Development of an infectious disease prevention behavior model for public health center workers in a rural area of Indonesia

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Abstract

The Infection Prevention Behavior (IPB) for health personnel at the Surade Public Health Center has not reached the target. The purpose of this study was to develop the IPB model for health personnel which is suitable to be applied in rural areas in Indonesia. The model was developed through a literature review from online journal database in the last 10 years. The model was tested using a cross-sectional design by the Structural Equation Model Partial Least Square (SEM-PLS). Six selected variables had direct and indirect influences on the IPB of health personnel. They were supervision (27.50%), facilities (9.87%), training (10.44%), compensation (16.97%), work climate (10.78%), and work motivation (8.15%). The model was valid and significant. The Q2 showed 95.7% which mean 95.7% of the components in the model could be applied to other Public Health Centers in the rural area. The development of IPB models for health personnel which wass measured from the direct and indirect effects of six variables proved valid and significant to help achievement Public Health Center reach the target of protecting health workers from infectious diseases.

Introduction

The incidence of nosocomial infections in Indonesia reached 19.2% and it was far from developed countries which achieved at 5.7-9.1%.[1] There are 9.8% of hospitalized patients who get a new infection during inpatients.[2] Patients and health personnel in health services are at risk of exposure to Healthcare Associated Infections (HAIs), including blood tract infections, urinary tract infections, pneumonia, and infections around the operating area.[3,4] This is happned due to the reasons of the non-compliance behavior of health personnel in washing hands after taking action to the patients.[5] This infection can be transmitted to patients and other health personnel. The study found that the application of Infection Prevention Behavior (IPB) has not yet implemented as the culture and it is not optimally applied in Indonesia.[6]

Health personnel who are getting the infection will be resulted in losses for health services.[7] These losses are work accidents, workers with disabilities, and death for health workers due to the severity from infection.[8] Patient infection also afflicted health personnel in primary health care and experienced severe cases due to infection.[9] Some efforts to reduce the incidence of infection to health personnel are using personal protective equipment (gloves, masks, etc.) and sterile equipment. Hand hygiene must be applied and obeyed by health personnel because 80% of infections are spread by hands.[10]

The assessment of IPB for health personel at the Surade Public Health Center as one of the primary cares in rural area Indonesia received a score of 72.4% from the target of 85% or it had not reached the target. There were 11 health personnel at the Surade Public Health Center who get infectious diseases while observations. Health personnel tend to be less obedient to hand hygiene procedures[11] accompanied by inadequate IPB facilities.[12] Health personnel in rural areas are still susceptible to get infectious diseases from patients, medical devices, and other transmission media.[13] It is not clear the structure efforts to achieve IPB, so that health personnel are more protected from the risk of disease infection at the Public Health Center. The purpose of this study is to develop an IPB model for health personnel in the public health center that is suitable to be applied in rural areas in Indonesia.

Materials and Methods

This study uses a quantitative method with a cross-sectional design. This study combined the literature review and survey. The survey was conducted in the Surade Public Health Center, one of the primary cares in rural areas in Indonesia. The study was conducted for 5 months in 2022.

The population was all medical personnel of 206 people in the Surade Public Health Center. The sample was determined based on the sample proportion formula with a 95% confidence interval and the proportion of 6% of health personnel have gotten infectious diseases during the observation. So, the minimum sample required is 79.87 or 80 health personnel. The inclusion criteria were health personnel in the Surade Public Health Center, Sukabumi Regency, Indonesia, and they were willing to be respondents. While the exclusion criteria were health personnel who have been in contact with patients who have an infectious disease when the data was collected, and respondents were not in the location during the data collection period.

The study procedure is divided into 6 stages. The first stage is exploring the literature related to IPB for health personnel. The literature review aims to determine potential latent variables and indicators as predictors of IPB models for health personnel. In addition, the literature review is used to develop questionnaire items based on the potential indicators and variables. The literature review uses the Pubmed database as the leading journal database for medical science for the last 10 years. The literature which is selected is the original literature article on the determinant of IPB for health personnel. The result was analyzed using a narrative review by displaying the source

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paper, the type of infection disease, the prevention effort, proposing latent variables, and proposing indicators. The output of this stage is the latent variable and its indicators to measure the effect on the IPB of health personnel. This stage also produces questionnaires that have been tested for validity and reliability.

The second stage is to develop the direct and indirect path between exogenous and endogenous latent variables of the IPB for health personnel. The path was developed based on the literature or previous studies. If there is evidence that there is an influence between the variables, we added the arrow path between the variables. The output of this stage is a model framework of IPB for health personnel.

The third stage is conducting a survey of health personnel at the Surade Public Health Center. Based on the sample proportion formula with a 95% confidence level, the minimum sample required is 79.87 or 80 people. At this stage, it begins with the permitting to conduct the research. The survey was conducted by collecting data from the respondent using a questionnaire. The output of this stage is the dataset from the answers of respondents and descriptions of respondents as the univariate analysis of this study.

The fourth stage is conducting the data analysis by using SEM-PLS. The validity test for the model is done by using convergent validity. The indicator is valid if the loading factor value is >0.5.[14,15] Indicators which are not valid are not continued for further analysis. The significance test of the model carried out after bootstrapping. The indicator is said to be significant if the T-value is >1.96.[14,15] The whole analysis was carried out using the Smart-PLS Version 2. The output at this stage is the final significant model of IPB for health personnel.

The fifth stage is calculating the direct and indirect influences of IPB. The analysis is done by calculating the path coefficient of each latent variable. The output is the percentage of direct and indirect influence of each latent variable on the IPB of health personnel at the Public Health Center. This study has received ethical approval from the ethics committee of the University of Indonesia Maju with number 549/Sket/Ka-Dept/RE/UIMA/V/2022.

Results

Table 1 shows 24 selected articles that identified the determinants, influences, or factors that influence IPB in health personnel.[16-38] They are supervision, infrastructure, compensation, training, work climate,

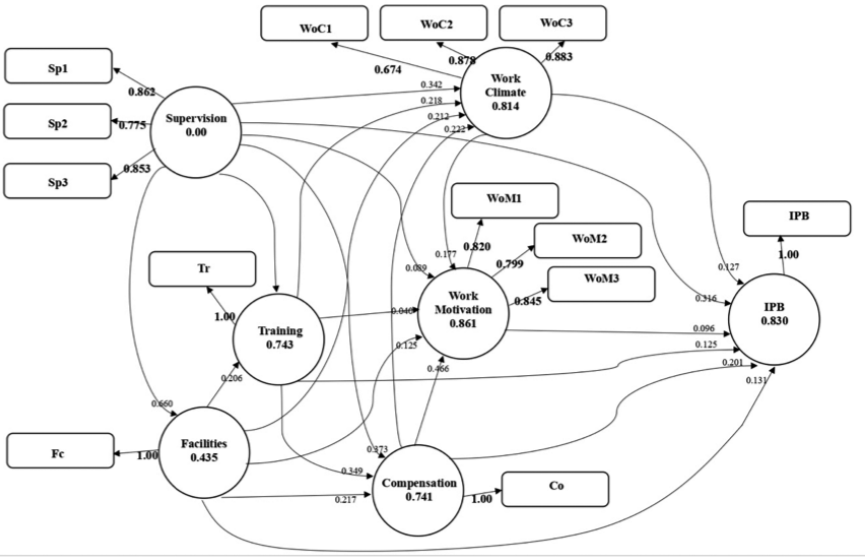

Figure 1. Evaluation of Model Indicators.

Table 1. Propose Latent Variables and Indicators of IPB in Health Personnel based on Literature Review.

No	Ref.	Types of Infectious Diseases	Prevention	Propose Latent Variables	Propose Indicators
1	16, 17, 18, 19, 20	Hepatitis B, Covid-19, MERS-CoV, Tuberculosis, Influenza H1N1	Vaccination, Social distancing, natural ventilation, sunlight, screening, hand washing facilities	Availability of facilities and infrastructure	Availability of disease prevention facilities and infrastructure
2	21, 22, 23, 24, 25 pathogen	Covid-19, HIV, Blood-borne	Knowledge of Personal Protective Equipment (PPE), training on prevention of blood-borne pathogens	Training	Training for health personnel
3	26, 27, 28, 29	HIV, Tuberculosis, Rabies	Encouragement of leaders and work partners to test, control the use of N95 masks, hand hygiene, TB infection screening, and vaccines	Supervision	Coaching (Sp1), Supervision Process (Sp2), and Responsibilities (Sp3)
4	30, 31, 32, 33	Overall infection disease, Tuberculosis, H1N1 Influenza, SARS-CoV-2	Motivation to use PPE, maintain hand hygiene, change masks before going to another patient	Work motivation	Sense of belonging (WoM1), adherence to procedures (WoM2), value orientation (WoM3)
5	34, 35, 36, 37	Covid-19, H1N1 Influenza, HBV, HCV, HIV, Hepatitis	Consistent in using protective equipment, Improvement of working procedures with colleagues	Work climate	Work atmosphere (WoC1), workspace (WoC2), work relations (WoC3)
6	38	All infectious disease	Protection support and incentives from the management	Compensation	Compensation for health personnel

and work motivation. Four paper journals explain that supervision has a significant and positive effect on IPB. Six paper journals also explain the influence of facilities and infrastructure on IPB. A total of 4 previous studies support training for the prevention of infection in health workers.

Four previous studies support the relationship between work motivation to IPB. Compensation was also identified as having a strong influence on IPB. Work climate as one of the factors that influence the behavior of health workers in preventing infection is supported by the findings of 2 previous studies.

Of the 80 respondents, the majority were young adults 36-45 (49%) (Table 2). Based on the level of education, the majority of respondents with an Academy/Diploma education were 70%, while the respondents who had a bachelor's degree were 30%. Meanwhile, based on work experience, most of the respondents worked more than one year of 41 people (51%). Based on marital status, most of the respondents were married (70%). As many as 49% of respondents were doctors (49%), and 40% were midwives. Most of them had a normal BMI (70%), did not smoke (75%), and had no history of infectious disease (81%).

Figure 1 shows that the indicator is valid because the loading factors value of the supervision including SP1 (0.862), SP2 (0.775), SP3 (0.853); work motivation including KK1 (0.874), KK2 (0.878), KK3 (0.883); work motivation including PS1 (0.820), PS 2 (0.799), PS 3 (0.845); and training (1.00), infrastructure (1.00), and compensation (1.00) are more than 0.5. The path coefficient with the largest value is the coefficient between supervision and training of 0.638, followed by the path between supervision and compensation of 0.373.

The R Square value of supervision, infrastructure, compensation, training, work climate, and work motivation on the IPB in health personnel is 83.0% and it means that 17.0% of it is influenced by other factors. The Q-Square value as a statistical variation if the model is applied to other rural public health centers is:

Q^2 = 1- (1-R_1^2) (1-R_2^2) (1-R_3^2) (1-R_3^2) (1-R_4^2) (1-R_5^2) (1-R6^2)
= 1- (1-0.435) (1-0.873) (1-0.741) (1-0.814) (1-0.861) (1-0.830)
= 1 – 0.043
= 0,957 atau 95.7%

Galat Model = 100% - 95.7%= 4.3%

It shows that the IPB model is able to explain 95.7% when it was applied to other rural public health centers, while 4.3% is explained by other variables that are not exist in this study.

After bootstrapping, indicators and path of direct and indirect influence on the IPB model are proved significant because the t-value >1.96 (Figure 2). The workspace indicator on the work climate variable has the greatest significance with a t-value of 134,481. The the second largest significance indicator is the development from the supervision variable with a t-value of 109,329. While the smallest indicator on the motivation variable is a sense of belonging with a t-value of 72.186.

Table 3 shows the magnitude of the latent correlation of each variable on IPB including supervision (0.854), infrastruc-

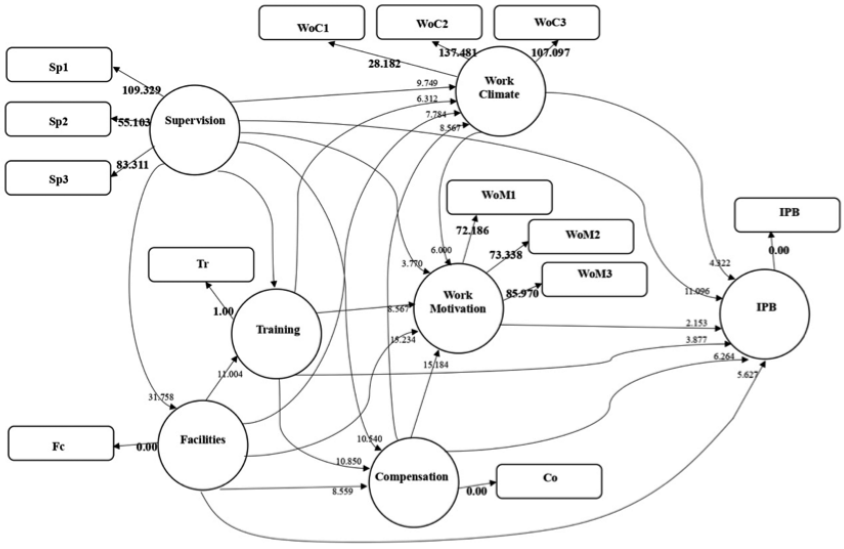

Figure 2. Evaluation of the Significant T-Value

Table 2. Characteristics of Respondents.

Characteristics	n	Percent (%)
Age		
26 – 35 years	32	40
36 - 45 years	39	49
> 46 years	9	11
Education		
Academic	56	70
Bachelor degree	24	30
Work experience		
< 1 years	39	49
≥ 1 years	41	51
Marital status		
Married	56	70
Unmarried	24	30
Profession		
Midwife	32	40
Medical doctor	39	49
Nurse	8	10
Pharmacist	1	1
Body Mass Index (BMI)		
Normal	56	70
Abnormal	24	30
Smoking Behavior		
Yes	20	25
No	60	75
Infectious disease history		
Yes	15	19
No	65	81

Table 3. Percentage of Influence between Variables on IPB to Health Personnel.

Latent Variables	Latent Var. Correlation	Direct Path Coeff.	Indirect	Total Path Coeff.	Direct Effect (%)	Indirect Effect (%)	Total (%)
Supervision	0.854	0.316	0.548	0.864	27.01	0.49	27.50
Infrastructure	0.746	0.131	0.191	0.322	9.76	0.11	9.87
Training	0.831	0.125	0.132	0.257	10.39	0.05	10.44
Compensation	0.843	0.201	0.076	0.277	16.95	0.02	16.97
Work climate	0.846	0.127	0.017	0.144	10.77	0.002	10.78
Work motivation	0.845	0.096		0.096	8.15		8.15
Total					83.0	0.7	83.7

ture (0.746), PPI training (0.831), compensation (0.843), work climate (0.846), and work motivation (0.845). The total sum of indirect pat coefficients based on Figure 2 on the variables of supervision, infrastructure, PPI training, compensation, and work climate, were 0.548, 0.191, 0.132, 0.076, and 0.017, respectively. There is the direct effect of IPB from the supervision (27.01%), infrastructure (9.76%), training (10.39%), compensation (16.95%), work climate (10.77%), and work Motivation (8.15%). Meanwhile, the indirect effect of supervision on the IPB in health personnel is 0.49%, 0.11% for facilities and infrastructure, 0.05% for training, 0.02% for compensation, 0.02% for work climate, and 0% for work motivation.

Discussion

This study develops an IPB model for health personnel in the public health center which is located in rural areas in Indonesia. The development of this model was not an easy because previous studies which were also located in rural areas assessed the IPB modelfrom various perspectives and variables.[3,5–7,9,12] It also happens for the studies which is conducted in Indonesia.[2,4,6] A literature review was chosen to strengthen the reasons for choosing selected latent variables in the development of IPB model for health personnel.

The review found 24 papers that pointed to 6 latent predictor variables of IPB for health personnel. They are supervision, infrastructure, compensation, training, work climate, and work motivation. Supervision has an important role in improving the IPB because it influence he health personnel team to work towards certain goals and objectives.[26,27] Positive influence between hospital infection control supervision on nurses' behavior in infection prevention and has a reciprocal relationship to conduct the screening tests, control the use of N95 masks, control the hand hygiene, control the vaccination, and give more protection for high risk health personnel.[26–29]

The reason for choosing facilities and infrastructure as the latent variable because it is quite meaningful especially for rural areas from the issue of limited facilities of screening equipment and hand washing procedures in the patients room, without soap and towels.[11,12] The results of literature review found that most of the availability of facilities and infrastructure was adequate with the results of the significant relationship between the availability of facilities and infrastructure with the IPB.[16–20]

Training is also an important variable. Training allows health personnel to do job tend to accordance with the standards.[21–23] Most of the findings from paper reviewed related to the training is stated that there was a positive influence between the implementation of the training to the behavior of health personnel in preventing nosocomial infections, using the Personal Protective Equipment (PPE), minimze the spread of infection, and having visit strategies to patients.[21–25] Training also plays a role in encouraging the motivation of health personnel to be more active in using PPE, maintaining hand hygiene, changing masks before going to another patient.[30–33]

Compensation is still included in the model even though there is only 1 supporting paper on predictors of the IPB.[38] Compensation is expected as the presence or support from the management to maintain performance of health personnel in accordance with the standards of the IPB. Compensation is a strategic function of human resources that has a major impact on the work function of health personnel.[38]

The results of the constructs of direct and indirect influence of 6 variables on the IPB provide valid and significant as statistically results. The model is also obtained from the development of questionnaire items based on valid and reliable indicators using an applied test.[14,15] Supervision has the greatest percentage of influence on the IPB of health personnel at 27.50%. Supervision can be conducted by monitoring health personnel compliance with hand washing procedures, using the PPE, and establishing an occupational safety and health team as part of comprehensive supervision. It can be added by monitoring the health condition of health personnel from regular medical check-up.[26–28] Supervision has an important role with the provision of compensation to health personnel.[38] Health personnel who are proven to apply IPB accordance with the standards are expected to get more compensation from the management.

The latent variable that has the smallest percentage of direct and indirect influence on infection prevention behavior is motivation at 8.15%. This is also shown from the indicator that has the smallest t-value significance, namely the sense of belonging at 72,186. This emphasizes concern of health personnel in terms of disease prevention. For instance, health personnel do not immediately change masks before going to another patient.[33] Moreover, they are not using the PPE when visiting patients.[31] In addition, there is a lack of interest of health personnel to increase immunity through vaccination. Indonesia has implemented a Covid-19 booster vaccination, especially for medical personnel. However, there is not much concern about vaccination for other infectious diseases such as hepatitis, influenza, or others.

The strength of this study is the use of the SEM-PLS technique to analyze the sample and it has a bootstrapping test technique to conduct internal validation without requiring external datasets from other locations. In our understanding, the development of IPB model specifically for rural areas in Indonesia has not been widely developed. So that, the model with a Q2 value of 95.7%, it can be able to have positive practical implications. This model is quite important to deal with the emergence of pandemics such Covid-19 peandemic in the future.

The limitation of this study is that the

characteristics of respondents such as work duration and smoking behavior were not analyzed further as predictors of the IPB for health personnel. The more cigarettes smoked, the higher the severity of infectious diseases and the risk of non-communicable diseases.[39] It can be prepared for the next pilot project in modifying the model of IPB for health care personel from the result of this study.

Conclusions

This study concluded that there are 6 variables based on the literature review and it is valid and significant after conducting the survey which has a direct and indirect influence on IPB to health personnel at a public health center in rural areas of Indonesia. The magnitude of the direct and indirect influence is supervision (27.50%), availability of infrastructure (9.87%), training (10.44%), compensation (16.97%), work climate (10.78%), and work motivation (8,15%) to IPB. The Path Model has an influence strength of 95.7% whether it was applied to other rural public health centers. Public health centers need to carry out continuous supervision to give the protection of health personnel from infectious diseases and supervise the PPE and hand hygiene of health personnel to achieve a better target of controlling disease infection. Other rural areas can use this model as a standard application for IPT to health personnel.

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