

# Using the health belief model to analyze nurses' perception toward their behaviors for keeping surgical instruments moist: a cross-sectional study

*Uso del modelo de creencias en salud para analizar la percepción de las enfermeras sobre sus comportamientos para mantener húmedos los instrumentos quirúrgicos: un estudio transversal*

Yanhua Chen<sup>1,2</sup>, Juan Hu<sup>1,2</sup>, Yan Huang<sup>1,2</sup>, Liangying Yi<sup>1,2\*</sup>, and Ruixue Hu<sup>1,2</sup>

<sup>1</sup>Department of Sterile Processing Nursing, West China Second University Hospital, Sichuan University/West China School of Nursing, Sichuan University;

<sup>2</sup>Key Laboratory of Birth Defects and Related Diseases of Women and Children (Sichuan University), Ministry of Education. Chengdu, Sichuan, China

## Abstract

**Background:** Nurses' perception toward their behaviors for keeping surgical instruments moist has been rarely studied.

**Methods:** The survey which utilized a questionnaire regarding respondent's demographic information and a self-designed nurses' perception-behavior scale for keeping surgical instruments moist was conducted with 360 nurses from a hospital in China. **Results:** Total score of nurses' perception-behavior scale for keeping surgical instruments moist was  $139.93 \pm 15.145$ . Score of nurses' perception-behavior scale for keeping surgical instruments moist varied with age, length of service, and job title, with a statistically significant difference ( $p < 0.05$ ). Length of service was the main factor affecting nurses' perception toward their behaviors for keeping surgical instruments moist. **Conclusions:** Nurses should be offered intensive training on keeping surgical instruments moist due to their inadequate perception on it. The nurses' change in health beliefs and behaviors must be based on developing the right attitude.

**Keywords:** Perception. Surgical instruments. Health belief model.

## Resumen

**Objetivo:** La percepción de los enfermeros sobre sus comportamientos para mantener húmedo el instrumental quirúrgico ha sido poco estudiada. **Métodos:** La encuesta que utilizó un cuestionario sobre la información demográfica del encuestado y una escala de percepción y comportamiento de las enfermeras de diseño propio para mantener húmedos los instrumentos quirúrgicos se realizó con 360 enfermeras de un hospital en China. **Resultados:** La puntuación total de la escala de percepción-conducta de las enfermeras para mantener húmedo el instrumental quirúrgico fue de  $139.93 \pm 15.145$ . La puntuación de la escala de percepción-conducta de las enfermeras para mantener húmedos los instrumentos quirúrgicos varió con la edad, la duración del servicio y el cargo, con una diferencia estadísticamente significativa ( $p < 0,05$ ). El tiempo de servicio fue el principal factor que influyó en la percepción de los enfermeros sobre sus comportamientos para mantener húmedo el instrumental quirúrgico. **Conclusión:** Se debe ofrecer a las enfermeras un entrenamiento intensivo sobre el mantenimiento de la humedad del instrumental quirúrgico por su inadecuada percepción al respecto. El cambio de creencias y comportamientos de salud de las enfermeras debe basarse en el desarrollo de la actitud correcta.

**Palabras clave:** Percepción. Instrumentos quirúrgicos. Modelo de creencias sobre la salud.

### \*Correspondence:

Liangying Yi

E-mail: yiliangying88@163.com

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## Introduction

China's national Health Industrial Standard (version number: WS 310.2-2016) which was released in December 2016 states that the user shall timely remove visible contaminants from medical instruments, implements and articles, and keep them moist as required after use. Guidelines of Association of PeriOperative Registered Nurses of the United States also expressly require keeping instruments moist before cleaning<sup>1</sup>. Failure in timely keeping instruments moist will lead to biofilm formation. Biofilm refers to a collective of bacteria attached to the surface of living or non-living objects and enclosed with bacterial extracellular macromolecules. Biofilm is very difficult to remove after formation<sup>2,3</sup>. According to the previous studies, bacteria may develop on dry contaminants in 4-20 min and biofilm will appear in 2 h. Therefore, contaminants shall be timely removed from surgical instruments after use, and subsequently the instruments shall be sent to the central sterile supply department (CSSD) for cleaning within 30 min. If it is not available, it will be necessary to keep instruments moist<sup>4,5</sup>. However, because of conflicts with work schedule of CSSD, surgical instruments may not be immediately cleaned or sterilized by CSSD staff members after use. If surgical instruments are not kept appropriately moist, tarnish or rusting may occur on the instruments, which will not only affect cleaning quality, but also shorten the normal service life of the instruments<sup>6,7</sup>. According to the initial investigation, only 57.59% of the surgical instruments were kept moist in our hospital, and the nurses did not have adequate perception toward their behaviors for keeping instruments moist. We aimed to use the health belief model to analyze the nurses' perception toward their behaviors for keeping surgical instruments moist. This study will contribute to improve implementation rate of keeping surgical instruments moist.

## Materials and methods

### Setting and participants

The survey was performed with 360 nurses from a grade a tertiary hospital in China during June 1 to August 31, 2019.

### Study design

The health belief model (HBM), first proposed by Hochbaum, and revised by Rosenstock<sup>8</sup>, was the

theoretical base of this study. HBM's 5 components, that is, perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and self-efficacy, were applied to define nurses' perceived susceptibility to instruments not kept moist, perceived severity of instruments not kept moist, perceived benefits of keeping instruments moist, perceived barriers for keeping instruments moist, and self-efficacy in keeping instrument moist<sup>9,10</sup> in analyzing nurses' perception toward their behaviors for keeping surgical instruments moist.

The survey was performed based on an electronic questionnaire regarding respondent's demographic information and a self-designed nurses' perception-behavior scale for keeping surgical instruments moist. The electronic questionnaire was produced through a smartphone application called "WJX." Quick response code of the questionnaire was only shared to the WeChat group for nurses of the hospital. Because WJX is a specialized online questionnaire survey tool and is commonly used in China, we did not test usability and technical functionality of the electronic questionnaire before sharing the quick response code to the WeChat group. Aims and importance of this study and time limit of the investigation were stated in the WeChat group chat. The nurses who were interested in participating in the research study accessed to the questionnaires by scanning the quick response code, and then they filled out the questionnaires voluntarily and anonymously without inputting username and password. Respondents were not provided with any form of incentives to participate in this study.

The questionnaire consisted of 41 questions, and all questions were shown on one page. There were no response options for "not applicable" or "rather not say." Respondents could review and change their answers before submitting the questionnaires. Respondents could scan the quick response code to view the questionnaire again at any time after submitting the questionnaires, but no changes were allowed to their answers after submitting the questionnaire. If respondent did not answer all questions, the questionnaire would not be submitted successfully. We were able to obtain the information of IP addresses and WeChat nicknames of the respondents who successfully submitted the questionnaires. If questionnaires from the same IP address or same WeChat nicknames were submitted multiple times, the first submission would be considered as valid and information from the first submission was analyzed.

The demographic information section was used to gather information about departments where the nurses were working in, and their age, length of service, educational backgrounds, and job titles. The

nurses' perception-behavior scale for keeping surgical instruments moist was designed based on the HBM, with Cronbach's alpha of 0.911 and the great overall consistency. Validity test was performed through the use of content experts. After two rounds of expert consultation, the content validity index of each item ranged from 0.833 to 1.000, and that of universal agreement was 0.852. The nurses' perception-behavior scale for keeping surgical instruments moist covered 5 components and 36 items, of which six items were for the component "perceived susceptibility to instruments not kept moist," six items were for the component "perceived severity of instruments not kept moist," eight items were for the component "perceived benefits of keeping instruments moist," nine items were for the component "perceived barriers for keeping instruments moist," and seven items were for the component "self-efficacy in keeping instrument moist." The 5-point Likert scale was used for scoring, namely, 5 = strongly agree, 4 = agree, 3 = neither agree or disagree, 2 = disagree, and 1 = strongly disagree.

### Data collection

Data were collected through cluster sampling. If respondent did not answer all questions in the questionnaire and did not submit the questionnaire successfully, we would not obtain any information about the unsubmitted questionnaire. A total of 360 questionnaires were distributed, and 360 questionnaires were returned, among which 351 questionnaires were valid. The valid response rate was 97.5%.

### Statistical methods

Data were analyzed in SPSS Version 20.0. The enumeration data were described with frequency (relative frequency), and the measurement data were expressed with mean ( $\pm$ ) and standard deviation (SD). A statistically significant difference ( $p < 0.05$ ) was found through t-test, variance analysis, and multivariable linear regression analysis.

## Results

### Demographic information of the nurses

The 351 nurses' average length of service was  $7.60 \pm 8.204$  years, their average age was  $30.14 \pm 7.327$  years. 275 (78.35%) of them had bachelor's degree qualifications, and 169 (48.15%) of them were nurse practitioners (Table 1).

**Table 1. Demographic information of nurses (n = 351)**

Item	n	Assignment	Percentage
Age (years)			
< 25	68	1	19.37
25-30	160	2	45.58
31-35	54	3	15.39
36-40	36	4	10.26
41-45	12	5	3.42
46-50	12	6	3.42
> 50	9	7	2.56
Length of service (years)			
< 1	15	1	4.27
1-5	185	2	52.71
6-10	57	3	16.24
11-15	39	4	11.11
16-20	25	5	7.12
> 20	30	6	8.55
Educational background			
Junior college diploma or below	60	1	17.09
Bachelor	275	2	78.35
Master or above	16	3	4.56
Job title			
Nurse	94	1	26.78
Nurse practitioner	169	2	48.15
Supervising nurse	86	3	24.50
Associate senior nurse	2	4	0.57

### Score of nurses' perception-behavior scale for keeping surgical instruments moist

For the 351 nurses, total score of nurses' perception-behavior scale for keeping surgical instruments moist was  $139.93 \pm 15.145$ , and the mean scale score was  $4.21 \pm 0.423$ . The HBM-based components placed in ascending order of their mean scores were perceived barriers for keeping instruments moist ( $3.47 \pm 0.945$ ), self-efficacy in keeping instruments moist ( $4.16 \pm 0.666$ ), perceived severity of instruments not kept moist ( $4.50 \pm 0.574$ ), perceived benefits of keeping instruments moist ( $4.57 \pm 0.523$ ), and perceived susceptibility to instruments not kept moist ( $4.62 \pm 0.484$ ).

### Impact of age

Single factor analysis showed that age had an impact on nurses' perceived barriers for keeping instruments moist, with a statistically significant difference ( $p = 0.001 < 0.05$ ) (Table 2).

### Impact of length of service

Single factor analysis showed that length of service had an impact on nurses' perceived benefits of

Table 2. Impact of age on nurses' perception toward their behaviors for keeping surgical instruments moist

Item	Perceived severity of instruments not kept moist	Perceived susceptibility to instruments not kept moist	Perceived benefit of keeping instruments moist	Perceived barriers for keeping instruments moist	Self-efficacy in keeping instruments moist
Age (years)					
< 25	27.2 ± 3.012	24.38 ± 2.144	36.90 ± 4.023	22.57 ± 7.522	28.96 ± 4.180
25–30	27.04 ± 3.633	24.66 ± 1.958	36.81 ± 4.132	20.97 ± 8.645	29.21 ± 4.893
31–35	27.13 ± 3.108	24.46 ± 1.910	36.09 ± 4.319	25.13 ± 8.239	29.22 ± 4.521
36–40	27.03 ± 3.211	24.61 ± 1.793	36.53 ± 4.074	23.47 ± 8.365	29.47 ± 4.313
41–45	26.08 ± 4.033	24.17 ± 2.250	35.42 ± 4.122	26.50 ± 8.274	27.50 ± 4.719
46–50	25.92 ± 4.231	23.67 ± 2.015	35.33 ± 4.997	25.83 ± 8.032	27.92 ± 5.435
> 50	25.67 ± 4.387	23.89 ± 2.619	34.89 ± 5.183	30.56 ± 7.828	30.44 ± 5.615
t	0.652	0.454	0.834	4.033	0.553
p	0.689	0.842	0.544	0.001	0.767

Table 3. Impact of length of service on nurses' perception toward their behaviors for keeping surgical instruments moist

Item	Perceived severity of instruments not kept moist	Perceived susceptibility to instruments not kept moist	Perceived benefit of keeping instruments moist	Perceived barriers for keeping instruments moist	Self-efficacy in keeping instruments moist
Length of service (years)					
< 1	28.00 ± 3.464	25.33 ± 1.633	39.13 ± 2.134	19.87 ± 5.986	29.60 ± 3.795
1–5	27.30 ± 3.320	24.56 ± 2.018	36.88 ± 4.130	21.74 ± 8.636	29.37 ± 4.614
6–10	26.35 ± 3.533	24.47 ± 1.919	35.95 ± 3.988	22.89 ± 8.010	28.70 ± 4.953
11–15	27.05 ± 3.464	24.62 ± 2.021	36.13 ± 4.714	24.62 ± 8.359	29.13 ± 4.691
16–20	26.72 ± 3.234	24.24 ± 1.877	36.04 ± 3.889	23.00 ± 8.495	28.76 ± 3.919
> 20	26.00 ± 4.009	23.87 ± 2.193	35.23 ± 4.651	27.87 ± 8.080	28.40 ± 5.462
t	1.483	0.833	2.396	3.547	0.397
p	0.195	0.527	0.037	0.004	0.851

keeping instruments moist and perceived barriers for keeping instruments moist, with a statistically significant difference ( $p < 0.05$ ) (Table 3).

### Impact of educational background

Single factor analysis showed that educational background had no impact on nurses' perception toward their behaviors for keeping surgical instruments moist (Table 4).

### Impact of job title

Single factor analysis showed that job title had an impact on nurses' perceived susceptibility to instruments not kept moist, perceived benefits of keeping instruments moist, and self-efficacy in keeping instruments moist, with a statistically significant difference ( $p < 0.05$ ) (Table 5).

### Multivariable linear regression analysis

Total score of nurses' perception-behavior scale for keeping surgical instruments moist was considered as the dependent variable. Age, length of service, and job title were considered as the independent variable. Stepwise regression (Alpha-to-Enter = 0.05, Alpha-to-Remove = 0.10) of multivariable linear regression analysis was carried out on the data. The analysis showed that one variable was entered into the regression equation, that is, length of service. A statistically significant difference existed, as shown in table 6.

### Discussion

As revealed in the results of this study, the mean score of nurses' perception-behavior scale for

**Table 4.** Impact of educational background on nurses' perception toward their behaviors for keeping surgical instruments moist

Item	Perceived severity of instruments not kept moist	Perceived susceptibility to instruments not kept moist	Perceived benefit of keeping instruments moist	Perceived barriers for keeping instruments moist	Self-efficacy in keeping instruments moist
Educational background					
Junior college diploma or below	27.13 ± 3.332	24.32 ± 2.103	36.35 ± 4.173	22.67 ± 8.136	29.28 ± 5.256
Bachelor	26.89 ± 3.466	24.49 ± 1.992	36.49 ± 4.211	22.87 ± 8.651	29.04 ± 4.519
Master or above	28.29 ± 3.405	25.47 ± 1.463	38.24 ± 3.597	20.88 ± 8.108	29.41 ± 5.075
t	1.124	2.011	1.232	0.167	0.253
p	0.326	0.135	0.293	0.846	0.777

**Table 5.** Impact of job title on nurses' perception toward their behaviors for keeping surgical instruments moist

Item	Perceived severity of instruments not kept moist	Perceived susceptibility to instruments not kept moist	Perceived benefits of keeping instruments moist	Perceived barriers for keeping instruments moist	Self-efficacy in keeping instruments moist
Job title					
Nurse	27.90 ± 2.915	24.89 ± 1.769	37.86 ± 3.304	21.61 ± 8.751	30.01 ± 4.287
Nurse practitioner	26.67 ± 3.587	24.31 ± 2.150	36.09 ± 4.440	22.05 ± 8.266	28.72 ± 4.783
Supervising nurse	26.67 ± 3.582	24.45 ± 1.883	36.00 ± 4.279	25.48 ± 8.304	29.02 ± 4.733
Associate senior nurse	25.00 ± 1.414	24.00 ± 2.828	35.50 ± 4.950	23.00 ± 5.657	24.50 ± 2.121
t	3.199	1.992	4.422	3.987	2.245
p	0.083	0.008	0.005	0.115	0.024

keeping surgical instruments moist was  $4.21 \pm 0.423$ . According to score assignments in the survey, the score above 4 meant “agree”<sup>8</sup>. This indicated that the nurses had positive health belief in keeping surgical instruments moist, possibly because 78.35% of them had bachelor's degree qualifications. The nurses with high levels of education had greater ability to learn and master many new skills and had higher-level perception. Their score for perceived barriers for keeping instruments moist was low, possibly because the hospital where the participants worked in was for women and children and most surgeries here were obstetric and gynecologic ones. The time for preparing each operation was short, the turnover time of operating rooms was short, the operating room nurses were unable to timely moisten surgical instruments, and CSSD staff members were unable to timely receive the surgical instruments. All of these led to low score for perceived barriers for keeping instruments moist<sup>7</sup>.

The single factor analysis showed that age, length of service, and job title affected nurses' perception

toward their behaviors for keeping surgical instruments moist. With an increase of experience and knowledge, nurses' perception, and behaviors also changed. The nurses with shorter length of service perceived more benefits of keeping surgical instruments moist than those with longer length of service, but had significantly less perceived barriers for keeping instruments moist than those with longer length of service, possibly because the nurses with shorter length of service had less clinical experience and insufficient basic knowledge on keeping surgical instruments moist, and were not familiar with the relevant procedures. However, the nurses with longer length of service experienced occupational fatigue due to long period of working, and had decreasing perception to benefits of keeping surgical instruments moist, which affected their handling of keeping instruments moist.

Multivariable regression analysis showed that length of service had an impact on nurses' perception toward their behaviors for keeping surgical instruments moist. The shorter the length of service was, the greater



**Table 6. Multivariable linear regression analysis on factors influencing nurses' perception toward their behaviors for keeping surgical instruments moist**

Variable	B	Standard error	$\beta$	t	p	95% CI
Age	1.597	1.326	0.147	1.204	0.229	-1.011-4.206
Length of service	-2.923	1.466	-0.261	-1.993	0.047	-5.807--0.039
Job title	-2.380	1.711	-0.114	-1.391	0.165	-5.745-0.985

R<sup>2</sup>=0.055; adjusted R<sup>2</sup>=0.047; F=6.721; p=0.001. CI: Confidential interval

perception of nurses to keeping instruments moist. The nurses with longer length of service had poorer attitude for keeping instruments moist than the newly employed nurses, possibly because such new nurses were full of enthusiasm in work but had less experience, and they handled surgical instrument moistening strictly according to requirements. In contrast, the nurses with longer length of service were insensitive to perception of the severity and benefits of keeping surgical instruments moist due to their long period of working, which led to poor health belief in keeping surgical instruments moist.

## Conclusions

In summary, training on basic knowledge for keeping surgical instruments moist should be enhanced for nurses with shorter length of service, including regularly attending seminars, reading brochures, watching relevant videos, and weekly post-training follow-up should be strengthened. For nurses with longer length of service, their awareness to benefits of keeping surgical instruments moist and their confidence in overcoming barriers should be enhanced, and eventually they could fulfill their task for keeping surgical instruments moist.

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## Conflicts of interest

All authors declare that they have no conflicts of interest.

## Ethical disclosures

**Protection of human and animal subjects.** The authors declare that no experiments were performed on humans or animals for this study.

**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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