

The Influence Of Knowledge Towards Physicians' Intention To Use Powered Air-Purifying Respirators As Advanced Personal Protective Equipment Mediated By Health Belief Model During Covid-19 Pandemic

Vania Josephine, Ferdi Antonio
Fakultas Kedokteran Universitas Pelita Harapan, Jakarta, Indonesia
vaniajosephine@gmail.com

ABSTRACT

The COVID-19 has become a devastating occurrence and an urgent intervention for public health in Indonesia. Until the beginning of 2021, Indonesia has the highest number of healthcare workers deaths in Asia and fifth in the world. One of the reasons that resulted in a high number of deaths is due to the lack of personal protective equipment (PPE) to be worn in high-risk environments. Powered Air-Purifying Respirator (PAPR) is one of the most advanced protective equipment and recommended by many countries for their healthcare workers in handling COVID-19 pandemic. This research is conducted to predict Indonesian physicians' intention to use PAPR as advanced PPE using the Health Belief Model. This research is a correlational study and a quantitative research using statistical tests in processing the data collected from online questionnaires. The findings collected from 163 respondents demonstrated that physicians in Indonesia have the intention to use PAPR as advanced PPE against COVID-19 based on their knowledge, perceived susceptibility, perceived severity, and perceived benefits of using PAPR. Perceived barriers do not have a significant influence towards physicians' intention to use. The impact of knowledge to intention to use mediated by perceived benefits has the strongest correlation. This empirical model has moderate predictive accuracy with medium predictive relevance, therefore it could be developed and tested on an extended population. There are few managerial implications that could be recommended for hospital managers, public health administrators, and medical device suppliers to encourage physicians' behavior. Several recommendations are given for further research development.

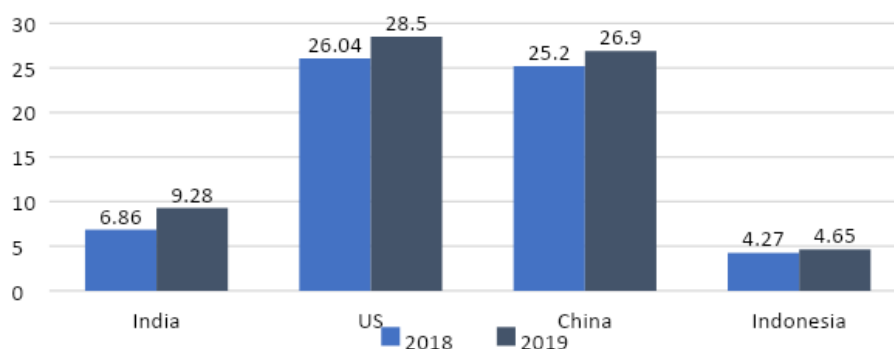
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INTRODUCTION

SARS-CoV-2, the virus that causes COVID-19 spreads easily through person to person contact by symptomatic and asymptomatic individuals. Due to the rapid increase in the numbers of cases, the World Health Organization (WHO) classified the situation as a Public Health Emergency of International Concern (PHEIC) in January 2020 and later on 11 March 2020, as a pandemic. Personal Protective Equipment and infection control

guidelines from the WHO are based on the assumptions that the primary mechanism of transmission of SARS-CoV-2 is direct and indirect droplet spread as well as fomite transmission (Cook, 2020). The WHO also recommended 10 physicians and above for every 10,000 population or 1:1000 physicians to population ratio to ensure equitable access to healthcare workers within a strengthened health system.

Figure 1. Number of Physicians every 10,000 Population as per 31 December 2019



According to data by WHO, Indonesia only had 3.77 physicians per 10,000 population ratio and 4.27 per 10,000 population in 2018. The ratio of specialist doctors is also considered low, with 0.13 per 1,000 population ratio. Based on data by the Board for Development and Empowerment Human Health Resources by Indonesian Ministry of Health, as per 31 December 2019, there were 107,707 physicians in Indonesia, including dentist and specialist dentists.

According to Indonesian Medical Doctor Association, as per 10 February 2021 there were 236 physicians hospitalized, 325 on self-quarantine, and 317 reported death cases due to COVID-19. More healthcare workers exposed to the disease means less there are to handle the surge of active cases. According to a research conducted by Labrague and Los Santos (2020), COVID-19 has caused fear, psychological distress, lower job satisfaction, decreased health perceptions, and increased turnover intention among frontline nurses in the Philippines. As excessive fear may intensify pre-existing mental health issues and

provoke anxiety (Colizzi et al., 2020), it will eventually affect healthcare workers' health and job outcomes, such as patient care quality.

One of the assumed reasons why more and more physicians are exposed to COVID-19, as reported by Indonesian Medical Doctor Association, is due to shortage of medical equipment such as Personal Protective Equipment (PPE) available to healthcare workers. According to COVID-19 Pandemic Protection Manual (2020), the Medical Doctors Association has defined that the enforcement of PPE availability to healthcare workers should be made a priority. Based on the data provided by the Badan Pusat Statistik (BPS) / Central Bureau of Statistic, the import value of medical products in Indonesia in 2020 (January to November 2020) is around \$1,384,102,461 USD or around 20 trillion rupiah. The Ministry of Trade and Central Bureau of Statistic forecasted the imported medical products market to reach 131 trillion rupiah in value by 2030. Indonesia's president Joko Widodo is targeting to decrease the importing of foreign

goods and enforcing local manufacturers to produce local medical equipment. Due to this pandemic, this may not be the case anymore when that importing medical equipment is prioritized to fulfill the urgent needs of COVID-19 related medical equipment, as classified by Indonesian Customs such as SARS-CoV-2 PCR testing devices, thermometers, PPE, and ventilators. The prioritizing of fulfilling the needs of COVID-19-related medical equipment may put research and development of locally manufactured devices on hold.

Due to the COVID-19 pandemic in early 2020, the Central Bureau of Statistic recorded a surge in import value of PPE. The value of imported PPE increased about 140% from 163 million to a striking 392 million US dollars. Imported face masks dominated the PPE import market in 2020. The value of imported face masks in 2019 was stagnant compared to 2018. Due to shortage of face masks in the beginning of the pandemic in 2020, the value surged over ten fold (1,047%) to 202,251,062 USD. On the contrasting side, the value of imported respirators showed 12.7% growth from 2018 to 2019. During the pandemic in 2020, a growth of 29% was reported. The value of imported respirators was 21,262,189 USD. This is concerning in contrast to the amount of growth shown in imported face masks, since respirators are one of the most renowned PPE used by frontline workers during an infectious outbreak.

Powered Air-Purifying Respirators (PAPR) is classified by the Indonesian customs according to its HS code as "breathing appliances and gas masks, excluding protective masks having neither mechanical part nor replaceable filters". This equipment utilizes the high efficiency particulate air (HEPA) filters and provide a higher level of protection than disposable respirators. It was believed to offer more protection to healthcare workers than surgical masks. PAPR has been widely used in countries such as The United States, United Kingdom, Singapore, South Korea, and many other countries by their healthcare workers.

Otos Co., Ltd. is one of the leading manufacturers of PPE in South Korea. The sales of PAPR in South Korea has grown by 435% from 2.9 million USD to 7.25 million USD. Out of the 38 export countries, The United States of America contributes to most of their sales since 2018. During the pandemic in 2020, the demand of PAPR has surged resulting in 210% growth in sales compared to the preceding year. The demand for PAPR from both South Korea and USA was driven by the alarming need to immediately overcome the shortage of PPE for frontline workers during the pandemic. However, a similar phenomenon does not occur in Indonesia. Unlike South Korea and United States, the sales growth of PAPR in Indonesia only rose by 18% in 2020 from 2.1 million USD to 2.48 million USD. Meanwhile in 2019 sales of PAPR also had a similar growth. This was perceived as a peculiar situation by PAPR manufacturers during pandemic. Aside from Otos Co., Ltd., other PAPR manufacturers, Drager, also reported almost no sales growth in 2020 for PAPR. According to the sales manager of Drager company, PAPR are still intended for industrial use.

Powered Air-Purifying Respirators is widely used for industries with hazardous environments, such as construction, heavy metal, manufacturing, transportation, chemical, and biological. While in healthcare industry, PAPR was mainly used only during outbreak or pandemic such as the Ebola Outbreak (CDC, 2018) and 2009 Influenza H1N1 Pandemic (Tompkins & Kerchberg, 2010), hence, the use of PAPR in healthcare industry may not be popular compared to the uses in other industries, especially in Indonesia. As Indonesia is now facing the COVID-19 pandemic, the use of PAPR will be relevant as this COVID-19 pandemic is risking lives, especially to Indonesian physicians. One of the assumptions is that the use of PAPR might not be popular among physicians in Indonesia, it is important to educate these physicians about the product knowledge of PAPR. Another assumption is that the demand for PAPR exists among physicians, however they are facing difficulties acquiring

the equipment. When this is the case, necessary actions must be taken by hospital management to bridge the gap. Eventually, this research aims to deep dive the intention to use PAPR by physicians.

The Health Belief Model is a theoretical model designed to predict health-related behavior in terms of certain belief patterns. The model was first developed by Hochbaum and Rosenstock (1952) in order to understand people's failure to adopt disease prevention strategies. However, later HBM were also used for patients' responses to symptoms, as well as compliances with medical treatments. The HBM has also been used by some scholars to predict an individual's intention to use Personal Protective Equipment (PPE). Originally, the HBM had five constructs consisting of Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, and Cues to Action. However, other constructs are also added as research about HBM evolved and one example is the Knowledge construct. The Knowledge construct is considered important, especially in measuring an individual's intention to use PPE context in Indonesia. Knowledge acquired by physicians may have a correlation with perceived susceptibility. Several researches show that knowledge about health behavior has a positive correlation with the perceived susceptibility and perceived severity of getting a disease. Prior research also shows that knowledge about a health behavior has a positive correlation with the perceived benefits and perceived barriers of enacting a health behavior. Based on the reasons stated regarding the importance of Knowledge construct in measuring intention to use on PPE context, this research will also add the Knowledge construct to the HBM. Therefore, in this research, the Knowledge construct will serve as the independent variable, while Perceived Susceptibility, Perceived Severity, Perceived Benefits, and Perceived Barriers will serve as the mediating variables, and the Intention to Use will be the dependent variable. This research model aims to predict

the usage intention of PAPR as PPE on physicians in hospitals in Indonesia, especially amid of COVID-19 Pandemic in Indonesia.

RESEARCH METHOD

This type of research, based on the time of data collection, is classified as a cross-sectional study, quantitative research with hypothesis testing. This type of research is correlational, and not causality (cause - effect) between research variables. Hence this study will only analyze the correlation between two or more variables in one research model based on the variance data. This research is a non-interventional study. Sample in this research is physicians (specialist doctors, general practitioners, dentists, specialist dentists, hospital management) who work in hospitals during COVID-19 pandemic in Indonesia. The sampling was done in January – April 2021 in Indonesia during COVID-19 pandemic.

The sampling size is determined using proportional formula (Lemesow et al., 1990) Since this research is using the PLS-SEM analysis method, therefore 160 is considered as the minimum sample size. This research was conducted to 163 respondents.

This research will be utilizing online questionnaires to gather data from respondents. For every variable, in each given statement five choices of answer will be provided in Likert scale. Aside from variable questions, the questionnaires will gather data about demographic profiles of respondents. Some secondary data that are collected by researchers for this study are statistical bulletins, government publications, data/information from related organizations, and published journals.

Data analysis method used in this research uses a multivariate analysis approach because the research model is quite complex and utilizes a latent variable or construct (Sekaran & Bougie, 2016). In this research model there are six variables with eight paths and four mediating variables. Therefore an analysis method with the ability to test the influence between variables simultaneously

towards the independent variable is required. Among several multivariate analysis methods available, variance-based partial least square – structural equation modeling (PLS-SEM) was selected.

In this research PLS-SEM analysis method is done using SmartPLS™ version 3.3. Beside its standard menu, this application provides an advanced menu as well (Ringle et al., 2015) for a deeper analysis. *Output* model of PLS-SEM calculation will produce two types of models. The first is the outer model or also known as the measurement model. In this outer model, relationship between indicators as manifested variables with the latent variables (Hair et al., 2019). The outer model

is intended to test the reliability and validity of indicators as construct measurement tool within a research model. The second is the inner model or also known as the structural model. In the inner model, the relationships between constructs are shown. Inner model is intended to validate the quality of research model and to test the influence significance between constructs and the coefficient analysis.

RESULTS AND DISCUSSIONS

Out of 163 respondents who are qualified as research respondents, the respondents' profiles are summarized as follows.

Table 1. Respondents' Demographic Profile

Descriptions	Categories	Quantity	Percentage (%)
Age	20 - 29	83	50.9
	30 - 39	38	23.3
	40- 49	28	17.1
	> 50	14	8.7
Total		163	100
Gender	Male	94	57.7
	Female	69	42.3
Total		163	100
Domicile	Jabodetabek	105	64.4
	Outside Jabodetabek	58	35.6
Total		163	100
Occupation	Hospital Management	12	7.4
	General Practitioner	81	49.7
	Specialist Doctor	43	26.4
	Dentist	25	15.3
	Specialist Dentist	2	1.2
Total		163	100

Table 2. Respondents' Number of Working Days/Week

Categories	Quantity	Percentage (%)
1 day	8	5
2 days	6	3
3 days	11	7
4 days	25	15
5 days	55	33
6 days	44	27
7 days	16	10

Table 3. Perception of The Sufficiency Level of Wearing N95 Masks of PPE

	Description	Frequency (f)	Percentage (%)
1-2.8	Very Insufficient	12	7.4
2.8-4.6	Insufficient	25	15.3
4.6-6.4	Neutral	42	25.8
6.4-8.2	Sufficient	54	33.1
8.2-10	Very Sufficient	30	18.4

Out of 163 respondents, the majority of respondents are in their twenties of age. All of the respondents are physicians in their productive age. Among the respondents, 57.7% identified themselves as male and there's no significant difference in gender of physicians who chose to continue practicing medicine or working in health facilities during the COVID-19 pandemic. About 64.4% of the respondents are based in Jabodetabek or Jakarta, Bogor, Depok, Tangerang, and Bekasi city, whereas 35.6% reside outside these cities. Almost half of the respondents are general practitioners working in health facilities. The number of general practitioners in Indonesia are significantly higher than specialist doctors and dentists in Indonesia, hence it is expected that the number of respondents working as general practitioners is higher than other specialties.

The questionnaire of this research includes three filtering questions. The first question is intended to ensure that all respondents were still employed by and working at health facilities during the time of research. The second filtering question is intended to ensure that all respondents know about Powered Air-Purifying Respirators. The third filtering question is intended to ensure that all respondents have never used PAPR before. All 163 respondents were working at health facilities, had heard of PAPR before but had yet to use it during the time of research, therefore qualified to fill out the questionnaires.

According to Table 2, the majority of the respondents take 6 working days in week during the COVID-19 pandemic. Only 26.5% of the total respondents take less than 4 working days in a week. It can be concluded that the majority of the respondents are

frequent visitors of health facilities during the pandemic.

Table 3 shows that the perception of the sufficiency level of wearing N95 masks as PPE was also gathered from the respondents. The respondents were asked, on a scale from one to ten, how sufficient wearing N95 masks as PPE is to prevent COVID-19 infection at work. It can be concluded that the majority of them perceive that wearing N95 masks as PPE is quite sufficient to protect themselves from COVID-19 infection at work. However, there are still a number of physicians who perceive that the N95 mask alone is not sufficient to protect themselves from COVID-19 infection at work.

In regards to the knowledge variable, the respondents showed that they agree on having prior knowledge on PAPR and understand that PAPR can be used as PPE. They are still neutral on the familiarity of PAPR as advanced PPE and having knowledge on how to use PAPR. This shows that education on PAPR can still be improved further to upgrade the knowledge of PAPR among physicians. In regards to the perceived susceptibility variable, all respondents agree that they are prone to COVID-19 infection. The respondents strongly agreed that they are at risk of COVID-19 exposure at work. Pertaining to perceived severity variables, all respondents agree that COVID-19 infection is a serious problem with future consequences. In regards to the perceived benefits variable, all respondents agree that wearing PAPR decreases the risk of COVID-19 infection. They strongly agree that they feel that PAPR may lower the risk of COVID-19 infection. Hospital managers or medical device suppliers need to pay attention to promote the perceived benefits of wearing PAPR to physicians to be able to improve the intention

to use. Regarding the perceived barriers variable, all respondents disagree that wearing PAPR as PPE is a hurdle. However, they're neutral when it comes to feeling that washing, storing, and reusing PAPR is an unpleasant task. This indicator can be further improved by educating physicians on the

proper way to disinfect and store PAPR in a practical way. Finally, it can be concluded based on the respondents' feedback that they agree to having the intention to use PAPR as PPE. They strongly agree that they want to use PAPR in a high-risk environment.

Tabel 4. Discriminant Validity

Variabel	Intention to Use	Knowledge	Perceived Barriers	Perceived Benefits	Perceived Severity
Knowledge	0,596				
Perceived Barriers	0.375	0.475			
Perceived Benefits	0.733	0.731	0.360		
Perceived Severity	0.577	0.313	0.261	0.369	
Perceived Susceptibility	0.674	0.210	0.303	0.544	0.700

The table above shows the discriminant validity test result where the Heterotrait-Monotrait (HT/MT) ratio of each variable is below 0.9. Based on this data, a conclusion can be drawn that all indicators in this research model have been properly discriminated therefore are able to measure each of their constructs. Each indicator is accurate and specific to measure its respective construct.

Based on the four parameters of reliability and validity testing in the outer model; indicator reliability (outer loading), construct reliability (Cronbach's alpha and composite reliability), construct validity (average

variance extracted or AVE), and discriminant validity (Heterotrait-Monotrait ratio), a conclusion can be drawn that in this measurement model all the indicators are reliable and valid to measure each of the constructs specifically, and therefore qualified to proceed to the next analysis, which is the inner model/structural model.

The next step is the significance test towards the eight paths and the significance of influence between variables in the research model. In this inner model analysis, one-tailed hypothesis testing with re-sample method or bootstrapping with software SmartPLS™.

Table 5. Hypothesis Testing Result

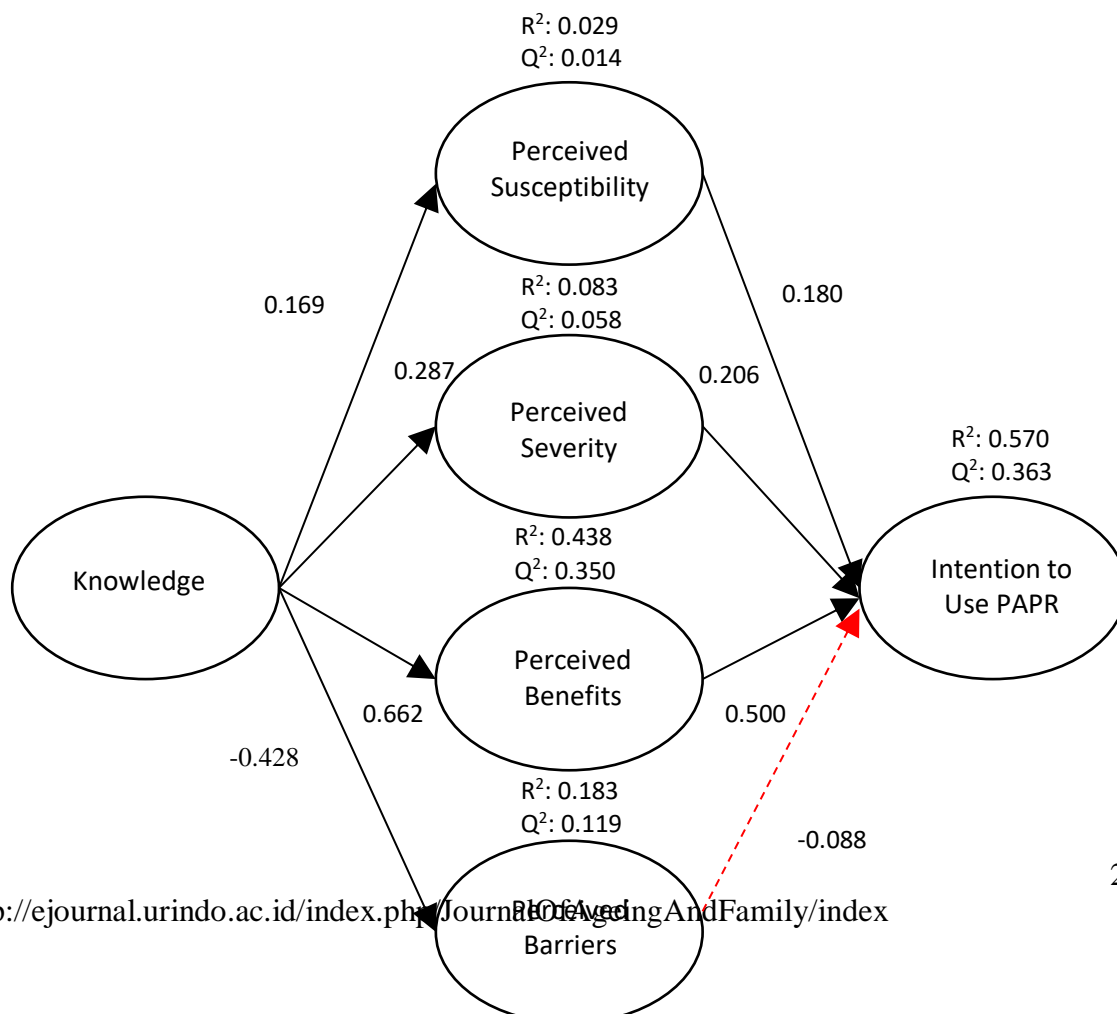
Hypothesis	Path	Standardized Coefficient	T-Statistics	Significance	Result
H1	Knowledge Perceived Susceptibility	□ 0.169	2.173	Significant	Hypothesis Supported
H2	Knowledge Perceived Severity	□ 0.287	3.765	Significant	Hypothesis Supported

H3	Knowledge Perceived Benefits	□ 0.662	13.320	Significant	Hypothesis Supported
H4	Knowledge Perceived Barriers	□ -0.428	4.707	Significant	Hypothesis Supported
H5	Perceived Susceptibility Intention to Use	□ 0.180	2.372	Significant	Hypothesis Supported
H6	Perceived Severity □ Intention to Use	0.206	3.382	Significant	Hypothesis Supported
H7	Perceived Benefits Intention to Use	0.500	4.169	Significant	Hypothesis Supported
H8	Perceived Barriers □ Intention to Use	-0.088	1.261	Not Significant	Hypothesis Supported

From the data presented on the above table, all eight hypotheses are significant. All variables except perceived barriers have positive coefficients in accordance with the

suggested hypotheses. Perceived barriers variable has a negative coefficient in accordance with the suggested hypothesis.

Figure 2. Empirical Model



—————▶ Significant
- - - - -▶ Not significant

In this model, out of all four mediating variables all are proven to have significant influence. Among four mediating variables, only three paths are significant while one of the paths is insignificant. Perceived barriers variable does not have a significant influence towards intention to use. An increase in variable perceived barriers will not lead to a decrease in intention to use. A decrease in variable perceived barriers will not lead to an increase in intention to use.

The independent variable in this model has a significant influence on the dependent variable. This finding strengthens the previous theory that a good knowledge affects perceived benefits of doing a health-promoting behavior which will impact the intention to use. The path of knowledge to intention to use mediated by perceived benefits has the strongest correlation. A good knowledge affects the perceived benefits of doing a health-promoting behavior which will impact the intention. Therefore, it is important for public health administrators and hospital managers to prioritize the knowledge of physicians.

Perceived benefits whereas users feel safe wearing PAPR in doing their job should be maintained. Public health administrators, hospital management, and medical device suppliers can maintain the campaign on the safety aspect of wearing PAPR. Good communication on PAPR as protection from virus-and-bacteria carrying droplets can also be maintained. Indicator BEN4 is also one of the most important indicators but considered the least among other perceived benefits indicators. Public health administrators may need to emphasize on the importance that PAPR can prevent pathways of airborne COVID-19 exposure.

Based on the values acquired from the structural model analysis, this research model has moderate predictive accuracy and medium predictive relevance on dependent variable intention to use and its mediating variables. The R-squared value of intention to use as a dependent variable is 0.570 and therefore categorized as moderate to strong. The variables in this research model are able to moderately predict the dependent variable. Furthermore, this research model can be developed with a larger and more specific sample to compare the R² of research using the same model. The research model's predictive accuracy can be further improved from moderate to strong by adding new mediating variables, such as perceived familiarity of evidence-based medicine. Another way is by adding moderating variables, such as age or gender.

The Q-squared value of intention to use as a dependent variable is categorized as having medium predictive relevance. The predictive relevance of this research model can still be improved by increasing sample size and sample criteria. The number of minimum sample sizes can be determined by reducing the precision level or sampling error from 10% to 5%. Using the proportional formula (Lemesow et. al., 1990), the minimum sample size should be 384. Some criteria of the sample can be added, such as respondents with older ages, only age 40 and above. Older physicians are more susceptible to developing severe symptoms of COVID-19 than younger physicians. Other criteria such as working location can also be added. Respondents can be physicians only from COVID-19 referral hospitals in red zones cities in Indonesia, which is a more high-risk environment. Other criteria for working

location can be physicians who are working in hospitals in peripheral cities with more limited facilities. Some hospitals in the peripheral cities do not have adequate facilities, such as a negative pressure room to isolate patients with contagious, airborne diseases such as COVID-19 from other patients, visitors, and healthcare workers. When the research model has a strong predictive accuracy and a large predictive relevance, it can be replicated for further research.

The first hypothesis where knowledge positively affects perceived susceptibility is supported. In Indonesia, he recommended protective equipment for medical workers that handle COVID-19 are N95 mask, hazmat suit, surgical gloves, face shield, coverall and boots (BNPB, 2020). The protective equipment mentioned are the ones that are commonly used instead of PAPR, thus making PAPR unfamiliar compared to the equipment stated among medical workers in Indonesia. Most respondents agree that PAPR can be used as PPE especially in handling COVID-19. Meanwhile, most of the respondents agree that they have a high risk of getting COVID-19 at work, they are worried about getting COVID-19 infection, and they have a high chance of getting COVID-19. This is aligned with the current situation in Indonesia, where many medical workers are still infected even after wearing protective equipment (Lotulung, 2021).

The second hypothesis where knowledge positively affects perceived severity is also supported. Most of the respondents agree that COVID-19 is a dangerous disease that could lead to death, they are worried about the severe symptoms of COVID-19 infection, COVID-19 causes a lot of chronic health effects, and COVID-19 is more serious than other diseases. This phenomenon could be explained as COVID-19 has resulted in 757 deaths of medical workers in Indonesia, making Indonesia as the country with highest medical workers death in Asia and 5th in the world (Suciatingrum, 2021). It can be concluded that Indonesian medical workers are worried about the severity of COVID-19,

thus making an advanced protective equipment a plausible option as a protective equipment.

The third hypothesis that stated knowledge positively affects perceived benefits is also supported in this study. Most respondents agree that wearing PAPR allows them to feel safer in doing their job as medical workers, PAPR is able to protect them from virus or droplets, PAPR lowers the risk of COVID-19 infection as well as prevents COVID-19 airborne exposure. Most of the respondents strongly agree that wearing PAPR could reduce the risk of COVID-19 infection. This perception could be possible, as PAPR could effectively filter particles by 99,97%. In addition, this finding also goes accordingly from Chungtai et al., (2020) where the study found that physicians believed that PAPR provides a higher protection, comfort, and reusability over N95 FFR, especially during pandemic or high-risk situations.

The fourth hypothesis where knowledge negatively affects perceived barriers is also supported in this study and this goes accordingly from previous studies (Saqlain et al., 2020 ; Samsiah et al., 2020). Most of the respondents disagree that wearing PAPR would be uncomfortable, not easy to use, and washing, storing, and reusing PAPR is an unpleasant task. This finding is aligned with the study by Licina et al., (2021) and Chungtai et al., (2020) where physicians believed that PAPR provides a higher protection, comfort, and reusability over N95 FFR, especially during pandemic or high-risk situations. In addition, Chungtai et al., (2020) also recommended that adequate training on storage, using, and cleaning of PAPR is imperative to health care workers that are using PAPR as PPE.

The fifth hypothesis where perceived susceptibility positively affects intention to use PAPR positively is also supported and goes according to previous studies (Ban & Kim, 2020 ; Edmonds et al., 2011). Most of the respondents agree that they have a high risk of getting COVID-19 at work, they are worried about getting COVID-19 infection, and they have a high chance of getting

COVID-19. Most respondents agree that they are willing to use PAPR at work, they will consider using PAPR as PPE if it is available to them, they would like to use PAPR especially in high-risk environments, and they prefer to use PAPR instead of conventional masks. Based on this finding, it is plausible to conclude that Indonesian medical workers are willing to use PAPR as PPE especially in handling COVID-19 as they are concerned about getting COVID-19 infection.

The sixth hypothesis where perceived severity positively affects intention to use is also supported. Most of the respondents agree that COVID-19 is a dangerous disease that could lead to death and they are worried about the severe symptoms of COVID-19 infection. It is possible that Indonesian physicians are concerned about the severity of COVID-19 and therefore willing to use PAPR as PPE in the future.

The seventh hypothesis where perceived benefits positively affect the intention to use PAPR is also supported in this study. Most of the respondents agree that wearing PAPR allows them to feel safer in doing their job as medical workers, PAPR is able to protect them from virus or droplets, PAPR lowers the risk of COVID-19 infection as well as prevents COVID-19 airborne exposure. This perception is highly possible as PAPR has been used for handling COVID-19 in several countries such as Singapore (Chen et al., 2020) and England (ICL, 2021). It is possible that the physicians perceive that wearing PAPR is desirable.

The last hypothesis where perceived barriers negatively affect the intention to use is not supported. Perceived barriers do not have influence on the intention to use. The finding is not consistent with previous studies (Ban & Kim, 2020 ; Sharifzadeh et al., 2019 ; Weng & Black, 2015 ; Phung et al., 2013), where a low level of barrier will lead to a positive intention of a specific action. Most of the respondents disagree that PAPR is not uncomfortable to wear, PAPR is not easy to use, and storing, washing, reusing PAPR is an unpleasant task. This finding is also consistent with previous study Chungtai et al., (2020) and where physicians believed that PAPR provides a

higher protection, comfort, and reusability over N95 FFR, especially during pandemic or high-risk situations. In addition, Chungtai et al., (2020) also emphasized the importance of adequate training in storing and washing PAPR to physicians. Therefore, it is possible that Indonesian physicians do not consider these as high barriers, but it does not necessarily mean that they are willing to use PAPR as advanced PPE.

Based on the descriptive analysis, the respondents have the intention to use PAPR as advance PPE. By looking at the mean value, three indicators are categorized as "agree" while the other one is categorized as "strongly agree". The respondents strongly agree to use PAPR in a high-risk environment, they are willing to use PAPR at work, are considering to use PAPR if it's available for them, and prefer to use PAPR instead of conventional mask, such as surgical mask. One of the ways to improve physicians' intention to use PAPR is by providing advantages of wearing PAPR compared to conventional masks to physicians. Medical device suppliers can also play a role by demonstrating the ease of use of its products. Public health administrators can help by promoting evidence-based practices of wearing PAPR compared to conventional masks. Since physicians agree that they are considering to use PAPR if it is available, hospital managers need to ensure that PAPR are accessible to use by physicians. Medical device suppliers also need to ensure availability of the stocks and health facilities are able to procure the equipment. The Ministry of Health and Indonesian National Board of Disaster Management need to ensure that PAPR is available for frontline workers by exploring the options to either importing the equipment or manufacturing the equipment locally.

CONCLUSIONS

This study is a quantitative research with knowledge as the independent variable and intention to use it as a dependent variable mediated by perceived susceptibility, perceived severity, perceived benefits, and

perceived barriers. Knowledge positively affects physician's perceived susceptibility, perceived severity, and perceived benefit. Knowledge negatively affects physicians' perceived barriers. Perceived susceptibility, perceived severity, and perceived benefits positively affects physicians' intention to use PAPR as advanced PPE. However, perceived barriers do not affect physicians' intention to use PAPR as advanced PPE. Based on the values acquired from the structural model analysis, this research model has moderate predictive accuracy and medium predictive relevance on dependent variable intention to use and its mediating variables. This research model can be applied for further research but still requires further development.

Among other variables in the health belief model, perceived benefits have the strongest influence on intention to use. A good knowledge affects the perceived benefits of doing a health-promoting behavior which will impact the intention. Therefore, it is important for public health administrators and hospital managers to prioritize the knowledge of physicians on PAPR as advanced PPE during COVID-19 pandemic. Public health administrators and hospital managers need to ensure that physicians perceive the benefits of PAPR, most importantly, the feeling of safety, protection from virus-and-bacteria carrying droplets, lower risk of COVID-19 infection, and pathway prevention of airborne COVID-19 exposure.

Physicians' knowledge on PAPR has a positive effect on the perceived benefits of wearing PAPR as advanced PPE during COVID-19 pandemic. Providing adequate information regarding PAPR as advanced PPE will enhance physicians' perceived benefits of wearing the device. This finding is able to provide managerial implication that physicians knowledge of PAPR as PPE needs to be promoted to raise its perceived benefits. Public health administrators and hospital managers need to ensure that all physicians as frontliners are well educated on the benefits of PAPR as advanced PPE through good communication, socialization, and

routine knowledge upgrade. This finding is also able to provide managerial implication to medical device suppliers to emphasize on promoting knowledge of the benefits of PAPR as PPE to physicians. The most important indicator is physician's prior knowledge on PAPR. This indicator needs to be maintained through good communication so information on PAPR is delivered to physicians. Other indicators are physicians' understanding that PAPR can be used as PPE and physician's familiarity of PAPR as advanced PPE. However, physicians' knowledge on how to use PAPR needs to be further improved through product demonstrations and trials. The finding of this research confirms that the respondents have the intention to use PAPR as advanced PPE. The strongest indicator is that the respondents strongly agree to use PAPR in a high-risk environment. While the respondents agree that they are considering to use PAPR if it's available, they prefer to use PAPR instead of conventional masks, and are willing to use PAPR at work, these three indicators still have room for further improvement. Since physicians agree that they are considering to use PAPR if it is available, hospital managers need to ensure that PAPR are accessible to use by physicians. Medical device suppliers also need to ensure availability of the stocks and health facilities are able to procure the equipment. The Ministry of Health and Indonesian National Board of Disaster Management need to ensure that PAPR is available for frontliners by exploring the options to either importing the equipment or manufacturing the equipment locally.

REFERENCES

- [1] Abraham, C., & Sheeran, P. (2015). *The Health Belief Model*. McGraw-Hill.
- [2] Ana Licina, A. S. (2021, April). Use of powered air-purifying respirator(PAPR) as part of protective equipment against SARS-CoV-2-a narrative review and critical appraisal of evidence. *Elsevier Public Health Emergency Collection*, 492-499.

- [3] Aravind Sesagiri Raamkumar, S. G. (2020, May). Use of Health Belief Model–Based Deep Learning Classifiers for COVID-19 Social Media Content to Examine Public Perceptions of Physical Distancing: Model Development and Case Study. *Journal of Medical Internet Research*, 6.
- [4] B.K. Rimer, K. G. (2005). *Theory at a glance: A guide for health promotion practice*. Washington DC: US Department of Health and Human Services.
- [5] Becker, N. K. (1984). The Health Belief Model: A Decade Later. *Health Education Quarterly*, 1-47.
- [6] BNPB. (2020, April). Retrieved from <https://bnpb.go.id>:
<https://bnpb.go.id/berita/rekomendasi-apd-berdasarkan-tingkat-perindungan-saat-tangani-covid-19>
- [7] Bonnie M Tompkins, J. P. (2010). Special article: personal protective equipment for care of pandemic influenza patients: a training workshop for the powered air purifying respirator. *Anesthesia Patient Safety Foundation*, 933-945.
- [8] CDC. (2018, January). *NIOSH - Approved Powered Air-Purified Respirators Meeting Criteria for Ebola*. Retrieved from Centers of Disease Control and Prevention : https://www.cdc.gov/niosh/npptl/topics/respirators/disp_part/paprtables.html
- [9] CDC. (2021, April 8). *Post-COVID Conditions*. Retrieved from <https://www.cdc.gov/coronavirus/2019-ncov/index.html>:
<https://www.cdc.gov/coronavirus/2019-ncov/long-term-effects.html>
- [10] *Centers for Disease Control and Prevention*. (2020, October 28). Retrieved from <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-covid-spreads.html>
- [11] Chen, Y., Zhou, R., Chen, B., Chen, H., Li, Y., Chen, Z., Zhu, H., & Wang, H. (2020). Knowledge, Perceived Beliefs, and Preventive Behaviors Related to COVID-19 Among Chinese Older Adults: Cross-Sectional Web-Based Survey. *Journal of medical Internet research*, 22(12), e23729. <https://doi.org/10.2196/23729>
- [12] Dinata, S. (2021, February 2). *Kelelahan, 95 Persen Nakes Khawatir Terpapar Covid-19*. Retrieved from www.republika.co.id:
<https://www.republika.co.id/berita/qnwh2k467/kelelahan-95-persen-nakes-khawatir-terpapar-covid19>
- [13] Eko Teguh Pribadi, S. R. (2020). Application of the Health Belief Model on the intention to stop smoking behavior among young adult women. *Journal of Public Health Research* , 121-124.
- [14] Fulford, B., Bunting, L., Tsibulsky, I., & Boivin, J. (2013). The role of knowledge and perceived susceptibility in intentions to optimize fertility: findings from the International Fertility Decision-Making Study (IFDMS). *European Society of Human Reproduction and Embryology*.
- [15] Glanz, K. (2015). *Health Behavior: Theory, Research, and Practice*. San Francisco, California: John Wiley & Sons.
- [16] Hochbaum, G. R. (1952). *Health Belief Model*. Washington DC: U.S. Public Health Service.
- [17] Janz, N. K., & Becker, M. H. (1984). *The Health Belief Model: A Decade Later*.
- [18] K. Glanz, B. R. (2008). *Health behavior and health education: theory, research, and practice*. San Francisco : Jossey-Bass, John Wiley and Sons.
- a. Knowledge, Perceived Beliefs, and Preventive Behaviors Related to COVID-19 Among Chinese Older Adults: Cross-Sectional Web-Based Survey
- [19] Li, JB., Yang, A., Dou, K. *et al.* (2020). `
- [20] Chinese public’s knowledge, perceived severity, and perceived controllability of COVID-19 and their associations with emotional and behavioral reactions, social participation, and precautionary behavior: a national survey. *BMC Public Health* 20, 1589 (2020).
- [21] Liverman, C. T., Domnitz, S. B., & McCoy, M. A. (2015). The Use and Effectiveness of Powered Air Purifying

Respirators in Health Care: Workshop Summary. 12.

[22] Ristamaya Dinar Dewi, S. S. (2019). Application of Health Belief Model on Factors Influencing the Use Of Personal Protective Equipment. *International Conference of Public Health*.

[23] Sakinah, Z. V. (2017). Aplikasi Health Belief Model Dalam Menganalisis Perilaku Penggunaan Kacamata Pelindung. *The Indonesian Journal of Health Promotion and Health Education*, 5.

[24] Samsiah, A., Othman, N., Jamshed, S. *et al.* Knowledge, perceived barriers and facilitators of medication error reporting: a quantitative survey in Malaysian primary care clinics. *Int J Clin Pharm* **42**, 1118–1127 (2020). <https://doi.org/10.1007/s11096-020-01041-0>

[25] Sarallah Shojaei, R. F. (2016). Effects of the Health Belief Model (HBM)-Based Educational Program on the Nutritional Knowledge and Behaviors of CABG Patients. *Journal of Tehran University Heart Center*, 181-186.

[26] Satyal, D. V. (2006). Knowledge, Attitude, and Practice (KAP) Survey under the Community-based Alternative Schooling Project (CASP) in Kathmandu District. 2.

[27] Sekaran, U., & Bougie, R. (2016). *Research Method for Business: A Skill-Building Approach*. John Wiley & Sons Ltd.

[28] Sharifzadeh, G. A. (2021). Predicting farmers' intention to use PPE for prevent pesticide adverse effects: An examination of the Health Belief Model (HBM). *Journal of the Saudi Society of Agricultural Sciences*, 40-47.

[29] Tamara Wright, A. A. (2019). Issue of Compliance with Use of Personal Protective Equipment among Wastewater Workers across the Southeast Region of the United States . *Environmental Research and Public Health*.

[30] Wisdha Riezqi Ginandhani, D. K. (2021). A Model of Factors Affecting the Use of Personal Protective Equipment Using a Path Analysis Among PLTU Contractor Workers in East Java. *The Indonesian Journal of Occupational Safety and Health*, 10.