

The effects of health belief model-based intervention on nurses' sterilizing practices when moistening surgical instruments

Los efectos de la intervención basada en el modelo de creencias de salud en las prácticas de esterilización de las enfermeras al humedecer los instrumentos quirúrgicos

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Abstract

Objective: We investigated the effects of the Health Belief Model (HBM)-based intervention on nurses' behaviors in terms of keeping surgical instruments moist. **Materials and methods:** Pre- and post-training surveys about instrument moistening were conducted with the same 356 nurses from a hospital in China. Both of the surveys contained questionnaire concerning general knowledge relating to instrument moistening, perception scale-based questions concerning the same issue, and an inspection form concerning the implementation of moistening procedures. Three months' training was provided for the nurses. **Results:** After training, the nurses' knowledge, attitudes, beliefs, and behaviors for instrument moistening were improved. **Conclusions:** The HBM-based intervention can bring about a significant improvement in nurses' compliance with surgical instrument moistening requirements, and corresponding improvements in instrument cleanliness and patient safety.

Keywords: Surgical instruments. Health belief model. Self-efficacy. Surveys and questionnaires.

Resumen

Objetivo: Investigar los efectos de la intervención basada en el modelo de creencias de salud en los comportamientos de las enfermeras en términos de mantener húmedos los instrumentos quirúrgicos. **Método:** Se realizaron encuestas previas y posteriores a la capacitación sobre la humectación de instrumentos con las mismas 356 enfermeras de un hospital en China. Ambas encuestas contenían un cuestionario sobre el conocimiento general relacionado con la humectación del instrumento, preguntas basadas en escalas de percepción sobre el mismo tema y un formulario de inspección sobre la implementación de los procedimientos de humectación. Se proporcionó una formación de 3 meses a las enfermeras. **Resultados:** Después de la capacitación se mejoraron los conocimientos, las actitudes, las creencias y los comportamientos de las enfermeras para la humectación del instrumento. **Conclusiones:** La intervención basada en el modelo de creencias en salud puede generar una mejora significativa en el cumplimiento de los requisitos de humectación del instrumental quirúrgico por parte de las enfermeras, y las correspondientes mejoras en la limpieza del instrumental y la seguridad del paciente.

Palabras clave: Instrumental quirúrgico. Modelo de creencias sobre la salud. Autoeficacia. Encuestas y cuestionarios.

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Introduction

Thorough cleaning of surgical instruments is the key to successful disinfection and sterilization¹. However, in practice, owing to various reasons, surgical instruments might not always be collected and cleaned timeously after use, resulting in the surfaces of instruments and those of articulation, grooves, slits, and lumen dry and remaining contaminated. The longer these surfaces remain uncleaned, the more difficult it is to remove the contaminants. Dried organic residue such as blood stains, sticky fluids, and proteins adhering to these instruments can easily form a biofilm, which is resistant to disinfection procedures². The guidelines stipulate that the operating room staff using surgical instruments shall decontaminate these instruments and moisten them in a timely manner after use to improve cleaning efficiency and prolong the service life of the instrument³⁻⁵.

The moisturizing methods commonly used by the operating room staff using surgical instruments include soaking the instrument with cleaning solution, rinsing the instrument with normal saline, or spraying a moisturizing agent on the instrument⁶⁻⁸. After the instrument is delivered to the central sterile supply department (CSSD) of the hospital, standard cleaning procedures including brushing and ultrasonic cleaning must be carried out³.

In our study, we examined a sample of instruments, and found that some were not moistened immediately after use or were not moistened properly; residues were especially pronounced around the articulation, grooves, and lumen. The contaminants on the collected instruments were found to have dried severely, making cleaning difficult. Our survey among the nurses in our hospital shows that some of the nurses were not fully aware of the necessity of having the instruments moisturized immediately after use, and were not fully acquainted with the method of moisturizing. The results of this study demonstrate the need for raising nurses' awareness of the importance of keeping surgical instruments moist to increase decontamination efficiency and raise the moistening and cleaning pass rates. The Health Belief Model (HBM) is an important theoretical model based on social psychology designed to explore the influence of individual subjective psychological processes on people's behavior, which has been widely used in behavioral research^{9,10}. The aim of this study is to investigate the effects of HBM-based intervention on nurses' behaviors in terms of keeping surgical instruments moist.

Materials and methods

Participants

A total of 356 nurses from the clinical departments of a Tertiary A hospital in Chengdu, Sichuan, China participated in this study between August and December 2019. Inclusion criteria: the nurses who were working in the clinical departments of the hospital and were responsible for moistening the surgical instruments after use. Exclusion criteria: (1) the nurses who were not responsible for moistening the surgical instruments after use; (2) the nurses who did not agree to participate in our study.

Theory

The HBM, first proposed by the US psychologist Hochbaum and revised by Rosenstock¹¹, consists of five components: perceived severity, perceived susceptibility, perceived benefits, perceived barriers, and self-efficacy. In the analysis of nurses' behaviors for keeping surgical instruments moist, these HBM components can be translated into the following: "perceived susceptibility that surgical instruments were not kept moist," "perceived severity of not keeping surgical instruments moist," "perceived benefits of keeping surgical instruments moist," "perceived barriers for keeping surgical instruments moist," and "increase self-efficacy in keeping surgical instruments moist."

Survey tools

Pre- and post-training surveys about the surgical instrument moistening protocol were distributed among 356 nurses. Both of the surveys contained three parts: (1) questionnaire concerning general knowledge relating to keeping surgical instruments moist; (2) perception scale-based questions concerning the same issue; and (3) an inspection form concerning the implementation of moistening procedures. The pre-training survey was conducted in August 2019. The same 356 nurses then received 3 months' training on keeping surgical instruments moist from September to November 2019, and then completed the post-training survey in December 2019.

The questionnaire concerning general knowledge relating to keeping surgical instruments moist consisted

of 10 questions regarding the definition of biofilm, the optimal time to moisten the instrument, where the moisturizing agent should be sprayed on when adopting spraying method, the ratio of the volume occupied by the instruments in the collection box to the volume of the collection box when adopting spraying method, correct moisturizing method for keeping lumen instruments moist, what operating room staff should do on surgical instruments after surgery, benefits of keeping surgical instruments moist, moisturizing methods, what dried blood on the surface of the instrument will result in if the instrument was not moistened after use, and protection measures for occupation exposure. The questionnaires contained single-choice and multiple-choice questions. A correct answer earned 10 points and an incorrect answer earned 0 point. The full marks of this questionnaire were 100.

The design of our perception scale in terms of keeping surgical instruments moist was based on the HBM, as well as relevant literature, books, and reports. It consists of 5 constructs: perceived severity of not keeping surgical instruments moist (6 questions), perceived susceptibility that surgical instruments were not kept moist (6 questions), perceived benefits of keeping surgical instruments moist (8 questions), perceived barriers for keeping surgical instruments moist (9 questions), and self-efficacy in keeping surgical instruments moist (7 questions) (total 36 questions). The 5-point Likert scale was used for scoring. For the questions about perceived severity, perceived susceptibility, and perceived benefits, 5 = Very good, 4 = Good, 3 = Average, 2 = Poor, and 1 = No knowledge; for the questions about perceived barriers, 5 = Strongly agree, 4 = Agree, 3 = Somewhat agree, 2 = Somewhat disagree, and 1 = Disagree; for the questions about self-efficacy, 5 = Extremely likely, 4 = Likely, 3 = Somewhat likely, 2 = Somewhat unlikely, and 1 = Unlikely. The scale-level content validity index was 0.833, construct validity (Kaiser–Meyer–Olkin index) was 0.933, Bartlett's test of sphericity value was 12136.637, $p < 0.001$, and Cronbach's alpha coefficient of internal consistency reliability was 0.911, indicating a high level of reliability and validity.

The inspection form concerning the implementation of moistening procedures was composed of 2 sections. Section 1 consisted of the questions regarding which campus and which department that the respondent worked in, as well as the respondent's age, length of service, educational background, and job title. Section 2 contained 4 open-ended questions regarding name of the surgical procedure, name of

the surgical pack, the end date and end time of the surgery, and time of moistening the instruments, and 11 close-ended questions regarding the place of moistening the instruments, job position of the person responsible for moistening, moistening method, moisturizing liquid, who supplied the moisturizing liquid, whether the moisturizing liquid was prepared in conformity with the manufacturer's instruction, type of the moisturizing liquid for spray, spray methods, and where the moisturizing liquid was sprayed on, the reasons why moistening procedures failed, and the reasons why the instruments were not moistened.

Data collection

The online questionnaires were produced through WJX, a Chinese survey app. A total of 356 pre-training questionnaires were distributed, and 356 pre-training questionnaires were returned, of which 351 pre-training questionnaires were valid; thus, the valid response rate was 98.60%. Health instructors from CSSD delivered the 3 months' training to the 356 nurses. Intervention measures included regular seminars on the rationale behind surgical instrument moistening procedures, optimal time for moistening, moisturizing methods, and on minimizing occupational exposure during moistening. In addition, brochures describing the importance of keeping instruments moist were distributed to the 356 nurses, videos about keeping instruments moist were provided for them, and a follow-up session was carried out every week during the 3-month training period. After the 3 months' training period, the post-training questionnaires were distributed to the 356 nurses, of which 356 valid post-training questionnaires were returned (valid response rate was 100%).

Statistical methods

Data analysis was conducted in SPSS 21.0. The measurement data was expressed as the standard deviation of the mean. t-test and linear regression analyses were conducted on the pre- and post-training effect data. $p < 0.05$ indicates a statistically significant difference.

Results

Since 351 of the 356 completed pre-training questionnaires were valid, even though all 356 completed

post-training questionnaires were valid, the results below are based on a sample size of n = 351.

Demographic data

The 351 nurses' average length of service was (7.60 ± 8.204) years. Of them, 275 (78.35%) had bachelor's degree qualifications, and 169 (48.15%) were nurse practitioners, as shown in table 1.

Change in nurses' knowledge, attitudes, and beliefs after training period

In general, the nurses' knowledge, attitudes, and beliefs concerning surgical instrument moistening improved during the course of the training period, as evidenced by increases in total scores and scores for individual components, as shown in tables 2 and 3.

Influence of job title, educational background, and length of service

The results in table 4 indicate connections between the nurses' degree of knowledge before the training period, and their attitudes and beliefs concerning surgical instrument moistening as well as their educational background. The higher their educational attainment, the more positive their attitude toward moistening, and the higher their knowledge score. The knowledge score after training is mainly a reflection of their attitude toward moistening. The results in table 5 show that the nurses' attitudes toward moistening before training are associated with the length of service, educational background, and knowledge of moistening. The nurses with longer lengths of service, higher educational attainment, and greater knowledge of surgical instrument moistening generally showed a more positive attitude towards moistening. After training, the main determinant of nurses' attitudes towards surgical instrument moistening appears to be their knowledge of moistening.

Change in nurses' behaviors during training

Before training, moistening implementation and pass rates among the nurses were 57.25% and 32.38%, respectively. After training, moistening implementation and pass rates had increased to 96.54% and 92.16%, respectively, which revealed a significant improvement in the nurses' behaviors in keeping surgical instruments moist.

Table 1. Demographic data (n = 351)

Item	Number	Assignment	Percentage
Length of service			
< 1 year	15	1	4.27
1-5 years	185	2	52.71
6-10 years	57	3	16.24
11-15 years	39	4	11.11
16-20 years	25	5	7.12
> 20 years	30	6	8.55
Educational background			
Junior college diploma and below	60	1	17.09
Bachelor	275	2	78.36
Master and above	16	3	4.56
Job title			
Nurse	94	1	26.78
Nurse practitioner	169	2	48.15
Supervisor nurse and above	88	3	25.07

Table 2. Comparison of nurses' knowledge, attitudes, and beliefs before and after training about keeping surgical instruments moist (n = 351, $\bar{x} \pm S$)

Time	Knowledge of keeping surgical instruments moist	Attitudes and beliefs in keeping surgical instruments moist
Before training	67.48 ± 12.805	139.93 ± 15.145
After training	89.27 ± 16.844	151.57 ± 15.264
t-value	-17.046	-10.143
p-value	0.001	0.001

Discussion

Zhang et al.¹² pointed out that modern health education, the purpose of which is to change people's behavior, focuses on integration and union of "knowledge, attitudes, beliefs and behaviours." Knowledge is essential; without it, it is impossible for the reader to exert oneself when they do not know how their exertions are to be directed. Attitude is the driving force for behavior change. Our study demonstrates that the nurses had developed a more comprehensive understanding of the necessity of keeping surgical instruments moist, and that the training period led to an improvement in their attitudes and beliefs regarding the same issue. Regardless of their length of service and educational background, their awareness of the importance of keeping surgical instruments moist had increased noticeably during the 3-month period.

Table 3. Comparison of Scores of the HBM constructs before and after training about keeping surgical instruments moist

Time	Perceived severity	Perceived susceptibility	Perceived benefits	Perceived barrier	Self-efficacy
Before training	26.99 ± 3.446	24.50 ± 1.998	36.54 ± 4.186	22.78 ± 8.509	29.12 ± 4.662
After training	28.14 ± 2.868	27.70 ± 2.901	38.73 ± 2.229	31.22 ± 8.509	32.88 ± 2.643
Glass delta	0.40	1.10	0.98	0.99	1.42
t-value	-2.974	-17.000	-2.429	-13.148	-4.070
p-value	0.003	0.001	0.016	0.002	0.001

Table 4. Multivariate analysis of knowledge score

Variable	Pre-training				Post-training			
	b-value	b-value standard error	t-value	p-value	b-value	b-value standard error	t-value	p-value
Length of service	2.535	1.333	1.902	0.058	-1.199	1.075	-1.115	0.266
Educational background	3.041	1.329	2.288	0.023	1.627	2.491	0.653	0.514
Job title	3.175	2.529	1.255	0.210	-1.012	2.181	-0.464	0.643
Attitude and belief score	3.766	1.385	2.719	0.007	1.557	0.681	2.286	0.023

Table 5. Multivariate analysis of attitude and belief score

Variable	Pre-training				Post-training			
	b-value	b-value standard error	t-value	p-value	b-value	b-value standard error	t-value	p-value
Length of service	2.899	1.434	2.022	0.044	-1.061	0.907	-1.170	0.243
Educational background	3.474	1.733	2.005	0.046	2.931	1.793	1.635	0.103
Job title	3.485	1.819	1.915	0.056	-3.002	1.713	-1.752	0.081
Knowledge score	3.993	1.379	2.896	0.004	1.078	0.503	2.144	0.041

The results in tables 2 and 3 show that many of the nurses lacked the necessary knowledge of surgical instrument moistening before training, and also had poor attitudes and negative beliefs. The shorter the length of service and the lower the educational attainment, the poorer their knowledge and the more negative their attitude. During the study, we established a multidisciplinary team composed of head nurses from in-patient operating rooms, CSSD, and outpatient operating rooms. The team explained to the nurses the importance, benefits, and operating procedures of, and precautions surrounding, surgical instrument moistening¹³. For the practical training sessions, the team developed a standard operating procedure for keeping instruments moist and produced

on-site guidance for the nurses responsible for instrument moistening. For theoretical training, the team first provided training for the key nurses of the clinical departments, and then such nurses provided training for other nurses in their respective departments, thus accelerating the dissemination of knowledge of surgical instrument moistening procedures across the nursing pool. For departments with more advanced personnel coordination, such as the department of obstetrics, the CSSD staff members were reassigned to these departments to handle moistening procedures. In summary, this study has shown that HBM intervention can lead to significant improvements in surgical instrument moistening implementation and pass rates among nursing personnel.

Conclusions

The findings of this case study indicate that HBM-based intervention can bring about a significant improvement in nurses' compliance with surgical instrument moistening requirements, and corresponding improvements in instrument cleanliness and patient safety. However, this study has one major limitation: because the intervention lasted only for a short period (3 months), we are unable to determine the long-term effect of the intervention. A follow-up study entailing a longer intervention period is therefore required.

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Conflicts of interest

The authors declare no conflicts of interest.

Ethical disclosures

Protection of human and animal subjects. The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code

of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of data. The authors declare that no patient data appear in this article.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

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