

Compliance with Personal Protective Equipment Use among Non-Medical Healthcare Professionals during Covid-19 Pandemic

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ABSTRACT

Non-medical healthcare professionals, including pharmacists, pharmacy technicians, nutritionists, and radiographers, have a high risk of COVID-19 infection during work. Personal protective equipment use has shown effective in preventing virus transmission. This study aimed to investigate the compliance with personal protective equipment use and identify the factors that may influence users' compliance. The study was designed cross-sectionally, with a self-administered questionnaire. The respondents were non-medical healthcare professionals recruited from covid and non-covid ward at Saiful Anwar General Hospital. The data were collected in November 2020. The questionnaire consists of four questions to assess compliance and eighteen questions to explore factors that may be related to their compliance. This study used the Chi-square test to differentiate the level of compliance between two groups and binary logistic regression to analyze factors that may influence the compliance. Most participants in this study were female (84.8%), with a median age of 33 (23 – 57) years. More than 80 % of participants worked in the non-covid ward. Only one-fifth of participants had work experience of more than 15 years. The compliance with personal protective equipment was 67.3%. From univariate analysis, factors that influenced the compliance were difficulty using, removing, and disposing of personal protective equipment, lack of training and regular monitoring, unsure feeling about the effectiveness of personal protective equipment, discomfort in donning personal protective equipment. Co-workers never reminding themselves to use personal protective equipment also influenced compliance. From multivariate analysis, the difficulty in using, removing, and disposing of personal protective equipment (OR 2.83 (0.730 – 3.478), p=0.025) significantly influenced compliance with personal protective equipment use.

Keywords: Personal protective equipment, compliance, non-medical healthcare professionals

INTRODUCTION

Coronavirus Disease (COVID-19), a very infectious disease caused by the new Coronavirus 2 (SARS-CoV-2), was first found in December 2019 in Wuhan City, China (Hozhabri *et al.*, 2020). The virus had spread worldwide, and World Health Organization (WHO) has determined a pandemic status since March 11, 2020 (World Health Organisation, 2020). At the end of November 2020, there have been more than 61.8 million cases and 1.4 million deaths reported around the world

(World Health Organization, 2020). There have been 586,842 cases in Indonesia, with 18,000 deaths reported on December 8, 2020, and the cases had increased rapidly to 8,369 positive cases per day (STPC19, 2021).

During the COVID-19 pandemic, healthcare workers experienced a severe impact. A survey on 37 nations showed that the median of healthcare workers' death was 0.05 per 100,000 populations (Erdem & Lucey, 2021). By the end of 2020, 507 Indonesian healthcare professionals died due to

covid-19, with the highest rate in December 2020 (Jahawir Gustav Rizal, n.d.).

The consistent use of personal protective equipment is critical to reducing viral transmission risk because the virus spreads mainly through droplets and direct contact (Verbeek *et al.*, 2020). A meta-analysis study provided evidence of the protective effect of masks and respirators against severe acute respiratory syndrome (SARS) (Offeddu *et al.*, 2017). According to WHO guidelines, all healthcare workers directly involved in patient care at hospitals should use appropriate personal protective equipment (PPE) according to different levels of the workplace (WHO, 2020). This recommendation should be applied by not only doctors and nurses, but also non-medical healthcare professionals involved in patient care including pharmacists, pharmacy technicians, nutritionists, and radiographers. However, these non-medical healthcare professionals generally pay less attention to the recommendation as they may feel safe because their contact with patients is not as intensive as doctors' or nurses'.

Monitoring the compliance of health workers in using PPE plays an essential role in mitigating the risk of infection (Bielicki *et al.*, 2020). Identification of the factors that influence compliance is also an important step to increase compliance. The study on compliance in using PPEs in non-medical healthcare professionals is limited. Houghton *et al.* showed that compliance in infection prevention is affected by driving and inhibiting factors. The driving factors include fear of infecting themselves and their families and responsible feelings for their patients. The inhibiting factors include their lack of confidence in the local guidelines, discomfort, the bad stigma of patients, work culture, management support, lack of PPE quality and quantity (Houghton *et al.*, 2020). A cross-sectional study at a private hospital in Malang showed that less than 60 % of nurses who served Covid-19 patients complied with the use of PPE (Gunawan & Chalidyanto, 2020). Therefore, we conducted a study to examine non-medical healthcare professionals' compliance and identify the factors that may influence their compliance in using PPE.

MATERIAL AND METHODS

Study setting

The study was conducted at the Saiful Anwar General Hospital (SAGH), the third referral hospital in East Java Province which is located in Malang district. The hospital has approximately a thousand

beds, with 2,811 healthcare workers, including 188 medical staff. Almost one-half of healthcare workers are non-medical professionals. The hospital served about 40,000 inpatients, 400,000 outpatients, and 30,000 emergency cases every year (Santoso, 2019). When the Covid-19 pandemic occurred, a VIP ward known as "Graha Puspa Husada" was converted into a COVID ward named INCOVIT. As a reference hospital for COVID-19, it has 103 beds for COVID-19 (Sasongko, 2020).

Study design and period

This study used a cross-sectional study design that was performed from November 1 to 30, 2020.

Inclusion / exclusion criteria

Participants included in this study were non-medical healthcare professionals, including pharmacists, pharmacy technicians, nutritionists, and radiographers who were willing to participate, directly involved in healthcare services, and aged 20 - 58 years. Participants who were not directly involved in healthcare services and unable to use the google form questionnaire were excluded.

Sample size determination

The total number of non-medical healthcare professionals in the hospital was 275, consisting of 53 pharmacists, 116 pharmacy technicians, 66 nutritionists, and 40 radiographers. The sample size was determined with the Slovin formula ($n = \frac{N}{1+N.e^2}$) because the population is known (Tejada & Punzalan, 2012). The sample size was $n = \frac{275}{1+275 \times 0.05^2} = 162.96 \approx 163$. We further calculated the sample size for each profession based on its proportion ($n - \text{profession} = \frac{N \text{ total population}}{N \text{ profession population}} \times n$). The sample size for pharmacists, pharmacy technicians, nutritionists and radiographers were 31, 69, 39, and 24, respectively.

Data collection instrument

Data were collected using an online questionnaire distributed via a google form. When we designed this study, we found no previous research assessing the compliance of non-medical healthcare professionals in using PPE and factors influencing their compliance. Therefore, the questionnaire we used was self-developed based on the literature available. To measure the level of compliance, the questions were developed based on Indonesian Minister of Health guidelines about technical instruction for PPE in facing the COVID-

19 outbreak (Kementerian Kesehatan RI, 2020). To identify factors affecting compliance, questions were developed based on results of a review about barriers and facilitators of healthcare workers adherence with infection prevention control guidelines for respiratory infectious diseases conducted by Houghton *et al.* (Houghton *et al.*, 2020).

The questionnaire includes three sections. In the first section, the questions were about participant's demographic characteristics. The second section of the questionnaire contained four questions asking participants' compliance in using PPE including donning, doffing, disposing, and PPE use according to a level area. On these questions, the options provided were never (1), sometimes (2), often (3), and always (4). The third section of the questionnaire consisted of 18 questions about factors that influence compliance. In this section, the participants may answer in four-point scales (1—strongly disagree, 2—disagree, 3—agree, 4—strongly agree). The four scales were converted into a two-scale format for descriptive interpretation as disagree (strongly disagree and disagree) and agree (strongly agree and agree).

The content validity of the questionnaire was tested by some experts. Construct validity test was done with Pearson's correlation. The r-values for questions about donning, doffing, disposing, and PPE use according to a level area were 0.938, 0.806, 0.904, and 0.904 ($p < 0.01$), respectively. Internal consistency with Cronbach α was used for the reliability test. In the reliability test of the 22 questions in the questionnaire, the Cronbach alpha value was 0.635 (r table 0.444); thus, the questionnaire was reliable.

Ethical Consideration

General Hospital Dr. Saiful Anwar Malang's ethics committee regarding the protection of human rights and welfare in medical research has carefully reviewed the research protocol and approved this study (Ethical Approval Number: 400.218/K.3/302/2020). We treated all participants' data with confidentiality.

Data processing and analysis

Data from google spreadsheet were entered and analyzed using SPSS version 25. The data were analyzed descriptively (frequency, percentages, mean and median) to explore the pattern of participants' compliance in using PPE. We defined the compliance based on their maximum score

from the four questions, which was 16. The participants with a score less than 16 were categorized as non-compliant. The Chi-square test was applied to differentiate the level of compliance between two groups, and binary logistic regression was used to analyze factors that may influence the compliance.

RESULTS AND DISCUSSIONS

Demographic characteristics

The participants involved in this study were 165 non-medical health care professionals, including 31 pharmacists, 68 pharmacy technicians, 37 nutritionists, and 29 radiographers (Table I). Most of them were female (84.8%), aged less than 40 years. The majority of them (80.6%) worked at non-Covid wards. Almost one-fifth of the participants did not know their working-level area. The level of workplace was defined according to the Indonesian Ministry of Health regulation about protective equipment use for COVID-19 (Kementerian Kesehatan RI, 2020). Level 1 workplace is a low-risk place with no direct contact with COVID-19 patients, does not handle infectious material, and does not provide direct services to patients. Level 2 is moderate risk places, no direct contact with patients under supervision or confirmed COVID-19 or infectious material but provide administrative services. Level 3 is high-risk places, no direct contact with patients under supervision or confirmed Covid-19 but have contact with infectious materials and provide direct services to patients. Level 4 is high-risk places, have direct contact with patients under the supervision or confirmed Covid-19, contact with infectious material, and provide direct services to patients (Kementerian Kesehatan RI, 2020).

Compliance in using PPE

The majority of participants answered 'always' in all questions about compliance. According to the level area, the participants who answered always donning, doffing, dispose, and use PPE were 83.6%, 80.0%, 87.9%, and 80.0%, respectively (Table 2). The median score was 16 (4 – 16). Participants who had total scores of 16 were categorized as compliant, while those with a total score less than 16 were classified as non-compliant. In this study, the compliance rate was 67.3%. The compliance rate among pharmacists, pharmacy technicians, nutritionists, and radiographers were 54.9%, 64.7%, 81.1%, and 69.0%, respectively (Table III).

Table I. The Characteristics of Participants (N=165)

Characteristics		n	%
Gender	Male	25	15.2
	Female	140	84.8
Age	≤ 30 years old	59	35.8
	31 – 40 years old	69	41.8
	41 – 50 years old	22	13.3
	> 50 years old	15	9.1
	Median (range)	33	(23 – 57)
Profession	Pharmacist	31	18.8
	Pharmacy Technician	68	41.2
	Nutritionist	37	22.4
	Radiographers	29	17.6
Workplace	Non-Covid19 ward	133	80.6
	Covid19 ward	32	19.4
Level of workplace*	Level 1	16	9.7
	Level 2	48	29.1
	Level 3	58	35.2
	Level 4	14	8.5
	Do not know	29	17.6
Employment status	Contract employee	116	70.3
	Civil servant	49	29.7
Working experience	Less than 5 years	40	24.2
	5 – 10 years	57	34.5
	10 – 15 years	34	20.6
	15 – 20 years	9	5.5
	More than 20 years	25	15.2

Notes: *= working-level area were defined based on Indonesian Ministry of Health regulation (Kementerian Kesehatan RI, 2020)

Table II. Compliance in using personal protective equipment

Questions	Always (%)	Often (%)	Sometimes (%)	Never (%)
Donned PPE properly before work	138 (83.6)	21 (12.7)	5 (3)	1 (0.6)
Removed PPE properly after finished work	132 (80.0)	29 (17.6)	2 (1.2)	2 (1.2)
Disposed PPE according to the hospital guidelines	145 (87.9)	15 (9.1)	4 (2.4)	1 (0.6)
Used PPE according to the level area of work	132 (80.0)	27 (16.4)	5 (3)	1 (0.6)

Table III. Total compliance score among participants

The summed compliance	Frequency	Percent
Median (range)	16 (4 – 16)	
Non-compliant (less than 16)	54	32.7
Compliant (equal to 16)	111	67.3

Notes: The compliance score was obtained by summing the four questions about compliance. The participants with a score less than 16 were categorized as non-comply. Otherwise, participants with a score equal to 16 were categorized as comply.

Table IV. Analysis between participant's characteristics and compliance in using PPE

Characteristics		Non-compliant (%)	Compliant (%)	p-value
Gender	Male	7 (13)	18 (16.2)	0.584*
	Female	47 (87)	93 (83.8)	
Age	≤ 33 years old	34 (63)	53 (47.7)	0.066*
	> 33 years old	20 (37)	58 (52.3)	
Profession	Pharmacist	14 (25.9)	17 (15.3)	0.068**
	Pharmacy technician	24 (44.4)	44 (39.6)	
	Nutritionist	7 (13)	30 (27)	
	Radiographer	9 (16.7)	20 (18)	
Working place	Non-COVID	48 (88.9)	85 (76.6)	0.061*
	COVID	6 (11.1)	26 (23.4)	
Working-level area***	Level 1	9 (16.7)	7 (6.3)	0.004*
	Level 2	11 (20.4)	37 (33.3)	
	Level 3	18 (33.3)	40 (36)	
	Level 4	1 (1.9)	13 (11.7)	
	Do not known	15 (27.8)	14 (12.6)	
Employment status	Hospital	40 (74.1)	76 (68.5)	0.460*
	Government	14 (25.9)	35 (31.5)	
Working experience	Less than 5 years	16 (29.6)	24 (21.6)	0.031**
	5 – 10 years	21 (38.9)	36 (32.4)	
	10 – 15 years	12 (22.2)	22 (19.8)	
	15 – 20 years	2 (3.7)	7 (6.3)	
	More than 20 years	3 (5.6)	22 (19.8)	

Notes: (p-value was obtained from chi-square test (*)) and Mann Whitney u test (**) ***= working-level area was defined based on Indonesian Ministry of Health regulation (Kementerian Kesehatan RI, 2020).

Factors that may influence the compliance in using PPE

We further analyzed the sociodemographic characteristics of the participants that may associate with the compliance levels. Based on professions, the pharmacist has the lowest level of compliance rate among other professions, although this difference was not statistically significant ($p=0.068$). There were significant differences in working-level area and experience between non-compliant and compliant groups. Participants who did not know the work level area tend to not comply with the use of PPE (27.8 vs. 12.6%, $p=0.004$). Participants who had work experience of more than 20 years tend to comply with PPE (19.6 vs. 5.6%). Inversely, participants who had fewer than five years of work experience tend to not comply with the use of PPE (29.6 vs. 21.6%) (Table IV).

We also analyzed some other factors related to organizational, individual, and environmental factors that may influence participants' compliance. In univariate analysis, organizational, individual, and environmental factors significantly influenced

compliance. The organizational factors included the difficulty to use PPE, lack of training program, and regular monitoring. The individual factors related to the compliance included unsure about the benefit of PPE and uncomfortable feelings. The environmental factor that influences the compliance included the co-worker's role in promoting PPE. The difficulty in donning, doffing, and PPE disposal significantly influenced compliance (2.83 (0.730–3.478, $p=0.025$)) (Table V).

Our recent study showed that 67.3% of non-medical health professionals complied in using PPE. More than 80% of the participants answered always donning, doffing, dispose, and using PPE according to the level area designated by hospital regulation. This result was higher than another publication. A study in China conducted during the H1N1 pandemic showed that only 18% of respondents correctly identified all PPE components, and 55% reported high compliance (>80%) with PPE use during patient care. In this study, they included medical doctors, nurses, and other professionals in the analyses (Hu *et al.*, 2012).

Table V. Factors influencing the compliance to PPE use

Factors	p-value		OR (95% CI)
	Univariate	Multivariate	
Organization factors			
Availability of PPE procedures.	1	-	-
Difficulty to use PPE.	< 0.0001*	0.025*	2.843 (1.138-7.102)
Lack of training program	0.007*	0.242	1.594 (0.730-3.478)
Regular monitoring	0.038*	0.173	0.564 (0.247-1.285)
Lack of punishment	0.195	-	-
Availability of PPE	0.028*	0.497	0.675 (0.217-2.101)
The number of PPE in the work area does not always match the needs	0.010*	0.100	1.930 (0.882-4.223)
Individual factors			
Fear of catching an infections	1.000	-	-
Afraid to infect the family	1.000	-	-
Afraid to infect the patient	0.243	-	-
Fear of being punished	0.954	-	-
Unsure about the benefit of PPE	0.039*	0.415	0.743 (0.363-1.519)
Increasing workload perception	0.608	-	-
Uncomfortable in wearing PPE	0.054	0.442	2.665 (0.219-32.354)
Environmental factors			
Co-workers do not use PPE	0.122	-	-
Co-workers never remind to use PPE	0.024*	0.729	1.265 (0.334-4.789)
The presence of posters about Covid-19	0.445	-	-
Family support	0.095	0.180	0.250 (0.033-1.897)

Notes: p-value was obtained from a binary logistic test; p-value marked with an asterisk (*) indicates a statistically significant value.

Katanami *et al.* conducted an observational study at a third referral hospital in Japan through video monitoring. This study showed that the adherence rate to appropriate PPE use was 34%. The nurses and the nursing assistant's adherence rate was low compared to infectious disease doctors and cleaning staff (27.9 vs. 100 and 85.7%). This study showed that medical engineering, pharmacists, and other professionals had the lowest adherence (7,7%) (Katanami *et al.*, 2018).

Comparing the compliance between healthcare professionals who worked in covid and non-covid areas showed a difference but not statistically significant. Participants who worked at covid ward tend to comply in using PPE (23.4 vs. 11.1%, $p=0.061$). A study from Neuwirth *et al.* (2020) supported this finding. The overall adherence to using PPE was significantly higher among HCWs who worked at covid ward than non-covid ward (Neuwirth *et al.*, 2020). 26 of 32 (81.25%) of our participants who work at covid ward complied using PPE. This result was higher than nurse compliance at a private hospital in

Malang (less than 60%) (Gunawan & Chalidyanto, 2020).

Our recent study demonstrated that lack of knowledge about work area level and lower work experience was associated with a decrease in compliance. A good understanding of the work area level is vital because staff who know the work area's level will understand the types of PPE used. Thus they use PPE appropriately, not overuse or misuse (Cook, 2020). Good knowledge and accumulation of experience during work had a significant correlation to compliance (Gunawan & Chalidyanto, 2020). These findings support that regular training to increase the knowledge may be able to change their behavior in using PPE.

Our study demonstrated that organizational factors, such as difficulty to use PPE, lack of training program and regular monitoring, the availability of PPE in the hospital, and the supply of PPEs matching the demand influenced the compliance. The difficulties in using PPE may be due to inappropriate PPE sizes, the PPE design, and its complexity for use (Fan *et al.*, 2020). Lack of

training program may correlate with poor knowledge. A study in Japan conducted among 735 nurses at 28 tertiary hospitals demonstrated that a lack of knowledge on standard precaution as the critical component to avoid infection significantly decreased PPE compliance (Morioka *et al.*, 2020). Furthermore, the evaluation of knowledge among nurses in the intensive care unit in Yogyakarta showed that only 60 % of the nurse had high knowledge about PPE use guidelines (Cahyaning Pramesti, 2017). Another study in Northern Uganda showed that 23.7% of nurses, nursing aides, cleaners, and doctors do not know how to donning and doffing PPE. 13.6% of them do not use PPE even when indicated (Okello *et al.*, 2017). This finding implies that the hospital management should perform routine training for their staff about the proper use of PPE.

The other organizational factor that influenced compliance in using PPE was the availability of PPE. The requirement and availability of PPE were imbalanced during the pandemic. Thus, the strategy to procure and supply a good-quality PPE may increase compliance (Sharma *et al.*, 2020).

The individual factors that influence compliance were uncertainty about the effectiveness of PPE and the feeling of discomfort when using PPE. Perceived PPE effectiveness has a strong correlation with compliance. Some Hospital staff felt uncertain about the quality and effectiveness of PPE. A review conducted by Brooks *et al.* showed that using PPE may induce discomfort. They reported several symptoms associated with the use of PPE, such as dehydration, skin desquamation, shortness of breath, sweating, dizziness, headaches, and skin rashes. The use of PPE may decrease healthcare service quality, making it challenging to communicate with patients due to muffled speech, inability to establish non-verbal cues with patients, and making them less 'visible' to their patients (Brooks *et al.*, 2020).

An environmental factor that influenced the compliance in using PPE found in this study was the co-worker's role in reminding PPE. Brooks *et al.* (2020) conducted a meta-analysis of 36 studies to identify factors associated with compliance with social and behavioral infection control measures among healthcare staff. This study showed non-compliant colleagues or managers were associated with non-compliant employees. They thought that the compliance of their colleagues might increase their compliance. They also believed that the

manager should give an example and also encourage the employee to use PPE (Brooks *et al.*, 2020).

STRENGTH AND LIMITATION

Our current study is the first study that evaluates the compliance among non-nurses or non-doctors healthcare professionals. We involved non-medical healthcare professionals included pharmacists, pharmacy technicians, nutritionists, and radiographers. These groups of healthcare professionals also had a similar risk to COVID-19 infection compared to doctors and nurses. The limitation in this study may come from the methods of gathering data. We used self-administered questionnaires without direct observation. This method may result in over-reporting of the compliance in using PPE. However, in this current situation, direct observation in the hospital was not recommended as it may increase the risk of viral transmission.

CONCLUSION

The practical problem, including the difficulty in using PPE and regular monitoring, plays a significant role in the non-medical healthcare professionals' compliance in using PPE. This finding suggests that regular training about the proper use of PPE and regular monitoring may increase compliance.

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