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Effect of Installation of Alcohol Gel Dispensers and Behavioral Nudges on Behavioral Drivers for Hand Hygiene: A Quasi-Experimental Study at a Tertiary Hospital during the COVID-19 Pandemic

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ABSTRACT

Objective: To compare the level of hand hygiene behavioral drivers before and after installation of alcohol gel dispensers and behavioral nudges among outpatients and visitors at a tertiary hospital in Thailand during the coronavirus disease 2019 (COVID-19) pandemic.

Material and Methods: A quasi-experimental study was conducted among outpatients and visitors in June 2020. We installed 12 alcohol gel dispensers with signs serving as behavioral nudges at a tertiary hospital in the Internal Medicine Outpatient Department (OPD), Surgery OPD, and the Pharmacy. We trained enumerators to interview outpatients and visitors regarding their behavioral drivers (beliefs about COVID-19 and hand hygiene based on the health belief model, plus handwashing social norms). We analyzed data using descriptive statistics.

Results: Enumerators recruited 206 participants in the pre-intervention phase (refusal rate = 37.6%) and 219 participants in the post-intervention phase (refusal rate = 32.2%). There were significant differences between the pre-intervention and post-intervention phases with regard to self-efficacy for hand hygiene (92.0% vs. 100%, respectively), perceived lack of barriers to hand hygiene with alcohol (93.2% vs. 98.2%, respectively), and the proportion of participants who reported that hand hygiene had become a habit (7.5 vs. 18.8%, respectively). Reports of other domains of health beliefs (perceived severity of COVID-19, perceived benefits of handwashing) were homogeneous in both periods.

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Conclusion: We found differences in perceived lack of barriers and reported habit of hand hygiene but while self-efficacy was homogeneous in both periods. Issues regarding selection bias, construct validity, and generalizability may limit the usefulness of the study data. Caveats should be considered in the interpretation of the study findings.

Keywords: COVID-19; hand hygiene; health beliefs; nudges; social norms

INTRODUCTION

Health facilities are places where a large number of the population gathers at the same time, enabling transmission of respiratory diseases, including coronavirus disease 2019 (COVID-19). It is evident that hand hygiene is associated with healthcare-associated pathogen transmission or nosocomial infection.[1,2] The United Nations has recommended frequent hand hygiene among patients and visitors at health facilities to ensure patient safety.[3] However, the patients and visitors at health facilities may not be able to readily perform hand hygiene when needed, and hand hygiene is generally not performed frequently in the global adult population.[4] Therefore, promotion of hand hygiene at health facilities is required including the improvement of access to hand hygiene materials such as water and soap or hand sanitizers and enhancing hand hygiene behavioral drivers (such as social norms on hand hygiene, barriers/self-efficacy in performing hand hygiene, perceived susceptibility to diseases, and perceived severity of diseases), which then improves handwashing behavior.[5]

Improving access to hand hygiene material at health facilities may include installation or relocation of alcohol gel dispensers within the service area.[5] Improving hand hygiene behavioral drivers may include installation of nudges, i.e., subtle physical cues such as symbols or signs that motivates behavior without direct order or health promotion activity.[2] According to the health belief model,[6] nudges may serve as cues to action, influence self-efficacy, alter perceived susceptibility and severity of diseases, alter perceived barriers to perform the behavior of interest, or change social norms regarding the behavior of interest.[5,7-9] The main doctrine in the use of nudges in improving health behaviors was that exposure to nudges alters the level of behavioral drivers, which then induces the health behavior of interest, including hand hygiene. For improvement in hand hygiene, it is important to improve access to hand hygiene material simultaneously with the exposure to nudges.

Although many health facilities have adopted installation of alcohol gel dispensers in combination with nudges to improve health behaviors[5], few studies have assessed the changes in the level of hand hygiene behavioral drivers before and after such installation at a tertiary hospital during the COVID-19 pandemic. Such information can help healthcare workers and health facility managers have a better understanding of hand hygiene behaviors among patients and visitors and plan future hygiene promotion activities accordingly.

The objective of this study was to compare the distribution of hand hygiene behavioral drivers among patients and visitors at outpatient service areas at a tertiary hospital in Thailand before and after installation of alcohol gel dispersers combined with behavioral nudges during the COVID-19 pandemic.

MATERIAL AND METHODS

Study design and setting

This was a quasi-experimental (pre-intervention vs. post-intervention comparison) study conducted from 15 June 2020 to 26 June 2020 in the outpatient service areas at a tertiary teaching hospital in southern Thailand, namely: 1) General Practice Outpatient Department (OPD); 2) Surgery OPD; 3) Pharmacy. Each of the service area was approximately 200 square meters in size.

Study samples

Our study samples included patients and visitors aged 18 years or older at the study sites on the day of the interview whom the enumerators approached via convenience sampling and agreed to participate in the study. We excluded those unable to communicate verbally and those who did not have an adequate command of the Thai language.

Intervention design and delivery

The intervention consisted of two components: 1) Installation of alcohol gel dispensers at the study sites; 2) Installation of the behavioral nudges (images designed to induce hand hygiene behaviors) on the alcohol gel dispensers. Alcohol gel dispensers used in this study were foot pedal-operated and dispensed approximately 1 milliliter of alcohol gel per pedal-step (Figure 1a).

We created conceptual designs of the gel dispensers with nudges after a review of the literature[5,8] and requesting the assistant of a graphic designer affiliated with the study hospital. We included the conceptual designs into the pre-intervention questionnaire and asked the respondents about their interpretation of the nudge images. We summarized the findings from pre-intervention data collection on the drivers of handwashing behavior and interpretation of the nudges and consulted with the same graphic designer, who made further changes and finalized the nudge images (Figure 1b). We then printed the nudge images in color on 180 grams paper, laminated the print-outs and attached the images to a plastic feature board and the alcohol gel dispensers for durability using double-faced adhesive tape. We also printed the footprint images and attached them to the body of the gel dispensers in a similar manner.

We installed the alcohol gel dispensers and attached the nudges on 20-21 June 2020 in all 3 study areas, 4 dispensers per area (Figure 2). We chose the locations in consultation with the nurses and health personnel in change of each area, and intended for the dispensers to be near a blood pressure measurement area and as evenly dispersed as possible. All authors were involved in the installation.

1a

1b

Figure 1 The Intervention: (a) pedal-operated alcohol gel dispenser with behavioral nudges: the footprint and arrow signs were designed to induce use of the pedal to operate the dispensers; (b) The sign, with texts translated from Thai to English.

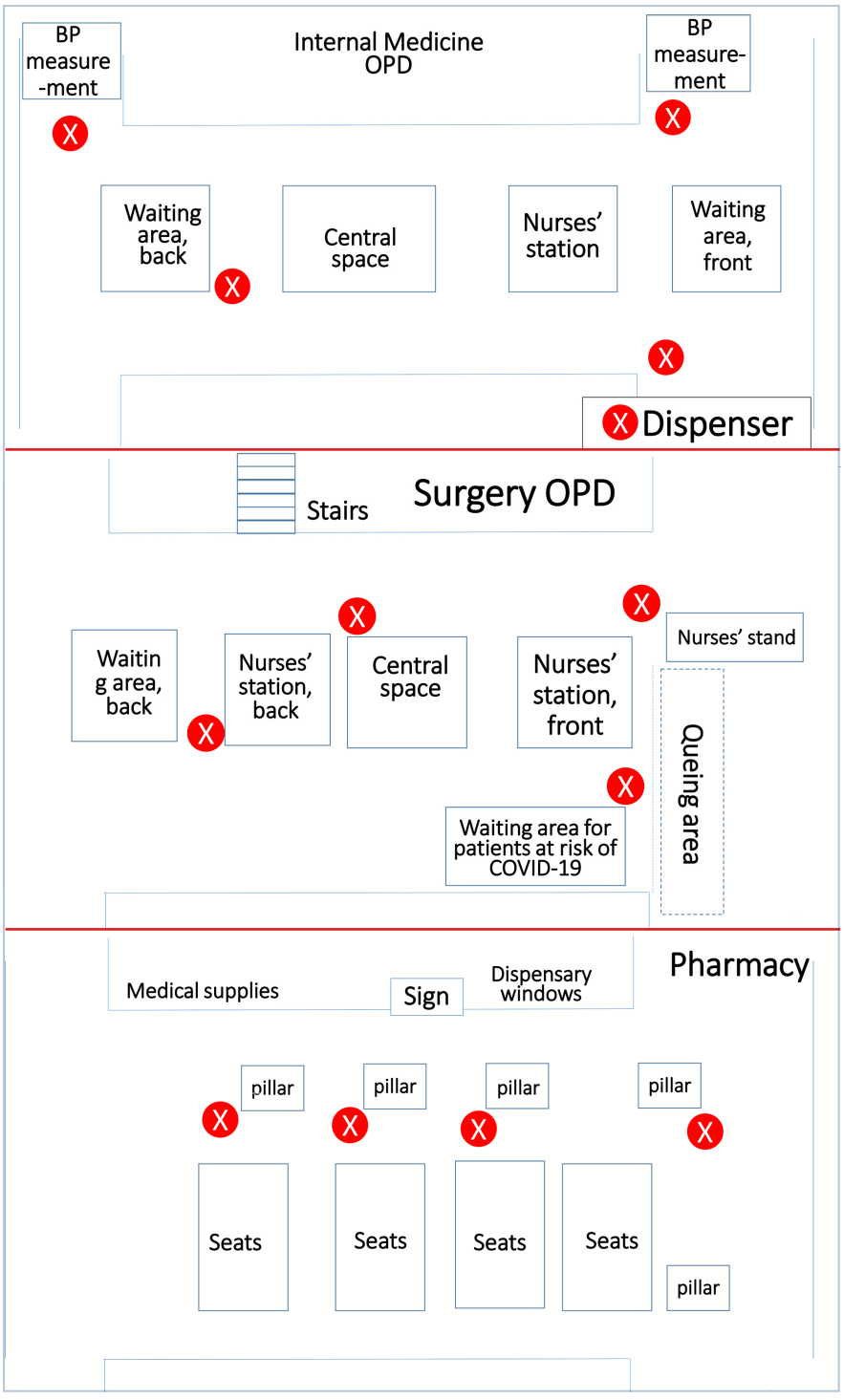

Figure 2 Representative diagram of the study sites and locations of the alcohol gel dispensers (denoted as a red circle with a white "X")

Outcomes: drivers of hand hygiene behaviors

We identified drivers of hand hygiene behaviors in this study based on the health belief model[6] and Bicchieri's theoretical framework on social norms[7] and adapted them to the practice of hand hygiene after respiratory fluid contact as per the context of our study. Components of health belief model included perceived susceptibility to COVID-19, perceived severity of COVID-19, perceived benefits of hand hygiene with alcohol on prevention of COVID-19, perceived barriers to performing hand hygiene at the interview location, cues to hand hygiene, and self-efficacy in performing hand hygiene. We used Bicchieri's theoretical framework[7] and defined social norms as the perceived extent that the respondents' peers perform hand hygiene after sneezing ("empirical expectation"), and the extent that the respondents' peers expect them to perform hand hygiene after sneezing ("normative expectation"). We drafted the questions in Thai, and pilot-tested the questions in 10 patients and visitors from the study sites prior to the pre-intervention phase, and used the feedback to make further changes and finalized the study instrument.

Based on a previously proposed model,[10] presence of the four main components of the health belief model were measured using a total of 8 statements with responses on a 5-categories Likert scale ("strongly disagree", "disagree", "not sure", "agree", "strongly agree"). The components were: 1) Perceived susceptibility to COVID-19 (3 questions); 2) Perceived severity of COVID-19 (2 questions); 3) Perceived benefit of handwashing with alcohol in prevention of COVID-19 (2 questions), and; 4) Self-efficacy for handwashing with alcohol (1 question). For affirmatively-worded question, those who answered "agree" or "strongly agree" to the statement were considered to affirmatively report the respective component of the health belief model. For negatively-worded question, those who answered "not sure", "disagree", or "strongly disagree" to the statement were considered to affirmatively report the component of the health belief model.

Barriers to handwashing was measured with the question "In your opinion, what are the barriers for handwashing with alcohol after coughing or sneezing? (multiple answers allowed". Participants who answered "No barriers" were considered to affirmatively report lack of barriers to handwashing. With regard to social norms on handwashing, those who answered that most or all other patients and visitors would wash their hands with alcohol after sneezing were considered to provide an affirmative answer for empirical expectation (perception that relevant others engage in the behavior of interest). Participants who answered that doctors, nurses, and other patients and visitors would take action if someone sneezed at the interview location without washing their hands (e.g., remind the person who sneezed to wash hands, bring alcohol container, others) were considered to provide an affirmative answer for normative expectation (perception that relevant others expect one to engage in the behavior of interest). Similar to the measurement of health belief model components, we considered participants who answered affirmatively to all social norms questions to have strong social norms on handwashing with alcohol after sneezing.

Sample size calculation

As there has been no previous quasi-experimental study with the same intervention and outcome as our study, we decided performed a naïve sample size calculation by assuming that 50.0% and 65.0% of individual outcomes among participants between pre-intervention and post-intervention periods gave an affirmative answer to all health belief model measurement questions. Assuming 80.0% power and 95.0% level of confidence, ratio of 1 to 1 for pre- and post-intervention, and 10.0% of incomplete data assumed, at least 203 participants in the pre-intervention phase and 203 participants in the post-intervention phase were required.

Data collection

We used paper-based questionnaire for study tool design and pilot-testing, and programmed the finalized study instrument onto KoBoCollect, an Android-based application for survey data collection.[11] We contacted and recruited four data collectors with previous survey research experience to be the enumerators in our study. During enumerator training, we briefed the enumerators on the overview of the project, principles of research ethics, covered each section of the questionnaire in details, and performed table-top exercises with mock interviews.

After the training session, we randomly assigned study sites for the enumerators for each day of scheduled pre-intervention and post-intervention data collection. For the interviews, enumerators identified and recruited out-patients and visitors at the study sites as our participants using convenience sampling. Throughout the data collection periods, we debriefed the enumerators each day on barriers to data collection, discuss the day's progress and set the target number of samples for the following day. The target number of samples per day was based on estimation of the minimum number of interviews needed each day in order to meet the calculated sample size. Potential participants would be approached and invited to participate while waiting for their medical appointment or prescription filling. Enumerators explained to the potential participants about the study and provided potential participants with a copy of the information sheet. Enumerators also asked the participants for their written informed consent and provided participants with a copy of the informed consent form to sign, and gave another copy to the participants for their records. Participants were reminded of their ability to refuse to answer any question or stop the interview at any time. Participants who did not give informed consent were not included in the interview data set.

We trained the enumerators on 13-14 June 2020. The enumerators conducted pre-intervention phase interviews on 15-19 June 2020. We delivered the intervention (installed the alcohol gel dispensers and the nudges) on 20-21 June 2020. The enumerators conducted post-intervention phase interviews on 22-26 June 2020. Enumerators were trained using paper-and-pencil questionnaire during the briefing, then switched to using KoboCollect application on an Android phone during the table-top exercise and the data collection periods.

Data management and statistical analyses

At each debriefing session, we asked the enumerators to upload the data from KoBoCollect application onto the server. One of the investigators then accessed the data on the server and performed data cleaning in R with epicalc package[12] by checking for inconsistencies and errors in the responses, such as values or responses that were not designated in the questionnaire. We did not find such inconsistencies in the data set, thus we did not perform any replacement or imputation. We analyzed data using descriptive statistics, primarily frequencies and percentages. We compared outcomes at pre-intervention and post-intervention periods using chi-square test of independence.

RESULTS

During pre-intervention period, 330 participants were invited, but 206 of whom agreed to participate and gave informed consent (refusal rate = 37.6%). During the post-intervention phase, 323 participants were invited, but 219 agreed to participate (refusal rate = 32.2%). During both phases, most participants were women, married, and the average age was 41 years. Half of the participants had college degrees, and about one-thirds were professionals (civil servants, corporate employees, business owners). Most participants were non-patient visitors. (Table 1).

At both pre-intervention and post-intervention, most participants were able to identify the nearest alcohol dispensers (Table 2). The proportion of those who mentioned seeing signs and symbols to help them identify the alcohol

Table 1 General characteristics of study participants in the pre-intervention and post-intervention periods

Characteristic	Pre-intervention (n=206) N (%)	Post-intervention (n=219) N (%)	p-value**
Sex (% Female vs. Male)	148 (72.2)	139 (63.8)	0.080
Age (mean±S.D.)	41.9±13.4	41.4±13.5	0.674
Interview location			
General medicine OPD	77 (37.4)	70 (32.0)	0.477
Surgery OPD	65 (31.6)	78 (35.6)	
Pharmacy	64 (31.1)	71 (32.4)	
Marital status			
Single	72 (35.3)	82 (37.4)	0.742
Married	124 (60.8)	131 (59.8)	
Widowed/Divorced / Separated	8 (3.9)	6 (2.7)	
Highest Level of Education Completed			
Less than Year 9	35 (17.2)	26 (11.9)	0.226
Year 9 thru associate's degree	66 (32.5)	83 (37.9)	
Bachelor's degree or higher	102 (50.2)	110 (50.2)	
*Occupation**			
Group 1	71 (34.5\)	71 (32.4)	0.257
Group 2	91 (44.2\)	96 (43.8)	
Group 3	41 (19.9)	52 (23.7)	
No answer	3 (1.5)	0 (0.0)	
Reason for visiting hospital			
Patients	47 (23.2)	66 (30.1)	0.131
Other visitors (including accompanying the patient)	156 (76.8)	153 (69.9)	

*Occupations: Group 1 = civil servants, corporate employees, business owners; Group 2 = shop owners, manual laborers, farmers/fishermen, independent professions; Group 3 = retired, students, unemployed, others

**Based on chi-square test of independence for categorical distribution or Student's t-test or Kruskal-Wallis test for continuous values
OPD = Outpatient Department

Table 2 Components of health belief model among study participants in the pre-intervention and post-intervention periods

Item	Pre-intervention (n=206) N (%)	Post-intervention (n=219) N (%)	p-value**
Perceived Susceptibility to COVID-19			
COVID-19 can be easily transmitted from one person to another (% strongly agree / agree)	196 (97.5)	201 (91.8)	0.018
You are susceptible to being infected with COVID-19 (% strongly agree / agree)	96 (47.8)	100 (45.7)	0.739
If someone is infected with COVID-19 but does not show symptoms, that person can transmit COVID-19 to others (% strongly agree / agree)	193 (96.0)	215 (98.2)	0.302
Perceived Severity of COVID-19			
COVID-19 is a serious disease and can cause severe illness or death (% strongly agree / agree)	183 (91.0)	203 (92.7)	0.660
If you are infected with COVID-19, you are at risk of having severe symptoms (% strongly agree / agree)	99 (49.3)	109 (49.8)	0.993
Perceived benefits of handwashing with alcohol			
Washing hands with alcohol can help prevent infection from COVID-19 (% strongly agree / agree)	194 (96.5)	208 (95.0)	0.591
Washing hands with alcohol does not help preventing spread of COVID-19 to others (% strongly disagree / disagree / not sure)	195 (97.0)	217 (99.1)	0.232
Self-efficacy for handwashing with alcohol			
At a hospital, if you wish to wash your hands when you need to, you can always find a tap and basin or alcohol hand sanitizers (% strongly agree / agree)	185 (92.0)	219 (100.0)	<0.001

COVID-19 = Coronavirus disease 2019

Table 3 Barriers to handwashing, cues to action, social norms and awareness of alcohol dispensers among study participants in the pre-intervention and post-intervention periods

Item	Pre-intervention (n=206) N (%)	Post-intervention (n=219) N (%)	p-value**
Barriers to handwashing			
Barriers: In your opinion, what are the barriers for handwashing with alcohol after coughing or sneezing? (% No barriers)	187 (93.5)	214 (98.2)	0.030
Alcohol is expensive or scarce	5 (2.5)	1 (0.5)	0.179
Facilities are not accommodating (e.g., too few alcohol distribution dispensers, publicly-available alcohol sanitizers are of limited quantity and runs out quickly)	3 (1.5)	1 (0.5)	0.555
It is inconvenient to walk up to the alcohol dispensers to perform hand hygiene	7 (3.5)	1 (0.5)	0.056
People do not realize the importance of handwashing	6 (3.0)	1 (0.5)	0.100
Frequent handwashing makes hands dry	3 (1.5)	0 (0.0)	0.216
Carrying own sanitizer is a hazzle	2 (1.0)	0 (0.0)	0.441
Alcohol is expensive or scarce	5 (2.5)	1 (0.5)	0.179
Cues to action: Reminders to wash hands when coughing or sneezing *(multiple answers allowed)*			
No need for reminders (handwashing has become a habit)	15 (7.5)	41 (18.8)	0.001
Seeing others cough, sneeze, or have influenza-like symptoms	72 (35.8)	79 (36.2)	0.999
Reaction from the general public when not washing hands after coughing or sneezing	7 (3.5)	7 (3.2)	0.999
Friends or family remind me when I don't wash my hands after coughing or sneezing	91 (45.3)	91 (41.7)	0.528
Seeing signs for handwashing after coughing or sneezing in public	128 (63.7)	155 (71.1)	0.129
Others / Don't know / No answer	2 (1.0)	0 (0.0)	0.443
Social norms on handwashing			
Empirical Expectation: In the participant's opinion, how many patients and visitors at the interview location wash their hands with alcohol after coughing or sneezing (% all of them / most of them)	59 (29.2)	53 (24.2)	0.293
Normative Expectation 1: If someone sneezes without washing hands, what would doctors and nurses here do? (% Remind the person to wash hands / bring alcohol container / others)	91 (45.0)	103 (47.0)	0.757
Normative Expectation 2: If someone sneezes without washing hands, what would other patients and visitors here do? (% *Remind the person to wash hands / bring alcohol container / others)*	72 (35.6)	87 (39.9)	0.424

Table 3 Continued

Item	Pre-intervention (n=206) N (%)	Post-intervention (n=219) N (%)	p-value**
Participants with strong social norms on handwashing with alcohol after sneezing	26 (12.9)	39 (17.9)	0.198
Awareness of available alcohol dispensers			
Can you point to where the nearest alcohol dispenser? (% pointed the correct dispenser)	194 (97.0)	216 (98.6)	0.189
Among those who pointed to the correct dispenser: how did you know that the dispenser is there?	(n=194)	(n=216)	
Could see the dispenser clearly	193 (99.5)	216 (100.0)	0.957
There is a symbol on the ground	16 (8.2)	77 (35.6)	<0.001
There is a sign	11 (5.7)	79 (36.6)	<0.001
Others	1 (0.5)	1 (0.5)	0.999
Don't know / no answer	N/A	N/A	N/A

dispensers significantly differed between pre-intervention and post-intervention. There also were significant differences between pre-intervention and post-intervention participants with regards to reported self-efficacy for hand hygiene.

Similarly, the proportion of participants who stated that there was no need for cues or reminders for handwashing because hand hygiene had become a habit, that seeing signs helped to remind the participants to wash hands, and that there were no barriers to hand hygiene with alcohol at the hospital were similar between the pre-intervention and post-intervention periods. There were also no differences in the proportion of participants who answered affirmatively on social norms with regard to hand hygiene after sneezing.

The vast majority of participants reported that there were no barriers to handwashing with alcohol after coughing or sneezing at both pre-intervention (93.5%) and post-intervention (98.2%), and this difference was statistically significant (Table 3). Prevalence of the most common barrier at pre-intervention, inconvenience in walking up to the alcohol dispensers to perform hand hygiene, was lower and was borderline significant at post-intervention (3.5% vs. 0.5%, p-value = 0.056). The proportion of participants who reported that hand hygiene had become a habit for them was significantly different between pre-intervention and post-intervention (7.5% vs. 18.8%, p-value < 0.001). With regard to social norms on hand hygiene, only around one-quarter of participants expected other outpatients and visitors to perform hand hygiene after coughing or sneezing, although nearly half of the participants expected health-care workers to correct non-compliance to hand hygiene rather than other outpatients and visitors. The responses were similar between pre-intervention participants and post-intervention participants. With regard to awareness of alcohol dispensers, nearly all participants could point correctly to the nearest dispensers at both pre-intervention and post-intervention. All participants could see the dispenser directly, although the proportion of those who noticed the symbols (8.2% vs. 35.6%, p-value < 0.001) and signs for

alcohol dispernsers was significantly different between the two periods (5.7% vs. 36.6%, p-value < 0.001).

DISCUSSION

Our quasi-experimental study showed that installation of alcohol gel dispensers with signs serving as behavioral nudge was associated with increases in self-efficacy of hand hygiene, proportion of those who reported "No need for reminders" for hand hygiene, and lack of barriers to hand hygiene. However, there were no changes in perceived susceptibility to COVID-19 or social norms on hand hygiene.

Increases in self-efficacy and lack of barriers to hand hygiene, though statistically significant, might be of limited public health implication due to the high prevalence of the responses in both pre-intervention and post-intervention periods (prevalence >90.0%). Patients and visitors who agreed to participate in this study were of higher socioeconomic status than the general population of Thailand. Socioeconomic attributes are potential determinants of hand hygiene[14,15], and this homogeneity could have partly accounted for the homogeneity in self-efficacy. It was also possible that selection bias was present in this study, as those suffering from severe diseases and their accompanying persons might have been unwilling or not in the state of mind to willingly participate in an interview. Future studies should consider including questions on reason for hospital visit at the severity of the disease.

On the contrary, there was heterogeneity in other components of the health belief model. For example, with regard to perceived severity, nearly all participants agreed with the statement in the first question (that COVID-19 could cause severe illness or deaths), but only half agreed with the statement in the second question (that they themselves were at risk of severe symptoms if infected). Such heterogeneity implied that social desirability and response acquiescence were unlikely to influence the responses[16], otherwise the proportion of participants who gave a positive answer to the second question would have been higher.[17] However, the answers to the second question might have been more consistent with the construct of perceived severity, i.e., the belief about the disease's impact on one's ability to function in work and social settings.[18] Such pattern was also found in questions that measured perceived susceptibility to COVID-19. Future studies on health belief model of COVID-19 should more thoroughly check for construct validity in the design of study instruments.

There were no changes in social norms with regards to both the perception of hand hygiene compliance among other patients and visitors, and what healthcare workers and other patients and visitors would do in case of hand hygiene non-compliance. Taking into account the small size of the signs, future studies should consider increasing the size and number of the nudge images[8] or minimizing the design of the nudges but make the texts more noticeable5 in order to ascertain whether the nudges were indeed ineffective rather than unnoticed. Content of the social norms-inducing message may also need to be change to motivate the target population more strongly.[7]

This is one of the first studies to assess components of health belief model with regard to COVID-19 and the perceived benefits of hand hygiene in COVID-19 prevention and control among hospital outpatients and visitors, and differences in these measurements before and after installation of alcohol gel dispensers with behavioral nudges. However, a number of limitations should be taken into consideration. Firstly, the participants were selected by convenience sampling and the participation refusal rate in our study was considerable, thus the possibility of selection bias was non-negligible. Future studies should consider a more randomized and non-subjective approach to reduce the potential for such bias. Secondly, our study was conducted at one tertiary hospital over a two-weeks period in a country where there had been no local transmission of COVID-19 and social restriction measures were easing,

and the findings may not be generalizable beyond such contexts. Furthermore, the COVID-19 pandemic situation was changing rapidly during the study period and included reduction in number of new cases and eases in lockdown restrictions, all of which could have affected the awareness of the importance of hand hygiene and influenced the interview responses. Caveat is advised in the interpretation of our study findings.

CONCLUSION

We measured health beliefs regarding COVID-19 transmission, prevention and control among hospital outpatients and visitors before and after installation of alcohol gel dispensers with behavioral nudges. We found differences in perceived lack of barriers and reported habit of hand hygiene but while self-efficacy was homogeneous in both periods. There were changes in certain domain of beliefs, while other domains of beliefs were homogeneous throughout the study period. There were issues with our study findings with regard to selection bias, construct validity of certain domains of the health belief model, and generalizability to other periods of the pandemic or other study settings. Caveats should thus be considered in the interpretation of the study findings.

CONFLICT OF INTERESTS

The authors have no conflicts of interest associated with the material presented in this paper.

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