Original Article

An investigation into the effect of health belief model-based education on healthcare behaviors of nursing staff in controlling nosocomial infections

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ABSTRACT

Background: Health-care acquired infections are significant given the risks and costs they impose. All previous studies indicate a poor level of knowledge and performance among the nurses in hospital infections; as such, educating nurses can play an important role in infection control. This study aimed at evaluating the effects of the health belief model (HBM) in making nurses adopting health-care behaviors needed to control nosocomial infections (Nis). **Materials and Methods:** The participants of the study were 135 nurses from two hospitals in Mashhad, Iran. A self-administered questionnaire was used to collect data. The questionnaire consisted of seven parts. The intervention group received four 45 min educational programs, both in individual and collective forms. After a 2-month interval, a post-test was conducted to see whether any difference has been resulted. **Results:** There was a significant relationship between knowledge ($P = 0.001$), perceived threat ($P = 0.004$), perceived benefits ($P = 0.001$), and practices ($P = 0.001$) in comparing to control and experimental groups after intervention. For the experimental and control groups, the most frequent cues to action at the preintervention stage were, respectively, related to the period of studying at university and in-service classes. **Conclusion:** According to this study, HBM-based education can increase knowledge, perceived threat, and perceived benefits of nurses. Additionally, it can reduce perceived barriers and improve the control of NIs among nurses.

Key words: Health care, health education, infection control, nurses

INTRODUCTION

Potentially, nosocomial infections (NIs) threaten all communities and may increase mortality and morbidity rate, prolongation of hospitalization, and treatment costs.[1,2] Depending on different populations and definitions, NIs' rate is estimated to vary from 9% to 37%.[3,4]

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According to the reports issued by the WHO, 107 million NIs cases occur annually in hospitals and out of every 20 hospitalized patients one suffers from NIs. Unfortunately, 99,000 deaths have been reported from the infections, which cost approximately 26–32 billion dollars annually.[5]

According to previous studies, in the context of Iran, the amount of NIs varied between medical units range from 3.9% to 34.0%.[6,7] Afhami *et al.*[8] reported that ventilator-associated pneumonia was 21.6%, or 9.96 episodes per 1,000 ventilator

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days among teaching hospital in Tehran. Another study was conducted in Iran by Masoumi Asl[9] has showed the same. The infection rates in 100 Iranian hospitals from 2007 to 2010 were 0.6%, 0.87%, 0.96%, 1.1%, respectively (range 0.2% to 5.7%). The mean extra length of hospitalization as a result of all main kinds of nosocomial infections was 6.62 days.

The most common NIs occurring in hospital settings are related to surgical wounds, urinary tract, respiratory, blood stream, and other soft tissue infections.[10]

Hand hygiene among hospital personnel could prevent an estimated 15% to 30% of the hospital-acquired infections.[11] However, one study revealed that overall hand hygiene compliance was 6.4% in Iranain Hospital,[12] as a result adherence to hand-hygiene among healthcare workers is low.[13] Nevertheless, these contagious infections can be easily prevented by hand-hygiene promotion.[14]

Thus, aforementioned studies are those which demonstrated that necessitate for strategies to develop infection-control procedures to prevent an increase in these Nis.[15] Different methods such as appropriate hand hygiene, skin antisepsis, and wearing gloves and masks are among usual recommendations to prevent NIs. Nurses can prevent these infections through using replacement infusion sets, taking precautionary measures, isolating infected patients, applying the principles of standard precautions, preventing accidental hand contacts with needles, and avoiding exposure to infectious fluids.[16] Nurses have significant roles on increasing awareness on infection-control issues and motivate staff to improve practice.[17] Hinkin and Cutter study conducted on the nursing students' knowledge in the field of infection control behaviors stresses the importance of continuing education for health-care workers and adherence to the standards by raising knowledge.[18] Also, in Payghan's study, the need for training programs and interventions through infection-control measures among the medical staff has been emphasized.[19] In another study, hand hygiene was not well performed by a large number of nurses and they had a moderate attitude.[20] The study of Yaghubi *et al*. in Iran showed a low level of knowledge and poor performance in infection control among the critical care nurses and stresses the need for education.[21] Abdollahi *et al*. study also reports the same results.[22] Therefore, the need for training in this field is greatly felt.

In our knowledge, the role of education in the prevention of hospital-acquired infections is significant[23] and many studies now employ health behavior change models to guide the development of health interventions with the aim of changing behaviors.[24] Research in behavioral science needs a theory-based intervention, and applying the theory in order to develop effective behavioral interventions is crucial.[25]

HBM is a psychological model which attempts to explain and predict health behaviors. It has six constructs as follows: perceived threat (possibility of facing the disease), perceived severity (beliefs about the disease outcomes), cues to action (including internal and external stimuli), perceived barriers (cost and obstacles which prevent us from doing a behavior), perceived benefits (of understand the benefits of adapting a new behavior), and self-efficacy (one's ability to perform successfully the recommended behavior.[26,27]

The model has been tested on different populations to clarify different types of health behavior. For example, it has been employed in studies that focused on predicting the participation rate of populations in vaccination programs and screening individuals for flu and high blood pressure, quitting smoking, and doing and improving behaviors related to exercise and nutrition.[28] This model is very good for prevention-based programs and is more suitable than the other models in this field. Therefore, the HBM has been used in this study as a framework. Thus, this study aimed at exploring the influence of HBM-based education on NI-related behaviors of nurses working in two hospitals of Mashhad, Iran.

MATERIAL AND METHODS

Participants

This is a quasi-experimental study with pre-and post-test and a control group.

There were only two hospitals in Mashhad under the coverage of Armed Forces: Imam Hossein Hospital and Shams-o-Shomoos Army Hospital. All the nurses of the aforementioned hospitals were included in the sample study. Purposeful sampling methods and census method were used to choose 135 nurses showing least nursing qualifications. In the pretest, questionnaires have been completed by the nursing staff in both hospitals (135 samples) vie a self-report method at the workplace. Attaining the score of 70 (according to the KAP pretest study) in the pretest was the deciding factor for determining the intervention samples in Shams-o-Shomoos Hospital.

It should be mentioned that Army Hospital has been selected as the experimental group for a better evaluation of the intervention results in the framework of the model, since it has provided less training on the issue of NI control and prevention and also because it has healthcare workers.

Inclusion criteria were applied in the intervention group, and finally, 35 subjects were selected for the experimental group, and 65 subjects in Imam Hossein Hospital as the control group.

Assuming that $\sigma_1^2 = \sigma_2^2 = \sigma^2$ 2 and using the effect size index and Cohen's 1998 formula $(d = \frac{\mu_1 - \mu_2}{\sigma})$, the sample size formula is as follows:

$$n = \frac{(k+1)\sigma^2\left(Z_{\frac{\alpha}{2}} + Z_{\beta}\right)^2}{k(\mu_1 - \mu_2)^2}$$

Considering that $k = 2$ and $d = 0.76$, therefore

$$n = \frac{3 \times 10.49}{2 \times (0.76)^2} = \frac{31.47}{2 \times 0.5776} = \frac{31.47}{1.1552} = 27.24 = 28$$

Hence, 28 samples in the second group and 56 samples in the first group are calculated. Therefore, by considering the drop-outs, 35 subjects are placed in the experimental group and 65 subjects in the control group.

The ethics of the study included: getting permission from the participants, making sure that the data would remain confidential, and observing honesty and integrity during data collection. Ethical considerations of the study were based in particular on the principle of benefit for the patient. Ethics Committee of Baqiyatallah University has approved of this project.

Measures

The study tool was the self-made questionnaire. Data were collected using a self-administrated questionnaire including two sections.

The first section of the questionnaire consisted of items on demographic information of the participants including sex, age, marital status, working shifts, education, professional status, job experience, receiving antibody titer, and vaccination.

The second part of the questionnaire included three different subsections.

Subsection 1 was about knowledge of the participants and included 23 different questions. Five of the questions were about the infection and its mode of transmission, source of infection, prevalence, prevention methods, and nurses' roles. Eight of the questions evaluated safe injections and participants' awareness of standard precautions in the field. Five questions were about hand washing and the rest five questions were about bandaging knowledge. The maximum and minimum scores attainable in the section by the participants were 23 and 0, respectively. Higher the obtained scores, higher the participants' level of knowledge was considered.

Subsection 2 included 11 questions about perceived threats (susceptibility and perceived severity) of nurses about the outcomes of NIs. Also, nine questions were related to the perceived benefits of adopting standard precautions against infections. Other nine questions of the subsection had to do with the obstacles to adopting a new behavior (perceived barriers).

Subsection 3 consisted of items on self-efficacy. The 11 items of the subsection evaluated the amount of individual's confidence and their ability to control and prevent NIs. These factors were assessed as weak, medium, and good.

The scores obtained for the HBM questions with a 5-choice Likert scale, excluding self-efficacy, ranged from zero (strongly disagree) to four (strongly agree). Therefore, the scores obtained for perceived barriers and benefits and perceived threats could range from 0 to 36 and 0 to 44, respectively. For the self-efficacy questions, the score range was from 0 to 33.

Concerning questions of performance, there were 13 5-choice questions ('always' with a score of 4 and 'never' with a score of 0) about washing hands, duration and method of drying them, disposal of needles after use, how to use the needle cap after using the needle, vaccination and antibody titers, standard tips on bandage, injections, washing hands, and encountering discharges during work. Also, four question were 4-choices (0 and 1 score). (Correct questions were scored one and incorrect ones were scored zero.) The score range was from 0 to 56.

Validity

Having designed the questionnaires through reading books, articles, and literature they were given to 15 university professors such as University of Medical Sciences in Mashhad, Sabzevar, Tarbiat Modarres University, and Baqiyatallah University. Afterwards, their expert comments and suggestions were gathered. The questionnaire was finalized after considering the comments and applying necessary changes, and was approved by teachers and specialists.

Reliability

To assess the repeatability of the questionnaire test/re-test was used. Thus, a questionnaire was given to the 15 subject under study, who completed it in person. Two weeks later, the questionnaires were given to the same subjects with certain codes. The results were analyzed, and the correlation coefficient for knowledge was calculated at 95%, perceived benefits at 0.76, performance at 0.84, and self-efficacy at 95%. It should be noted that the range of the correlation is between zero and one, with more than 0.75 indicating a good level of stability, between 0.5 and. 075 average, and less than 0.5 a poor level of correlation. Few writers have also considered the range 0.5–0.6 as acceptable.[29]

Intervention program

The study was implemented in three steps. During the first stage, one of the researchers introduced himself and explained the purpose of the study to the participants. Then, pretest questionnaires were completed and 35 respondents were considered for further investigation about the inclusion criteria. In order to achieve better results, those who did not have much training in preventing NIs were selected. Inclusion criteria were:

- Having at least a diploma in nursing
- Consent to participating in research
- A working experience of at least 3 months in the sector.

Exclusion criteria were:

- Unwillingness to continue with the project
- Vacation, illness and a lack of cooperation during the project.

During the second stage (intervention stage), an educational program was implemented based on the results of the pretest and the HBM framework.

The training program was held at the hospital's training classes during the three work shifts, in four sessions lasting 45 min each. The sessions were done in person and in the morning, afternoon, and night work shifts. Each session was dedicated to one HBM construct including perceived threat, benefits and barriers, self-efficacy, and performance. The content of the program focused on NIs, their consequences and threats, importance of safety procedures, taking safety measures when washing hands and injecting, dressing care, and prevention of spreading NIs based on HBM components and elements.

Although the results of the pretest revealed a high level of perceived severity about hospital infections among the nursing staff, the study attempted to decrease the barriers to health behaviors in the content of the programs and instead, to introduce the nurses to the benefits of health behaviors. At the end of each session, a few minutes were devoted to Questions and Responses and resolving ambiguities. During training, a pamphlet was given to each participant in order to encourage people toward health behaviors. The pamphlet was based on resources, new books, and articles with guidelines for hand washing, injections, and dressings. Also, the benefits and barriers in the way of health behaviors were specified and several strategies to reduce perceived barriers were discussed. During the stage, done groups and individuals were trained on a face-to-face basis using pamphlets and educational posters.

After two months, the initial questionnaire was once again completed by both the experimental and control groups, and thus the post-test was administered. The participants had been given 30 min to complete the questionnaire.

Participants' behaviors were assessed using a Likert scale format ranging from 'always', 'often', 'sometimes', 'rarely', and 'never'. The highest and lowest scores were assigned to 'always' and 'never' answers, respectively. Correct and incorrect answers were given one and zero points, respectively.

Statistical analysis

Data were analyzed using descriptive statistics (mean and standard deviation) of SPSS 16. For control groups, match-independent T-Test was used and for checking the relationship between sample characteristics. In order to check the belief-health pattern, partial correlation test was used. All values were set at 0.05.

RESULTS

Demographic data

In terms of homogeneity, the results of the Chi-square test showed no significant relationship between the intervention and control groups regarding demographic variables (except age, sex, and work position). As a result, the two groups were homogenous. Most of the participants in the intervention and control groups were 40 to 50 and 20 to 30 year old, respectively. Sixty percent of the intervention group and 34% of the control group were males.

All participants of the control group were nurses while only 49% of the experimental group was nurse. There was no statistically significant relationship between HBM factors such as knowledge, perceived threat, self-efficacy, and practice and variables of age, sex, and work position ($P > 0.05$).

To assess the level of knowledge about how to prevent and control NIs, pre- and post-test mean scores of each group were compared and there was statistically significant difference between the two groups [Table 1]. The results of the independent *t*-test showed a significant difference between two groups in terms of the perceived threat and before and after the educational intervention [Table 2].

Moreover, in this study two groups showed a significant difference before and after the educational intervention regarding the perceived barriers and benefits.

There was a statistically significant differences between the scores obtained for perceived barriers [Table 3]. The results of independent T-test comparing the obtained mean

Table 1: Comparison of mean (SD) scores of knowledge scale and overall knowledge in studied groups

Dimension	Groups (mean±SD)		Independent *t*-test *P* value
	Intervention	Control	
General			
Before	2.94±0.68	3.50±1.11	0.008
After	3.71±0.92	1.10±3.56	0.51
Differences between mean	0.77±0.97	0.06±0.55	*
Dressing			
Before	2.05±0.76	3.19±1.02	*
After	3.17±0.95	3.18±1.04	*
Differences between mean	1.43±1.07	0.09±0.49	*
Injections			
Before	5.23±1.22	4.73±1.43	0.06
After	5.88±1.34	4.80±1.50	*
Differences between mean	0.60±1.09	0.61±0.39	*
Hand washing			
Before	2.64±0.88	3.55±1.03	*
After	3.88±0.99	3.52±1.00	0.08
Differences between mean	1.26±1.02	0.30±0.43	*
General knowledge			
Before	12.82±1.62	14.88±2.16	*
After	16.82±2.17	15.26±1.9	*
Differences between mean	3.94±1.89	0.38±1.5	*

SD=Standard deviation. 0.0001=*

Table 2: Comparison of mean (SD) perceived threats scores in studied groups

Steps	Groups (mean±SD)		Independent *t*-test *P* value
	Intervention	Control	
Before	35.0±4.43	37.4±4.63	0.13
After	37.7±4.34	38.0±4.47	0.7
Differences between mean	2.7±1.97	0.63±1.7	0.004

SD=Standard deviation

Table 3: Comparison of mean (SD) perceived benefits and barriers scores of observing the precautions in NIS control in both groups

Perceived benefits	Groups (mean±SD)		Independent *t*-test *P* value
	Intervention	Control	
Perceived benefits related to nurses			
Before	18.71±2.73	19.16±2.96	0.4
After	21.22±2.17	19.20±2.90	*
Differences between mean	2.54±2.36	0.03±0.82	*
Perceived benefits related to patients			
Before	8.85±1.94	10.15±1.66	*
After	10.2±1.60	10.25±1.59	0.8
Differences between mean	1.37±1.62	0.10±0.71	*
Perceived barriers related to nurses			
Before	20.06±2.21	18.42±2.84	*
After	17.91±2.68	18.45±2.84	0.3
Differences between mean	2.68±2.32	0.03±0.61	*
Perceived barriers related to hospital			
Before	9.94±1.64	9.71±1.74	0.7
After	9.05±1.96	9.81±1.60	0.05
Differences between mean	0.88±0.99	0.10±0.80	*

SD=Standard deviation. 0.001=*

scores for self-efficacy in both groups before and after the educational intervention showed no statistically significant differences.

Before intervention, it was known that control and case groups gained most of their information through schools and books (43%) and educational interventions (54%). However, after intervention both groups acknowledged that educational intervention was the most appropriate method to gain information ($P = 0.001$). In terms of cues to action, before the intervention experimental and control groups mentioned schools and books (43%) and in-service education (54%), respectively, as their main sources of obtaining information. However, both experimental (55%) and control (54%) groups referred to in-service education as their main information source.

The best time of training for both groups was before and after the educational intervention. The best way to inform intervention groups was distributing educational booklets. However, for the control group it was hospital posters.

There was a significant difference between the scores of the two groups regarding applying standard behaviors in controlling Nis ($P = 0.0001$).

In terms of the performance of the nursing staff in controlling NIs, the following results were found: (a) Considering hand-washing scores obtained for the experimental and control groups before and after the intervention phase, we found a significant relationship (using an independent *t*-test) ($P = 0.01$), (b) considering dressing scores obtained for the experimental and control groups before and after the intervention phase, there was no significant relationship between the two groups, ($P = 0.07$), and (c) considering IV injection performance scores obtained for the experimental and control groups before and after the intervention phase, there was a significant relationship between the two groups ($P = 0.008$) [Table 4].

There was a significant difference between the scores of both groups regarding washing hands and injection before and after educational interventions. However, there was no significant difference in wound dressing [Table 4].

DISCUSSION

Based on the results of this study, it can be observed that HBM-based educational interventions are effective in improving the knowledge level of nursing staff about NIs control especially in hand washing and injections.

These findings are consistent with the results of other studies such as Suchitra and Lakshmi Devi (2007)[30] and Ghaffari[31] based on which education can efficiently improve the knowledge of participants. Also, Motamedi *et al.* following HBM-based interventions showed that there is a great improvement in the knowledge level of school students about preventive health behaviors against leishmanias.[32] We have suggested that group base intervention can improve knowledge of health care workers about medical procedures.

Considering the effects of HBM-based interventions on the perceived threat of NIs in the intervention group, the results of the study are consistent with the theory-based studies by Gorman *et al.*[33] and Tehrani *et al.*[34] Contrary to this study, Hashemi Parast's study did not report a significant impact of the application of HBM-based education on the perceived susceptibility of the prevention of urinary tract infections;[35] perhaps urinary tract infection is not a sensitive issue among mothers.

The findings of this study indicated that the HBM is a valuable framework for planning intervention programs.

Table 4: Comparison of mean (SD) practice dimension scores total practice in studied groups

Dimension	Groups (mean±SD)		Independent *t*-test *P* value
	Intervention	Control	
Dressing			
Before	4.91±1.70	5.96±1.66	0.03
After	5.07±1.49	6.0±1.54	0.008
Differences between mean	0.14 (1.72	0.23±0.98	0.7
Intravenous injections			
Before	14.37±2.96	15.75±2.97	0.04
After	16.57±2.60	16.59±3.16	0.09
Differences between mean	2.20±2.54	0.80±2.00	0.008
Washing hands			
Before	18.85±4.03	19.23±3.19	0.17
After	20.42±2.66	19.54±2.90	0.17
Differences between mean	1.57±3.01	0.30±1.37	0.01
Overall rating			
Before	37.88±5.78	40.4±6.15	0.04
After	41.9±5.42	40.08±6.11	0.35
Differences between mean	4.05±4.95	0.38±3.00	0.0001

SD=Standard deviation

Using HBM to adopt the most appropriate childbirth method, Rahimikian *et al.*[36] focused on educating pregnant women. The study indicated a significant difference between two experimental groups regarding the perceived threat and perceived susceptibility. The HBM was a useful model in the interpretation of community response to infection disease.[37] By highlighting the severity of a condition in society, people would find themselves at an increased risk and these feelings may lead to a series of health related actions. Based on the findings of this study, it can be concluded that HBM-based education increases perceived benefits of doing health-related practices and NIs control. Also, it reduces perceived barriers of doing health-related practices and NIs control in the intervention group. The study conducted by Norouzi *et al.*[38] suggested that perceived benefit is the most important predicting factor in adopting the physical activity. Also, the studies stated that HBM-based interventions are highly effective in enhancing the perceived benefits, which is consistent with our results. Also, talking about the application of the model for breast self examination (BSE) behaviors, Karimy *et al.*[39] noted that in the studied samples the level of perceived benefits was low and there was an increase in the level after intervention. Anderson *et al.*[40] used HBM to reduce the perceived barriers of healthy eating behaviors of female students. The researchers concluded that the model is effective.

Also, Shalanski[41] concluded that perceived barriers are the most important obstacle to adopting new behaviors. This model is effective in self-care and preventive behaviors. In education, special emphasis on perceived barriers should be taken.

Practically speaking, it is concluded that HBM-based educational interventions improve the performance of nursing staff regarding NIs control. There were no significant changes in bandaging-related scores which can be accounted for by the fact that in nursing care, bandaging is always treated with greater sensitivity. Moreover, in terms of injections and hand washing it should be noted that given the fact that nurses face serious risks of infection transmission, they tend to improve their performance and adopt safety precautions. The findings are consistent with Kaewchana *et al.*[42] and Farzan *et al.*[43] Therefore, training centers play an important role in the prevention of Nis.[23]

Postintervention self-efficacy scores showed no statistically significant difference. The results are inconsistent with Rahimikian *et al.*[36] Regarding the influence of different factors on self-efficacy, self-confidence achieved through experience is one of the aspects that can be accounted for by these differences. Other studies indicated that education can improve preventive self-efficacy.[44] Skill development on health-care workers was effective in increasing self-efficacy of NIS control and prevention. The results of this study can be used to develop guidelines for the prevention of nosocomial infection and educational interventions. Additionally, one must also consider other environmental and preventive health measures.

Limitation

Using self-report tools and a small sample size are among the limitations of the study. A longitudinal study is needed to assess the impact of interventions.

CONCLUSIONS

The study's hypothesis that training in the context of HBM construct is effective on nurses' health behaviors concerning NIs-control was confirmed. Considering the findings of the study, educating nursing staff in HBM frameworks results in an increase in their knowledge, perceived threat, increased perceived benefits, and reduced perceived barriers and can improve their NIs-related preventive and controlling practices. Thus, increasing knowledge, attitudes, and beliefs are among the effects of this study which have been obtained in the context of HBM construct.

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Conflicts of interest

The author(s) declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

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