakistan where the rate of adequate hand washing was reported at 95.4% and 85.7% respectively.<sup>17,23,24</sup> In PPUKM, alcohol sanitisers are placed strategically at the entrance of each ward and staff are instructed to perform hand sanitising before entering each ward. In addition, these alcohol sanitisers are available at the end of every hospital bed. There are also posters reminding the public to perform hand wash and wearing of face mask. This study found that the practice of cleaning and disinfecting surfaces and carrying personal hand sanitisers to be lower. While hand washing campaigns are widely promoted on radio and TV, details of cleaning of disinfecting surfaces as well as promotion of hand held sanitisers are less so. Contaminated surfaces have been known to play an important role in the spread of health care associated infections such as *Clostridium difficile*, methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant *Enterococci*.<sup>25</sup> However, the transmission of COVID-19 by fomites on inanimate surfaces or objects is debatable.<sup>26</sup>

At the start of the pandemic PPUKM had multiple sessions on the correct sequence of PPE donning and doffing training aimed at HCWs. Subsequently each ward was responsible for their own staff training. There was no fixed schedule for retraining. Due to the possible lack of regular retraining, only 14.3% and 1.5% of our subjects knew the correct sequence of donning and doffing respectively. This is similar to a study conducted in United States of America where up to 90% of cases had incorrect selection and/or the sequence of doffing PPE.<sup>27</sup> Subjects were less familiar with the doffing sequence. A study done in China also showed that there were more errors in doffing PPE compared to donning where donning and doffing videos were reviewed.<sup>28</sup> The above study postulated that the errors were related to fatigue after intensive duties.<sup>28</sup> Our study found poorer recall of doffing. It is possible that subjects view doffing as a less likely source of contamination. This incorrect sequence of practice could affect patient care in a negative way as it can be a potential source of cross infection and self-contamination.<sup>29</sup> Direct exposure is always immediately treated, however occupational exposure from incorrect doffing may be missed. Improvement of procedures in PPE should emphasise not just donning but also doffing to ensure safety of HCWs.

The limitation of this study is the small sample size and cohort limited to the medical department of PPUKM. The results may not be generalised to other hospital HCWs and to other HCWs in other departments.

## CONCLUSION

Although majority our HCWs had good knowledge and practiced proper preventive measures, there was a poor recall in donning and doffing steps regardless of place of practice. Regular training and retraining of HCWs on donning and doffing of PPE is needed. The MOH website is a useful platform for dissemination of COVID-19 information and should be updated regularly.

## AUTHOR CONTRIBUTIONS

- (1) Concept or design: BHN, ABYL, HJL
- (2) Acquisition of data: BHN, ABYL, MFAH, NNNA
- (3) Analysis or interpretation of data: BHN, ABYL, HJL, PP
- (4) Drafting of the article: BHN, ABYL
- (5) Critical revision for important intellectual content: CIS, ABYL, PP, MFAH

All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

## CONFLICTS OF INTEREST

All authors have disclosed no conflicts of interest.

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## ETHICS APPROVAL

This research was approved by the Health Research Ethical Committee of the University Kebangsaan Malaysia Teaching Hospital with the approval project code JEP-2020-573. Informed consent was obtained from all patients.

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