Using the Health Belief Model to Analyse Nurses’ Perception Towards their Behaviours for Keeping Surgical Instruments Moist

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Research Article

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Abstract

**Background:** Because of conflicts with work schedule of central sterile supply department (CSSD), surgical instruments might 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. Nurses’ perception towards their behaviours for keeping surgical instruments moist has been rarely studied. We aimed to use the health belief model to analyse nurses’ perception towards their behaviours for keeping surgical instruments moist.

**Methods:** The survey utilising a general information questionnaire, and a self-designed nurses’ perception-behaviour scale for keeping surgical instruments moist was conducted with 360 nurses from the West China Second University Hospital, Sichuan University. Data was gathered with cluster sampling, and analysed in SPSS20.0.

**Results:** Total score of nurses’ perception-behaviour scale for keeping surgical instruments moist was 139.93±15.145, among which mean score for perceived severity, perceived susceptibility, perceived benefits, perceived barriers, and self-efficacy was 4.49±0.57, 4.62±0.48, 4.57±0.52, 3.47±0.94 and 4.16±0.66, respectively. Single factor analysis showed that score of nurses’ perception-behaviour scale for keeping surgical instruments moist varied with age, length of service and job title, with a statistically significant difference (P < 0.05). Multivariable linear regression analysis showed that length of service was the main factor affecting nurses’ perception towards their behaviours for keeping surgical instruments moist.

**Conclusion:** Nurses should be offered intensive training on keeping surgical instruments moist due to their inadequate perception on it. However, an increase in knowledge does not necessarily bring behavior change. The nurses’ change in health beliefs and behaviours must be based upon developing the right attitude. As a result, they could realize the benefits of keeping surgical instruments moist, identify the barriers, and finally obtain the solutions.

**Background**

Health Industrial Standard (WS 310.2–2016) of the People's Republic of China provides that the user shall timely remove visible contaminants from medical instruments, implements and articles, and keep them moist as required after use. Guidelines of US Association of Perioprative Registered Nurses also expressly require keeping instruments moist before cleaning [1]. 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 [2–3]. According to reference materials, bacteria may develop on dry contaminants in 4–20 minutes and biofilm will appear in 2 hours. Therefore, contaminants shall be timely removed from surgical instruments after use, and subsequently the instruments shall be sent to
CSSD for cleaning within 30 minutes. If it is not available, it will be necessary to keep instruments moist [4–5]. 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 [6–7]. According to the initial investigation, only 57.59% of the surgical instruments were kept moist in our hospital, and nurses did not have adequate perception towards their behaviours for keeping instruments moist. We aimed to use the health belief model to analyse the nurses’ perception towards their behaviours for keeping surgical instruments moist.

**Methods**

**Participants**

The survey was conducted with 360 nurses from the West China Second University Hospital, Sichuan University between June 1 and August 31, 2019. Data was gathered with cluster sampling.

**Survey tools**

The health belief model (HBM), first proposed by Hochbaum, and revised by Rosenstock [8], was the theoretical base of this study. HBM includes 5 components, i.e. perceived susceptibility, perceived severity, perceived benefits, perceived barriers and self-efficacy. The application of HBM in analysing nurses’ perception towards their behaviours for keeping surgical instruments moist was defined as perceiving susceptibility to instruments not kept moist, emphasizing severity of instruments not kept moist, analysing benefits of keeping instruments moist, perceiving barriers for keeping instruments moist, and improving self-efficacy intervention [9-10].

The survey utilised a general information questionnaire and a self-designed nurses’ perception-behaviour scale for keeping surgical instruments moist. The general information questionnaire 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-behaviour 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 conducted 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-behaviour scale for keeping surgical instruments moist covered 5 components and 36 items, i.e. perceived susceptibility (6 items), perceived severity (6 items), perceived benefits (8 items), perceived barriers (9 items) and Self-efficacy (7 items). 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.
All methods were performed in accordance with the relevant guidelines and regulations. This study was performed in accordance with the Declaration of Helsinki. Ethics approval of this study was obtained from the Medical Ethics Committee of West China Second University Hospital, Sichuan University (No.: YXKY2020LSP(163)). Informed consent to participate in this study was obtained from all participants. This study was carried out based on the online questionnaires which were voluntarily and anonymously completed by participants. Purpose and significance of this study was clearly mentioned in the questionnaire. Completion of the questionnaire was regarded as verbal consent to participate in this study. Medical Ethics Committee of West China Second University Hospital, Sichuan University reviewed and approved the research proposal and procedure of verbal consent of this study, and thought written consents from participants were not necessary. All data collected were confidential and used only by this study.

Data collection

The electronic questionnaire was distributed through WJX. The nurses scanned a QR code to complete the questionnaire voluntarily and anonymously. 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 was analysed in SPSS20.0. The enumeration data was described with frequency (rate), and the measurement data was described with mean (±) and standard deviation (SD). A statistically significant difference (P < 0.05) was found through t-test, variance analysis and multivariable linear regression analysis.

Results

General information acquired from 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. Two hundred and seventy-five (78.35%) of them had bachelor’s degree qualifications, and one hundred and sixty-nine (48.15%) of them were nurse practitioners, as shown in Table 1.
Table 1
General demographic characteristics (n = 351)

| Item                          | Number | Assignment | Percentage (%) |
|-------------------------------|--------|------------|----------------|
| Age                           |        |            |                |
| < 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             |        |            |                |
| < 1 yr                        | 15     | 1          | 4.27           |
| 1–5 yrs                       | 185    | 2          | 52.71          |
| 6–10 yrs                      | 57     | 3          | 16.24          |
| 11–15 yrs                     | 39     | 4          | 11.11          |
| 16–20 yrs                     | 25     | 5          | 7.12           |
| > 20 yrs                      | 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-behaviour scale for keeping surgical instruments moist
For the 351 nurses, total score of nurses' perception-behaviour 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 components placed in ascending order of their mean scores were perceived barriers, self-efficacy, perceived severity, perceived benefits, and perceived susceptibility. Details are shown in Table 2.

**Table 2**
Score of nurses' perception-behaviour scale for keeping surgical instruments moist ($\bar{x} \pm S$)

| Mean score of perceived barriers | Mean score of perceived susceptibility | Mean score of perceived benefits | Mean score of perceived barriers | Mean score of self-efficacy | Mean scale score |
|----------------------------------|----------------------------------------|---------------------------------|---------------------------------|-----------------------------|-----------------|
| $4.50 \pm 0.574$               | $4.62 \pm 0.484$                      | $4.57 \pm 0.523$               | $3.47 \pm 0.945$               | $4.16 \pm 0.666$           | $4.21 \pm 0.423$ |

**Impact of age on nurses’ perception towards their behaviours for keeping surgical instruments moist**

Single factor analysis showed that age had an impact on perceived barriers, with a statistically significant difference ($P = 0.001 < 0.05$), as shown in Table 3.
### Table 3
Impact of age nurses’ perception towards their behaviours for keeping surgical instruments moist

| Item  | Perceived severity | Perceived susceptibility | Perceived benefit | Perceived barriers | Self-efficacy |
|-------|-------------------|--------------------------|-------------------|-------------------|---------------|
| < 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-value | 0.652                     | 0.454               | 0.834                     | 4.033                     | 0.553  |
| P-value | 0.689                      | 0.842               | 0.544                      | 0.001                      | 0.767  |

**Impact of length of service on nurses’ perception towards their behaviours for keeping surgical instruments moist**

Single factor analysis showed that length of service had an impact on perceived benefits and perceived barriers, with a statistically significant difference (P < 0.05), as shown in Table 4.
### Table 4
Impact of length of service on nurses’ perception towards their behaviours for keeping surgical instruments moist

| Item       | Perceived severity | Perceived susceptibility | Perceived benefit | Perceived barriers | Self-efficacy |
|------------|--------------------|---------------------------|-------------------|-------------------|---------------|
| Length of service |                    |                           |                   |                   |               |
| <1 yr      | 28.00 ± 3.464      | 25.33 ± 1.633             | 39.13 ± 2.134     | 19.87 ± 5.986     | 29.60 ± 3.795 |
| 1–5 yrs    | 27.30 ± 3.320      | 24.56 ± 2.018             | 36.88 ± 4.130     | 21.74 ± 8.636     | 29.37 ± 4.614 |
| 6–10 yrs   | 26.35 ± 3.533      | 24.47 ± 1.919             | 35.95 ± 3.988     | 22.89 ± 8.010     | 28.70 ± 4.953 |
| 11–15 yrs  | 27.05 ± 3.464      | 24.62 ± 2.021             | 36.13 ± 4.714     | 24.62 ± 8.359     | 29.13 ± 4.691 |
| 16–20 yrs  | 26.72 ± 3.234      | 24.24 ± 1.877             | 36.04 ± 3.889     | 23.00 ± 8.495     | 28.76 ± 3.919 |
| >20 yrs    | 26.00 ± 4.009      | 23.87 ± 2.193             | 35.23 ± 4.651     | 27.87 ± 8.080     | 28.40 ± 5.462 |
| t-value    | 1.483              | 0.833                     | 2.396             | 3.547             | 0.397         |
| P-value    | 0.195              | 0.527                     | 0.037             | 0.004             | 0.851         |

### Impact of educational background on nurses’ perception towards their behaviours for keeping surgical instruments moist

Single factor analysis showed that educational background had no impact on nurses’ perception towards their behaviours for keeping surgical instruments moist, as shown in Table 5.
Table 5
Impact of educational background on nurses’ perception towards their behaviours for keeping surgical instruments moist

| Item                  | Perceived severity | Perceived susceptibility | Perceived benefit | Perceived barriers | Self-efficacy |
|-----------------------|--------------------|--------------------------|-------------------|--------------------|---------------|
| 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-value               | 1.124             | 2.011                    | 1.232              | 0.167              | 0.253         |
| P-value               | 0.326             | 0.135                    | 0.293              | 0.846              | 0.777         |

Impact of job title on nurses’ perception towards their behaviours for keeping surgical instruments moist

Single factor analysis showed that job title had an impact on perceived susceptibility, perceived benefits and self-efficacy, with a statistically significant difference (P < 0.05), as shown in Table 6.

Table 6
Impact of job title on nurses’ perception towards their behaviours for keeping surgical instruments moist

| Item                  | Perceived severity | Perceived susceptibility | Perceived benefits | Perceived barriers | Self-efficacy |
|-----------------------|--------------------|--------------------------|--------------------|--------------------|---------------|
| 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-value               | 3.199              | 1.992                    | 4.422              | 3.987              | 2.245         |
| P-value               | 0.083              | 0.008                    | 0.005              | 0.115              | 0.024         |
Multivariable linear regression analysis on influencing factors of nurses’ perception towards their behaviours for keeping surgical instruments moist

Total score of nurses’ perception-behaviour 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 1 variable was entered into the regression equation, i.e. length of service. A statistically significant difference existed, as shown in Table 7.

| Variable    | B-value | Standard error | \(\beta\)-value | t-value | P-value | 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  |

Note: \(R^2 = 0.055\), adjusted \(R^2 = 0.047\), \(F = 6.721\), \(P = 0.001\)

Discussion

As revealed in the results of this study, the mean score of nurses’ perception-behaviour scale for keeping surgical instruments moist was 4.21 ± 0.423. According to score assignment in the survey, the score above 4 meant ‘agree’ [8]. 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 was low, possibly due to the nature of obstetric and gynecologic operations in our hospital. 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 [7].

The single factor analysis showed that age, length of service and job title affected nurses’ perception towards their behaviours for keeping surgical instruments moist. With an increase of experience and knowledge, nurses’ perception and behaviours also changed. 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 than those with longer length of service, possibly because 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, 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 towards their behaviours for keeping surgical instruments moist. The shorter the length of service was, the greater perception of nurses to keeping instruments moist. Nurses with longer length of service had poorer attitude for keeping instruments moist than 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, 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.

**Conclusion**

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.

**Abbreviations**

CSSD: Central sterile supply department; HBM: Health belief model

**Declarations**

**Ethics approval and consent to participate**

This study was performed in accordance with the Declaration of Helsinki. Ethics approval of this study was obtained from the Medical Ethics Committee of West China Second University Hospital, Sichuan University (No.: YKKY2020LSP(163)). Informed consent to participate in this study was obtained from all participants. This study was carried out based on the online questionnaires which were voluntarily and anonymously completed by participants. Purpose and significance of this study was clearly mentioned in the questionnaire. Completion of the questionnaire was regarded as verbal consent to participate in this study. Medical Ethics Committee of West China Second University Hospital, Sichuan University reviewed and approved the research proposal and procedure of verbal consent of this study, and thought written consents from participants were not necessary for this study. All data collected were confidential and used only by this study.
Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding authors on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

YC, JH and YH contributed to the questionnaire design. LY and RH carried out the data collection. YC, JH and YH conducted the data analysis. YC drafted the manuscript. JH revised the manuscript. All the authors read and approved the final manuscript.

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