

# HEALTH BELIEF MODEL-BASED INTERVENTION ON KNOWLEDGE AND PRACTICE OF STANDARD PRECAUTIONS AMONG PRIMARY HEALTHCARE WORKERS IN A STATE OF MALAYSIA

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**Abstract.** Standard precautions (SP), such as hand and respiratory hygiene, use of personal protective equipment and safe injection procedure, are crucial in preventing healthcare-associated infections (HAIs) and occupational infections among healthcare workers (HCWs). HAIs cause antimicrobial resistance, increase mortality and financial burden to health organizations. Health belief model (HBM)-based intervention has been developed to promote behavioral changes among HCWs. Effectiveness of an HBM-based intervention module in improving knowledge and practice of SP among HCWs was carried in a cluster randomized control trial involving 104 HCWs in control group and 94 HCWs in intervention group from eight health clinics in a state of Malaysia. Knowledge scores and practice were computed using a self-administered questionnaire at pre-, immediate post- and month 6 post-intervention. Intervention group was given a one-day intervention course while control group had received the same intervention course after study completion. There is a significant difference in knowledge and practice scores between and within groups after adjusting for covariate and cluster effect ( $p$ -value  $<0.050$ ). All HBM constructs demonstrated significant improvement ( $p$ -value  $<0.050$ ) between and within groups except for perceived barrier and cues to action. In conclusion, the intervention module was effective in improving knowledge and practice of SP among HCWs, and regular and periodic educational training incorporated with HBM is essential to promote behavioral changes.

**Keywords:** health belief model-based intervention, knowledge, standard precautions practice, healthcare worker

## INTRODUCTION

Standard precautions (SP) constitute a set of practices in infection control to prevent transmission of diseases acquired by contact with blood and body fluids except sweat, such as human immunodeficiency virus (HIV), tuberculosis (TB) and conjunctivitis (AIDS/STI Section, 2002).

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These precautionary practices should be applied regardless of whether blood and body fluids contain visible blood, non-intact skin or mucous membrane. SP includes hand washing, wearing personal protective equipment (PPE), disinfection and sterilization of patient-care equipment, and proper housekeeping and management of spillage, management of contaminated laundry and disposal of sharps and clinical wastes (Siegel *et al*, 2007; WHO, 2007). The main objective of SP is to reduce risk of transmission of microorganisms from both recognized and unrecognized sources regardless of patients' diagnosis and perceived infection status.

An infection acquired by a patient during receiving cares in healthcare facility either hospital, outpatient clinic or others that is not present during treatment care or time of admission (HAI) can (but not necessarily) include occupational infections acquired by healthcare workers (HCWs) at the workplace (WHO, 2011). SP is vital in controlling and preventing HAIs among HCWs (CDC, 2019). Prevalence of HAIs in developed countries is 5.1-11.6% while in the developing countries is 5.0-19.0% (Allegranzi *et al*, 2011). In Malaysia, central-line-associated bloodstream infection rate is 6.2/1000 central line-days, ventilator-associated pneumonia rate 17.7/1000 mechanical ventilator-days and the catheter-associated urinary tract infection rate 3.0/1000 urinary catheter-days in three adult intensive care units (ICUs) and one pediatric ICU from two hospitals (Rai *et al*, 2016).

A longitudinal cohort study in China reported 46.0% of 880 village doctors have latent tuberculosis infection (LTBI) (He *et al*, 2015). In a primary healthcare (PHC) setting in Brazil, a cross sectional study reported a prevalence of 54.1% of

HCWs with suggestive LTBI (tuberculin skin tests positive with cut-off  $\geq 5$  mm) (Lacerda *et al*, 2017). In Malaysia, the importance of SP and infection prevention and control measures in PHC facilities has not been given priority in previous years, leading to many occupational infections among HCWs in such locations, such as a hospital reporting 46.4% prevalence of LTBI among 401 HCWs (Jaafar and Krishnan, 2016). A report from the Ministry of Health (MOH) Malaysia stated a prevalence of TB infection among HCWs of 135-157 per 100,000 population, higher than the general population 36.4% of the cases occurred at PHC setting including outpatient, maternal and child healthcare and private clinics (Liew *et al*, 2019). In addition, the presence of newly emerging highly infectious diseases such as COVID-19 poses a challenge to public health and PHC in providing adequate first line defense in prevention and control of this global pandemic. The task includes active case detection among patients and contact tracing in the community (Padoveze and Figueiredo, 2014; PHCPI, 2020). HCWs might be exposed to infection if there are deficiencies in carrying out SP practice. Given the importance of infection prevention and control measures in a PHC setting, compliance to SP must be prioritized and warrants implementation of an intervention program to promote knowledge, perceptions and practice of SP among HCWs.

When HCWs become infected with HAIs, it results in an adverse impact on quality and productivity of the healthcare system (Andersson *et al*, 2010; WHO, 2011), increasing days absent from work and imposing additional burden to other colleagues, and thus ending up with a shortage of resources, and in fatigue and burnout among HCWs. Despite the

importance of SP, the practice of SP among HCWs is not optimized, for example, Europe and Israel reporting 40.0% of 4649 hand hygiene opportunities observed in several hospitals (Lee *et al*, 2011), and in Sarawak, Malaysia, 50.8% of nursing students exhibiting overall good practice of standard precautions (Khuo, 2010). In several PHC clinics in Malaysia, percent respondents having good knowledge and practice in the control of TB infection is 70.6 and 51.6 respectively (Ramlan *et al*, 2020). Even though many policies and guidelines have been implemented by MOH Malaysia, the practice of SP among HCWs is still inadequate especially in PHC settings (MOH Malaysia, 2013; MOH Malaysia, 2010).

Health belief model (HBM) describes how people's beliefs, whether or not they are at risk of a health problem and their perceptions of benefits of taking action to avoid it and how it influences their readiness to take action (Glanz *et al*, 2008). Several studies incorporating HBM constructs reported promising results (Jeihooni *et al*, 2018; Sadeghi *et al*, 2018; Pinyaphong *et al*, 2020), while others indicated barriers in HCWs practicing SP, including lack of knowledge and false perception of risk and illness severity (Atalla *et al*, 2016; Powers *et al*, 2016). Factors in improving practice and compliance of SP among HCWs include generating awareness of susceptibility to infection, severity of disease, barriers to and benefits from compliance, and ability for self-learning (Luo *et al*, 2010; Yousafzai *et al*, 2015).

In order to control and prevent HAIs and occupational infections, effective intervention needs to be implemented to improve and empower HCWs to practice SP. Here, we describe the effectiveness of a self-developed HBM-based intervention

module on SP knowledge and practice among HCWs in government primary healthcare clinics in a state of Malaysia.

## MATERIALS AND METHODS

### Study design

The study was a cluster randomized controlled trial comprising pre- and post-tests in parallel groups with a 1:1 allocation ratio, conducted from December 2018 to November 2019 in government primary care clinics in a state of Malaysia. A cluster in this study refers to a clinic, activities of which include outpatient services, management of non-communicable (including mental health) and communicable diseases (HIV and TB), maternal and child health (MCH) services, dietary services, running units for smoking abstinence and providing methadone for intravenous drug users, as well as carrying out laboratory tests, radiology examination, physiotherapy and speech therapy. Clinics operate from 08:00 to 17:00 hours, Monday to Friday. Services are provided to individuals of all ages.

### Study participants and data analysis

Participants sample size is calculated assuming individual random allocation and inflated by design effect to account for randomization of the cluster. Formula of continuous outcome with equal cluster sizes in both test and control groups was used at 5% significance and 80% statistical power (Donner *et al*, 1981). Intracluster correlation coefficient of 0.04 is used (Temime *et al*, 2018). Calculation indicated four intervention and four control clinics are required, including a 30% increment to allow for dropouts. Each clinic was represented by 25-26 consenting HCWs, selected through random sampling after being stratified according to job positions

and consisted of medical officers, nurses and medical assistants (total  $n = 204$ ). HCWs from infection control unit such as link nurses were excluded from the study but were involved as facilitators during the intervention period as they had been trained in SP infection prevention and control measures.

Data were collected following approval from the National Medical Research Register, Ministry of Health Malaysia (NMRR 18-2038-42587), and the trial was also registered under the Thai Clinical Trials Registry (TCTR20200124002). Prior written informed consents were obtained from all participants.

#### **Randomization and allocation concealment**

Of 13 health clinics agreeing to participate, only eight clinics that handle >800 patients per day were eligible. Block randomization of the clinics using a block size of four was performed to preserve a balanced distribution between intervention and control groups. Randomization of clusters was conducted by a neutral third party to maintain allocation concealment. Single blinding was applied in this study.

#### **Instruments employed**

##### **HBM-based intervention module**

Intervention module was developed, incorporating the six HBM components as framework (Glanz *et al*, 2008). Guidelines on infection control by WHO, CDC, MOH Malaysia, as well as evidence-based literature, were developed based on a process of consultations with a group of experts from MOH Malaysia and Universiti Putra Malaysia. A pre-test of the intervention module among a group of 20 HCWs from non-participating clinics showed satisfaction with language and meaning of the items presented. Intervention module consists of health

education talks, short edutainment videos, demonstrations and interactive hands-on sessions. Small group activities and discussions on SP components, such as hand and respiratory hygiene, use of personal protective equipment and good management practice, were also conducted. Intervention module was delivered in a one-day course by researchers and link nurses.

#### **Questionnaire**

A validated, self-administered questionnaire adapted from several surveys on infection control was drafted. Participants were assessed at pre-, immediate post- and month 6 post-intervention to determine effects of the intervention module on knowledge and practice of SP. This questionnaire consisted of four parts:

- i. participants demography (age, gender, job position, employment duration and working unit),
- ii. knowledge on SP (comprising 23 items requiring “yes”, “no”, or “do not know”, with maximum score of 46),
- iii. perceived susceptibility, severity, barrier, benefit, cue of action and self-efficacy on SP (32 items using a 5-point Likert’s scale, with maximum score of 96), and
- iv. practice of SP (22 items using a 5-point Likert’s scale, with maximum score of 88).

#### **Validity**

Validity of the questionnaire contents and intervention module were assessed by four panels of experts drawn from the Community Health Department, UPM and MOH Malaysia using an item-content validity index (I-CVI). Items with I-CVI <90.0% were removed from the respective construct (Terwee *et al*, 2007). Mean

I-CVI for each part of the questionnaire ranged 0.91-1.00 and 0.91-1.00 for each component of the intervention module. A pre-test involving 22 HCWs from an unrelated clinic was performed to evaluate language and understanding of the items. Subsequently, based on the comments from the HCWs, the questionnaire was modified accordingly.

### Reliability

Reliability test was carried out to identify internal consistencies of the questionnaire using a Cronbach's alpha value as well as intra-cluster correlation coefficient (ICC) (Valim *et al*, 2015). Cronbach's alpha values for the questionnaire ranged 0.71-0.95 ( $\geq 0.60$  considered acceptable) and ICC ranged 0.56-0.87, with constructs  $< 0.60$  modified accordingly.

### Statistical analysis

Statistical calculations were performed using IBM corporation, the Statistical Package for the Social Sciences (SPSS) for Windows, Version 25.0. (Company's name, Armonk, NY). A two-tailed  $p$ -value  $< 0.050$  is considered statistically significant at 95% confidence interval (CI). Descriptive statistics are presented as median  $\pm$  interquartile range (IQR) and frequency (percentage). At baseline, between-group comparison was analyzed using Mann Whitney U test and Chi-square test, and within-group comparison of HBM constructs using the Wilcoxon Signed-Rank test. Comparison of knowledge and practice score between and within groups was performed using repeated measures analysis of variance (RM-ANOVA). Comparison of effectiveness of intervention employed a generalized estimating equation (GEE) as it allows analysis of repeated measurements and adjusts for clustering effect of the clinics.

The model also includes main between-group and within-group effects (time). Variables that are significant by bivariate analysis are included in the analysis model as covariates. Data are analyzed on an intention-to-treat (ITT) basis.

## RESULTS

Overall participation was 97% (198/204 HCWs), and participation per intervention and control group 94% (94/100) and 100% (104/104 HCWs) respectively. Only 158 HCWs completed all three time-point assessments with an attrition rate of 20%. There are no significant differences between the two groups as regards sociodemographic and employment characteristics and HBM constructs except in job position and working unit (Table 1). The discrepancy in the distribution of job position between groups was due to replacement of selected participants by others who were not from the same job position during the intervention day; nurses replaced medical officers and medical assistants who were required at the clinics. Imbalance in participants was attributed to an implementation of a family doctor concept in which HCWs work at both outpatient and maternal child health units simultaneously without definite separation between both units (MOH Malaysia, 2018).

The intervention group showed significant increases in scores of all HBM constructs ( $p$ -value  $< 0.050$ ), except for perceived barrier and cues to action, between pre- and month 6 post-intervention, but no significant changes in control group (Table 2). There are significant differences in scores of HBM constructs, except for perceived barrier and cues to action, between intervention

Table 1

Baseline between-groups of sociodemographic and employment characteristic and health belief model constructs (HBM) of participants from government primary care clinics in a state of Malaysia (December 2018 - November 2019).

Characteristic	Group		<i>p</i> -value*
	Intervention	Control	
Gender, number (%)			0.287
Female	82 (87)	85 (82)	
Male	12 (13)	19 (18)	
Job position, number (%)			0.014
Nurse	53 (56)	48 (46)	
Medical Assistant	18 (19)	11 (10)	
Medical Officer	23 (25)	45 (44)	
Working unit, number (%)			0.001
MCH	44 (47)	21 (20)	
OPD	50 (53)	83 (80)	
Age in years, mean $\pm$ SD	31 $\pm$ 6	31 $\pm$ 6	0.992
Employment duration in years, mean $\pm$ SD	7 $\pm$ 7	7 $\pm$ 5	0.487
HBM construct, median score (IQR)			
Perceived susceptibility	14 (3)	14 (3)	0.644
Perceived severity	12 (5)	11 (5)	0.417
Perceived barrier	19 (6)	17 (5)	0.086
Perceived benefit	14 (3)	13 (4)	0.222
Cues to action	2 (0)	2 (0)	0.623
Self-efficacy	14 (6)	13 (6)	0.589

\*Significant at *p*-value <0.050; IQR: interquartile range; MCH: maternal and child health clinic; OPD: outpatient department; SD: standard deviation.

and control group at month 6 post-intervention. Because reverse scoring was used for questions on perceived barriers, lesser the perception of barriers higher were the scores given on the Likert scale.

There are significant increases in knowledge and practice scores in intervention compared to control group at both post- and month 6 post-intervention periods (Table 3). For within-group comparison, both knowledge and practice

scores are significantly increased in intervention group at both post- and month 6 post-intervention compared to pre-intervention periods; however, in control group there is only a significant increase in practice score at month 6 post-intervention compared to pre-intervention period.

GEE analysis of standard precautions practice scores showed significant increase in intervention compared to control

Table 2  
Health belief model (HBM) construct scores on standard precautions at pre- and month 6 post-intervention periods of control and intervention participant groups from government primary care clinics in a state of Malaysia (December 2018 - November 2019).

HBM construct	Intervention group			Control group			p-value**	
	Median score (IQR)			Median score (IQR)				p-value*
	Pre-test	Month 6 post-test	Month 6 post-test	Pre-test	Month 6 post-test	Month 6 post-test		
Perceived susceptibility	14 (3)	15 (1)	15 (1)	0.001	14 (3)	14 (2)	0.999	0.001
Perceived severity	12 (5)	13 (4)	13 (4)	0.005	11(5)	11 (5)	0.125	0.006
Perceived barrier	19 (6)	18 (9)	18 (9)	0.931	17 (5)	20 (6)	0.129	0.813
Perceived benefit	14 (3)	15 (0)	15 (0)	0.001	13 (4)	13 (4)	0.999	0.001
Cues to action	2 (0)	2 (0)	2 (0)	0.030	2 (0)	2 (0)	0.999	0.028
Self-efficacy	14 (6)	18 (1)	18 (1)	0.001	13 (6)	13 (6)	0.999	0.001

\*Significant at p-value <0.050; \*\*Comparison between intervention and control groups at month 6 post-intervention; IQR: interquartile range.

groups ( $\beta = 0.029$ ) and in both immediate post- and month 6 post-intervention periods compared to pre-intervention period ( $\beta = 0.035$  and  $0.051$ , respectively). In addition, there is a significant difference of baseline standard precautions practice score between intervention and control groups ( $\beta = 0.01$ ) (Table 4). Similar results were obtained using GEE analysis of standard precautions knowledge scores (Table 5).

### DISCUSSION

All HBM constructs are significantly increased when intervention was compared with control study groups and with post- with pre- intervention except for perceived barriers and cues to action. The same scenarios were observed by Khodaveisi *et al* (2017) and Jeihooni *et al* (2018). However, Adly *et al* (2014), Zeigheimat *et al* (2016), Osta *et al* (2018), and Sadeghi *et al* (2018) reported significant differences in perceived barrier between intervention and control groups. Masoudi *et al* (2016) found perceived barrier has a negative and inverse relationship with the practice of SP. These contradictory findings could be explained by differences in research environment, information resources and teaching methods. In addition, perceived barriers are subject to less improvement than the other constructs, most

Table 3

Scores on knowledge and practice of standard precautions at pre-, immediate post-, and month 6 post-intervention periods of control and intervention participant groups from government primary care clinics in a state of Malaysia (December 2018 - November 2019).

Time period	Intervention group		Control group		<i>p</i> -value** (effect size)
	Mean score ± SD	<i>p</i> -value* (effect size)	Mean score ± SD	<i>p</i> -value* (effect size)	
Knowledge					
Pre-intervention <sup>#</sup>	39 ± 3	0.001 (54%)	39 ± 3	0.080 (3%)	0.001 (20%)
Immediate post-intervention	44 ± 2		40 ± 3		
Month 6 post-intervention	42 ± 2		39 ± 2		
Practice					
Pre-intervention <sup>#</sup>	71 ± 8	0.001 (34%)	71 ± 7	0.020 (5%)	0.001 (5%)
Immediate post-intervention	76 ± 7		71 ± 6		
Month 6 post-intervention	76 ± 7		72 ± 6		

\*Significant at *p*-value <0.050. \*\*Comparison between mean score of intervention and control groups at post- and month 6 post-intervention, significant at *p*-value <0.050; SD: standard deviation.

probably due to a lack of guidance and monitoring from the supervisors and peer leaders after the intervention indicating the importance of continuous teaching and supervision (Adly *et al*, 2014). Availability of other supplementary references such as booklets could be a contributing factor for the significant changes reported (Sadeghi *et al*, 2018). Nevertheless, participants showed significant improvement in the practice scores despite the absence of changes in perceived barriers and cues to action.

The significant increase in knowledge score in the immediate post- and month 6 post-intervention compared to pre-intervention shown by GEE analysis was also reported in Egypt, India and Nigeria (Edet *et al*, 2010; Aby, 2015; Chauhan and Kumari, 2016; Orabi, 2017). In the current study, knowledge score increased from pre- to immediate post-intervention but slightly reduced at month 6 post-intervention, similar to studies in Egypt and Switzerland (Adly *et al*, 2014; Wolfensberger *et al*, 2019), indicating knowledge retention is reduced over time and refresher training needs

Table 4

Intention-to-treat analysis of intervention on standard precautions practice scores of participants from government primary care clinics in a state of Malaysia (December 2018 - November 2019).

Variable	$\beta$	95% CI		<i>p</i> -value*
		Lower	Upper	
Trial group <sup>a</sup>				
Control				
Intervention	0.029	0.019	0.039	0.001
Period				
Pre-intervention <sup>a</sup>				
Immediate post-intervention	0.035	0.026	0.043	0.001
Month 6 post-intervention	0.051	0.036	0.066	0.001
Unit				
MCH <sup>a</sup>				
OPD	-0.005	-0.014	0.005	0.341
Baseline perceptions <sup>b</sup>	0.000	0.000	0.001	0.442
Baseline practice <sup>b</sup>	0.010	0.010	0.011	0.001

\*Significant at *p*-value <0.050 compared to reference (a); <sup>b</sup>Comparison between control and intervention groups; CI: confidence interval; MCH: maternal and child health clinic; OPD: outpatient department;  $\beta$ : beta coefficients.

to be conducted regularly. In addition, if the knowledge is not being practiced as a result of lack in monitoring, then improvement in knowledge will gradually decline (Wolfensberger *et al*, 2019). In the present study (as expected), there was also a significant increase in knowledge scores of the intervention compared to control group, findings supported by studies in Egypt, Iran, Kenya, and Switzerland (Adly *et al*, 2014; Mahrous, 2016; Zeigheimat *et al*, 2016; Mukthar *et al*, 2017; Wolfensberger *et al*, 2019).

Several studies have shown HBM-based educational intervention is effective in improving the knowledge score of HCWs on SP (Zeigheimat *et al*, 2016; Jeihooni *et al*, 2018; Sadeghi *et al*, 2018;

Ardakani *et al*, 2019). In Kenya, Mukthar *et al* (2017) developed a structured education program based on other behavioral models such as social cognitive theory. In the present study, HBM was chosen to be incorporated into the intervention module as there are more studies using HBM that show more promising results (Mohseni *et al*, 2015; Koohsari *et al*, 2016; Khorsandi *et al*, 2017).

In Switzerland, a recent intervention study reported watching an “edutainment” video is more useful in improving knowledge on SP compared to reading the standard operating procedure named “Standard precautions – the Basics” or no intervention (Wolfensberger *et al*, 2019). In view of this, edutainment video was

Table 5

Intention-to-treat analysis of intervention on standard precautions knowledge scores of participants from government primary care clinics in a state of Malaysia (December 2018 - November 2019).

Variable	$\beta$	95% CI		<i>p</i> -value*
		Lower	Upper	
Trial group				
Control <sup>a</sup>				
Intervention	0.044	0.037	0.051	0.001
Period				
Pre-intervention <sup>a</sup>				
Immediate post-intervention	0.067	0.054	0.080	0.001
Month 6 post-intervention	0.040	0.028	0.052	0.001
Unit				
MCH <sup>a</sup>				
OPD	-0.003	-0.011	0.005	0.527
Baseline knowledge <sup>b</sup>	0.016	0.015	0.017	0.001

\*Significant at *p*-value <0.050 compared to reference (a); <sup>b</sup>Comparison between control and intervention groups; CI: confidence interval; MCH: maternal and child health clinic; OPD: outpatient department;  $\beta$ : beta coefficients.

also included on such topics as disease transmission, six steps of hand hygiene, cough etiquette, sequences in donning and doffing PPE, and common scenarios leading to physical injuries among HCWs. These edutainment videos proved to increase participants' knowledge of SP. Mukthar *et al* (2017) noted knowledge of SP is a significant predictor of compliance by highlighting misconceptions and confusion on correct SP implementation.

There was a significant increase of practice score in immediate post- and month 6 post-intervention compared to pre-intervention shown by GEE analysis, findings consistent with studies in Iran reporting significant increase in adherence and performance scores within three periods of assessment (Jeihooni *et al*,

2018; Gomarverdi *et al*, 2019). However, the present study demonstrated in the control group increment of scores between baseline and month 6 post-intervention. This might be due to a post-exposure effect of the questionnaire as observed in other studies (Mukthar *et al*, 2017; Wolfensberger *et al*, 2019). Thus, pre-test results acted as a confounding factor and has to be taken into account during analysis.

Mean practice score in intervention group was significantly increased compared to control group, in keeping with several quasi-experimental studies on infection control intervention in Egypt, Kenya and Nigeria, which demonstrated a significant increase in mean self-reported practice scores in intervention

compared to control group (Mahrous, 2016; Nmadu *et al*, 2016; Mukthar *et al*, 2017), although Nmadu *et al* (2016) also noted observed practice scores are not significantly different among trial groups. A Hawthorne effect (Merrett, 2006) and over-reporting could explain this discrepancy between self-reported and observed practices by HCWs. In addition, a lack of available resources for the practice of SP could also be responsible as evidenced by findings from a facility checklist showing insufficient supplies and equipment for the practice of SP after intervention (Nmadu *et al*, 2016).

Gomarverdi *et al* (2019) used a multi-component intervention similar to that employed in the present study, *ie* educational talk using PowerPoint presentation, video presentation, small group discussion and demonstration followed by hands-on practice supervised by link nurses. All these methods supported by audiovisual aid were evaluated by Wolfensberger *et al* (2019) to be successful in delivering the importance of SP.

Several recent studies, which incorporated HBM into their intervention reported its effectiveness in increasing the practice and adherence to SP and pointed out the need to develop a system of continuing education related to SP as well as training incorporated with health behavior theory to improve the knowledge and practice of SP among HCWs (Zeigheimat *et al*, 2016; Jeihooni *et al*, 2018; Osta *et al*, 2018). However, Osta *et al* (2018) noted the studies lack control groups and use baseline data as controls. In view of this concern, the present study incorporated a complete two-arm cluster random control trial.

There was several limitations in

this study: (i) it was a single-blinded, self-reported practice and lacked direct observation of SP practice owing to technical and financial constraints; (ii) there was a high attrition rate (20%) because a number of participants were transferred to other clinics, on extended medical leave or submitted unanswered questionnaires; and (iii) there was a discrepancy in baseline comparison of between-groups as regards position and working unit, which were unavoidable due to technical constraints. Nevertheless, the strength of this study lies in the cluster randomized control trial study design that prevented contamination and the intervention was supported by a well-established HBM that has been proven to promote behavioral changes (Giraudeau and Ravaud, 2009; Janz and Becker, 1984).

In summary, this study shows a health belief model-based intervention module was effective in increasing knowledge and practice of standard precautions among healthcare workers in primary healthcare clinics in Malaysia. Given the importance of prevention of hospital-acquired infections and occupational infection, there is a need for proper planning of a fundamental solution to improve the knowledge and practice of standard precautions. The elements of belief are crucial in promoting behavioral change with higher potential for future adherence by healthcare workers. It is recommended regular and periodic evidence-based educational training on standard precautions be held, preferably every six months. In addition, clinic managers should include credible peer leaders in each unit to reinforce best practices and ensure adherence to standard precautions among healthcare workers. Further investigations are recommended employing observation-

based studies on the practice of standard precautions and its effect on prevalence of hospital acquired and occupational infections.

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#### CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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