Knowledge, Attitude, and Practice of Nurses Towards the Prevention and Control of COVID-19

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Abstract

**Background:** Coronavirus disease 2019 (COVID-19) has been spreading globally, with severe impacts on health and economies. Nursing is an essential component of medical care, and nurses' knowledge, attitude, and practice (KAP) about the prevention and control of the disease directly affects patient's outcomes, but there is little know about the nurses' KAP during the COVID-19 epidemic.

**Methods:** An anonymous survey was conducted using customized questionnaires designed by Sojump platform. 1323 nurses in Wuhan were the survey object for the KAP survey. The survey included 48 questions regarding the basic information of nurses and knowledge, attitude, and prevention measures for COVID-19.

**Results:** A total of 1323 nurses in Wuhan were included in the survey, of whom women (95.7%) under 40 years old (94.6%) accounted for the majority. Nurses have a comprehensive knowledge of problems such as the COVID-19 susceptible population, isolation ward layout process, environmental cleaning and disinfection, hand hygiene measures, infectious disease case reporting processes, standard prevention measures, and personal protection level, with more than 60% accuracy. However, they have a general lack of knowledge about the route of transmission of COVID-19, the use of protective equipment, patient management, medical waste disposal, and occupational exposure emergency response, with less than 45% accuracy. There was a gap between the attitude and the practice of nurses (p <0.05). Moreover, the knowledge level of nurses has an impact on their attitude (OR 1.52, 95% CI 1.10-2.08, p = 0.008), and title (OR 1.48, 95% CI 1.01-2.15, p = 0.042), place of work (OR 1.59, 95% CI 1.36-1.85, p <0.001), and attitude (OR 1.93, 95% CI 1.52-2.46, p <0.001) had an impact on their practice.

**Conclusion:** The nurses in Wuhan during the epidemic have insufficient knowledge about COVID-19 infection prevention and control, and there are gaps in attitude and practice, which further affect their attitude and practice. It is therefore necessary to strengthen relevant knowledge training on COVID-19 among nurses.

**Background**

Coronaviruses are a large family of viruses known to cause common colds and more severe diseases such as Middle East respiratory syndrome (MERS) and severe acute respiratory syndrome (SARS). Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a new species of coronaviruses that was recently found to infect human. It is highly contagious and pathogenic. Pneumonia associated with SARS-CoV-2 infection has been named coronavirus disease 2019 (COVID-19) by the World Health Organization (WHO) [1–3]. Since its outbreak in December 2019, COVID-19 has been spreading globally with severe impacts on health and economies. Since the outbreak, the Chinese government and health authorities have issued a range of prevention and control policies and have actively taken various measures to control the development and spread of the outbreak. The SARS outbreak in 2003 revealed that knowledge, attitude, and practice (KAP) play equally important roles in the prevention and control of
an outbreak. Therefore, many researchers have conducted surveys to investigate the outbreak-related KAP of the general public in China during the outbreak in order to identify gaps for prevention and control and provide a theoretical basis for the development of targeted prevention and control measures [4–8].

Nursing is an essential component of medical care, and nurses’ knowledge about disease directly affects patient outcomes. Similarly, during an outbreak, nurses’ KAP play positive roles in improving the recovery rate, reducing the length of the hospital stay and mortality, and preventing in-hospital infection and occupational exposure [9, 10]. To date, most studies focus on the KAP of the general public, and few have investigated the KAP of nurses [11, 12]. To further understand the current status of the KAP of nurses towards the prevention and control of COVID-19 during the outbreak, we conducted a cross-sectional survey of some hospital nurses.

**Methods**

**Study population**

This voluntary survey was conducted with nurses who worked at designated COVID-19 hospitals, nondesignated hospitals, and Fangcang shelter hospitals in Wuhan between March 5 and March 20, 2020. The inclusion criteria included the following: licensed practicing nurses who participated in the outbreak prevention and control and voluntarily participated in the survey of this study. Visiting nurses and interns were excluded.

**Study design**

We designed a survey with 48 items to collect the following information:

1) Background information, including age, sex, education level, marital status, childbearing history, title, work experience (year), health status, place of work, hospital department, and role (11 items);

2) Knowledge about the prevention and control of COVID 19 infection, including susceptibility, route of transmission, ward layout and procedures, cleaning and disinfection, hand hygiene measures, infectious disease case reporting, standard preventive measures, use of personal protective equipment (PPE), level of personal protection, patient management, medical waste disposal, and occupational exposure emergency response (12 items). All items were single-choice responses (1 for correct answer, 0 for incorrect answer; total score: 12). A higher score indicated a better understanding of prevention and control of in-hospital infection;

3) Attitude towards the prevention and control of COVID 19 infection, including personal protection, patient management, environmental disinfection, and knowledge training (10 items). A 5-point Likert scale was used, where 1 indicated “strongly disagree”, 2 indicated “disagree”, 3 indicated “not sure”, 4 indicated “agree”, and 5 indicated “strongly agree”. The total score ranged from 10 to 50, and a higher score indicated more positive attitude towards the prevention and control of in-hospital infection;
4) Practice to prevent COVID-19 infection, including standard preventive measures, personal protection, hand hygiene, prediagnosis and triage, patient management, proper zoning, strict environmental disinfection, proper disposal of medical waste, occupational exposure emergency response, and training regarding in-hospital infection (15 items). For scoring, 1 indicated "rarely", 2 indicated “occasionally”, 3 indicated “sometimes”, 4 indicated “often”, and 5 indicated “always”. Some items were scored in reverse, and the total score ranged from 15 to 75. A higher score indicated more standardized prevention and control of in-hospital infection;

5) To “pass” the survey, the KAP scores have to be higher than 7, 24, and 36, respectively.

This survey was conducted via a questionnaire, which was distributed to eligible subjects via a Sojump link and could be completed by the participants in approximately 8–10 minutes [13, 14]. Any question about the questionnaire was addressed by the investigator through telephone communication, etc. This questionnaire was developed and modified based on the study team meetings and consultations with experts on nursing and in-hospital infection.

**Ethical approval**

Permission for the study was obtained from ethical committee of the hospital. Special item was set on the questionnaire, and participants responding to “agree” were considered as informed consent.

**Statistical analysis**

We collected the background information of nurses and provided descriptive statistics of KAP towards the prevention and control of COVID-19 infection. SPSS v21.0 was used for the statistical analysis. Count data are expressed as frequency and percent and were analyzed with Pearson’s chi-square test or Fisher’s exact test. For 5-point items, the responses were divided into 2 groups (≥4 vs <4). Non-conditional logistic regression analysis was performed to identify relevant factors. The significance level was α=0.05, and p<0.05 was considered statistically significant.

**Results**

**General information**

A total of 1453 questionnaires were retrieved, 1323 of which (91.1%) were valid. We collected general information from these 1323 nurses. The highest proportion of nurses were below 40 years of age (94.6%), were female (95.7%), had an undergraduate education (76.7%) and 5-10 years of working experience (47.1%), were married (62.4%) with children (55.9%) and healthy (90.2%), and were engaged in clinical nursing (79.7%) at designated hospitals (66.4%), followed by Fangcang shelter hospitals (25.2%) (Table 1).

**Knowledge**
The 1323 nurses had a good understanding of COVID-19-susceptible populations (76.9%), isolation ward layout and procedures (70.5%), environmental cleaning and disinfection (60.7%), hand hygiene measures (71.0%), infectious disease case reporting (78.3%), standard preventive measures (61.9%), and level of personal protection (69.7%). However, the nurses had less knowledge about the route of transmission (23.7%), use of PPE (19.6%), patient management (40.7%), medical waste disposal (19.1%), and occupational exposure emergency response (28.6%). See Table 2.

**Attitude versus practice**

Attitude and practice were concordant on items ranging from personal protection, hand hygiene, prediagnosis and triage, and patient management to training regarding in-hospital infection \( (p > 0.05) \) and were discordant on items ranging from standard preventive measures, proper zoning, strict environmental disinfection, and proper disposal of medical waste to occupational exposure emergency response \( (p < 0.001) \), primarily due to a gap in practice. See Table 3.

**Factors related to participants’ attitude and practice**

Unconditional logistic regression analysis showed that attitude were positively related to knowledge (OR, 1.52, 95% CI 1.10-2.08, \( p = 0.008 \); Table 4), while practice were related to title [OR 1.48, 95% CI 1.01-2.15, \( p = 0.042 \)], place of work (OR 1.59, 95% CI 1.36-1.85, \( p < 0.001 \)), and attitude [OR 1.93, 95% CI 1.52-2.46, \( p < 0.001 \); Table 5].

**Discussion**

In this study, we surveyed the current status of the KAP of nurses towards the prevention and control of COVID-19 infection during the outbreak and found that nurses had some knowledge deficiency regarding the prevention and control of COVID-19 infection, thus affecting their attitude and practice and resulting in discordance between attitude and practice.

**Knowledge deficiency**

The knowledge of nurses about the COVID-19 outbreak directly affects patient outcomes and the prevention and control of COVID-19 infection. This study showed that nurses had a good understanding of isolation ward layout and procedures and infectious disease case reporting procedures, which may be the result of relevant training. In this survey, 91.6% of the nurses worked at a designated hospital or a Fangcang shelter hospital, and they received required training and passed field simulation tests before they started to work, suggesting that continuing education plays a significant role in improving KAP \([15,16,17]\), which also applies to the general public [5]. Strict hand hygiene also plays an important role in disease prevention and control. During the influenza A virus subtype H1N1 (H1N1) outbreak in 2009, some researchers conducted a survey on hand hygiene compliance among medical staff, including doctors and nurses, and found that medical staff had a very good understanding of hand hygiene measures, with a higher compliance rate in nurses (> 80%). This study showed that more than 70% of the
nurses understood hand hygiene measures, a result that is consistent with previous reports [18,19]. However, some studies show that occupational burnout may affect hand hygiene compliance, with a negative impact on nursing, and which should be paid to attention [20]. This study showed that only 23.7% of the investigated nurses knew the routes of COVID-19 transmission. Potential reasons include a lack of adequate information on routes of transmission of this novel virus other than respiratory transmission. In addition, this study showed that nurses generally lacked adequate knowledge about medical waste disposal and occupational exposure emergency response, especially the use of PPE. This may be related to the emergent nature of this public health crisis, the rapid spread, and the lack of nurses with special training in infectious diseases. In this survey, only 22.5% of the nurses were front-line nurses who worked in an isolation ward.

**Gap between attitude and practice**

This study showed a gap between attitude and practice. The nurses had positive attitude towards personal protection, hand hygiene, prediagnosis and triage, patient management, and training regarding in-hospital infection. They implemented practical preventive measures such as the proper use of PPE, strict hand hygiene measures, setting-up fever clinics, isolation wards, and designated hospitals. However, this study showed discordance between attitude and practice in standard preventive measures, proper division of wards, strict environmental disinfection, proper disposal of medical waste, and occupational exposure emergency response ($p<0.001$).

Concordance between attitude and practice may be attributed to public media and the enforcement of national policies. Since the outbreak, various guidelines have emphasized personal protection, hand hygiene, and centralized management of suspected and confirmed cases. Medical facilities have been strictly following these guidelines, which explains the concordance between attitude and practice towards common items in this survey. During the SARS outbreak, the general public was very optimistic—70-80% believed that SARS would be successfully controlled or prevented, and 95-100% believed that China would win the war against SARS [21, 22]. At the time, the general public actively took measures such as avoiding crowded places and wearing masks when in public, and these measures were also actively promoted by government policies.

The gap between attitude and practice was consistent with the medical situation in Wuhan during the early outbreak. As the hardest hit area, in the early outbreak Wuhan faced a shortage of medical supplies such as masks and protective equipment, which hampered the efforts to implement standard protective measures in some roles. Moreover, many wards were temporarily reorganized to alleviate the shortage of infectious disease wards, making it difficult to implement the “three zones and two pathways” design. In addition, these may be related to the lack of comprehensive knowledge of the virus in the early stage. As new scientific information emerges, the guidelines and protocols for the diagnosis and treatment of COVID-19 are being updated with clearer instructions regarding environmental disinfection, medical waste disposal, and occupational exposure emergency response. Furthermore, during the outbreak,
medical staff had to rely on self-paced online training, which was not as effective as classroom training and contributed to the gap between attitude and practice.

Factors related to attitude and practice

In this study, we performed nonconditional logistic regression analysis to identify factors related to participants’ attitude and practice and found that attitude were related to knowledge (OR 1.52, 95% CI 1.10-2.08, \( p = 0.008 \)), which was consistent with that of the general public during the COVID-19 outbreak [5]. Moreover, practice was related to title (OR 1.48, 95% CI 1.01-2.15, \( p = 0.042 \)), place of work (OR 1.59, 95% CI 1.36-1.85, \( p < 0.001 \)), and attitude (OR 1.93, 95% CI 1.52-2.46, \( p < 0.001 \)). These data indicate that knowledge influences attitude, which then influences practice, which is consistent with the findings during other acute infectious disease outbreaks, such as SARS and H1N1 [18,21,22]. In addition, this study showed that practice were related to title and place of work. Senior nurses were relatively older and may have experienced the SARS outbreak in 2003 and H1N1 outbreak in 2009, which had a direct impact on their practice during the COVID-19 outbreak. Wuhan was the hardest hit area as such, designated hospitals and Fangcang shelter hospitals were set up to admit and treat patients with confirmed cases, all of whom were infectious, requiring nurses to implement strict prevention and control measures to prevent in-hospital infection. As a result, the working place (whether you work in an infectious ward or ICU) affected practice.

This study has some limitations, including a small sample size of both participants and hospitals and a limited survey scope, which may have resulted in certain bias. Further in-depth studies are needed to validate the results.

Conclusion

This study showed that nurses in Wuhan during the epidemic lacked adequate knowledge about the prevention and control of COVID-19 infection, with a gap between attitude and practice that in turn affected both attitude and practice. As important members of prevention and control teams, nurses are on the front line for the prevention and control of in-hospital infection. Therefore, nurses must strictly follow prevention and control measures for in-hospital infection; improve their understanding about COVID-19 prevention and control; ensure proper personal protection, patient management, and environmental disinfection; and minimize occupation exposure in order to facilitate the successful prevention and control of in-hospital infection and the safety of medical staff and patients.

Abbreviations

KAP
knowledge, attitude, and practice; COVID-19: coronavirus disease 2019; SARS-CoV-2: respiratory syndrome coronavirus 2; SARS: severe acute respiratory syndrome; MERS: Middle East respiratory syndrome; WHO: World Health Organization
Declarations

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Authors’ contributions

ZJ and XL designed this research and guided the other authors (WZ, ZW, LY, NL) in data collection. Analysis and interpretation of data and literature review were done by ZJ, LL and WZ. ZJ and LL involved in writing up the manuscript and all authors read and approved the final manuscript.

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Availability of data and materials

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

Ethics approval and consent to participate

This study was approved by ethical review committee of Maternal and Child Health Hospital of Hubei Province. Participants responding to the questionnaire were considered as informed consent.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Tables
| Item                      | Response          | Subject |
|---------------------------|-------------------|---------|
|                           | n        | %      |
| Age                       |          |        |
| 20–30                     | 790      | 59.7   |
| 31–40                     | 462      | 34.9   |
| 41–50                     | 63       | 4.8    |
| > 50                      | 8        | 0.6    |
| Sex                       |          |        |
| Male                      | 57       | 4.3    |
| Female                    | 1266     | 95.7   |
| Education level           |          |        |
| College and below         | 303      | 22.9   |
| Undergraduate             | 1015     | 76.7   |
| Postgraduate and above    | 5        | 0.4    |
| Marital status            |          |        |
| Single                    | 477      | 36.1   |
| married                   | 826      | 62.4   |
| Divorced                  | 17       | 1.3    |
| Other                     | 3        | 0.2    |
| Childbearing history      |          |        |
| No                        | 584      | 44.1   |
| Yes                       | 739      | 55.9   |
| Title                     |          |        |
| Nurse                     | 992      | 75.0   |
| Attending nurse           | 307      | 23.2   |
| (Associate) chief nurse   | 24       | 1.8    |
| Role                      |          |        |
| Clinical nursing          | 1054     | 79.7   |
| Nursing management        | 138      | 10.4   |
| Other                     | 131      | 9.9    |
| Work experience (years)   |          |        |
| < 5                       | 350      | 26.5   |
| 5–10                      | 623      | 47.1   |
| 11–15                     | 210      | 15.9   |
| 16–20                     | 74       | 5.6    |
| > 20                      | 66       | 5.0    |
| Underlying disease       | Yes | 77 | 5.8 |
|-------------------------|-----|----|-----|
| No                      | 1193| 90.2 |    |
| Unknown                 | 53  | 4.0 |    |
| Place of work           |     |    |     |
| Designated hospital     | 879 | 66.4 |    |
| Nondesignated hospital  | 111 | 8.4 |    |
| Shelter hospital        | 333 | 25.2 |    |
| Hospital department     |     |    |     |
| Isolation ward          | 298 | 22.5 |    |
| General ward            | 367 | 27.7 |    |
| Intensive care unit (ICU)| 273 | 20.6 |    |
| Clinic and emergency department | 81  | 6.1 |    |
| Laboratory and imaging  | 21  | 1.6 |    |
| Other                   | 283 | 21.4 |    |

Table 2
Knowledge about the Prevention and Control of COVID-19 Infection

| Knowledge                                           | Correct | Incorrect |
|-----------------------------------------------------|---------|-----------|
|                                                     | n       | %         |
| Susceptible populations                             | 1018    | 76.9      |
| Route of transmission                               | 314     | 23.7      |
| Isolation ward layout and procedures                | 933     | 70.5      |
| Environmental cleaning and disinfection              | 803     | 60.7      |
| Hand hygiene measures                               | 939     | 71.0      |
| Infectious disease case reporting                   | 1036    | 78.3      |
| Standard preventive measures                        | 819     | 61.9      |
| Use of personal protective equipment                | 259     | 19.6      |
| Level of personal protection                        | 922     | 69.7      |
| Patient management                                  | 539     | 40.7      |
| Medical waste disposal                              | 253     | 19.1      |
| Occupational exposure emergency response            | 379     | 28.6      |
Table 3
Preventive Measures Considered Useful by Subjects versus Practice

| Preventive Measures                        | Positive Attitude ("Agree" and "Strongly Agree") | Practice ("Often" and "Always") | p*   |
|--------------------------------------------|-------------------------------------------------|---------------------------------|------|
|                                            | n      | %     | n     | %     |
| Standard preventive measures               | 1215   | 91.8  | 456   | 34.5  | < 0.001|
| Personal protection                        | 1234   | 93.3  | 1158  | 87.5  | 0.248  |
| Hand hygiene                               | 1234   | 93.3  | 1060  | 80.1  | 0.459  |
| Prediagnosis and triage                    | 987    | 74.6  | 1278  | 96.6  | 0.619  |
| Patient management                         | 893    | 67.5  | 1310  | 99.0  | 0.767**|
| Proper zoning                              | 876    | 66.2  | 643   | 48.6  | < 0.001|
| Strict environmental disinfection          | 1089   | 82.3  | 789   | 59.6  | < 0.001|
| Proper disposal of medical waste           | 1156   | 87.4  | 376   | 28.4  | 0.021  |
| Occupational exposure emergency response   | 1065   | 80.5  | 432   | 32.7  | < 0.001|
| Training on in-hospital infection          | 1226   | 92.7  | 1023  | 77.3  | 0.614  |

Note: * chi-square test
** Fisher's exact test
| Factor               | Attitude | OR (95% CI)  | p     |
|----------------------|----------|--------------|-------|
|                      | Positive (%) | Negative (%) | p     |
| **Age**              |          |              |       |
| 20–30                | 495 (62.7) | 295 (37.3)   | 1.08 (0.77–1.53) | 0.652 |
| 31–40                | 300 (64.9) | 162 (35.1)   |       |       |
| 41–50                | 45 (71.4)  | 18 (28.6)    |       |       |
| > 50                 | 5 (62.5)   | 3 (37.5)     |       |       |
| **Sex**              |          |              |       |
| Male                 | 43 (75.4) | 14 (24.6)    | 1.06 (0.61–1.86) | 0.834 |
| Female               | 802 (63.3)| 464 (36.7)   |       |       |
| **Education level**  |          |              |       |
| College and below    | 180 (59.4)| 123 (40.6)   | 1.24 (0.95–1.62) | 0.112 |
| Undergraduate        | 662 (65.2)| 353 (34.8)   |       |       |
| Postgraduate and above | 3 (60.0) | 2 (40.0)     |       |       |
| **Marital status**   |          |              |       |
| Single               | 293 (61.4)| 184 (38.6)   | 1.05 (0.78–1.40) | 0.762 |
| Married              | 538 (65.1)| 288 (34.9)   |       |       |
| Divorced             | 0 (0.0)   | 3 (100.0)    |       |       |
| Other                | 14 (82.4) | 3 (17.6)     |       |       |
| **Childbearing history** |        |              |       |
| No                   | 361 (61.8)| 223 (38.2)   | 1.07 (0.75–1.53) | 0.706 |
| Yes                  | 484 (65.5)| 255 (34.5)   |       |       |
| **Title**            |          |              |       |
| Nurse                | 621 (62.6)| 371 (37.4)   | 1.05 (0.74–1.50) | 0.779 |
| Attending nurse      | 210 (68.4)| 97 (31.6)    |       |       |
| (Associate) chief nurse | 14 (58.3)| 10 (41.7)    |       |       |
| **Role**             |          |              |       |
| Clinical nursing     | 680 (64.5)| 374 (35.5)   | 0.91 (0.76–1.10) | 0.327 |
| Nursing management   | 82 (59.4) | 56 (40.6)    |       |       |
|                                |       |       |       |       |
|--------------------------------|-------|-------|-------|-------|
|                                | Other | Work experience (years) | < 5 | 302 (63.2) | 176 (36.8) | 0.96 (0.77–1.18) | 0.676 |
|                                |       | 5–10  | 309 (62.4) | 186 (37.6) |       |       |
|                                |       | 11–15 | 138 (65.7) | 72 (34.3) |       |       |
|                                |       | 16–20 | 52 (70.3) | 22 (29.7) |       |       |
|                                |       | > 20  | 44 (66.7) | 22 (33.3) |       |       |
|                                | Underlying disease | Yes | 51 (66.2) | 26 (33.8) | 0.95 (0.66–1.37) | 0.782 |
|                                |       | No | 760 (63.7) | 433 (36.3) |       |       |
|                                |       | Unknown | 34 (64.2) | 19 (35.8) |       |       |
|                                | Place of work | Nondesignated hospital | 563 (64.1) | 316 (35.9) | 0.92 (0.81–1.06) | 0.251 |
|                                |       | Designated hospital | 75 (67.6) | 36 (32.4) |       |       |
|                                |       | Shelter Hospital | 207 (62.2) | 126 (37.8) |       |       |
|                                | Hospital department | Isolation ward | 182 (61.1) | 116 (38.9) | 1.04 (0.96–1.13) | 0.372 |
|                                |       | General ward | 235 (64.0) | 132 (36.0) |       |       |
|                                |       | ICU | 184 (67.4) | 89 (32.6) |       |       |
|                                |       | Clinic and emergency department | 49 (60.5) | 32 (39.5) |       |       |
|                                |       | Laboratory and imaging | 13 (61.9) | 8 (38.1) |       |       |
|                                |       | Other | 182 (64.3) | 101 (35.7) |       |       |
|                                | Knowledge | Fail | 675 (62.2) | 410 (37.8) | 1.52 (1.10–2.08) | 0.008 |
|                                |       | Pass | 170 (71.4) | 68 (28.6) |       |       |
Table 5
Logistic Regression Analysis of Factors Related to Participants’ Practice

| Factor            | Attitude | OR (95% CI)   | p   |
|-------------------|----------|---------------|-----|
|                   | Attitude | (Positive (%) | Negative (%) |       |
|                   |          | OR (95% CI)   |     |       |
|                   |          | p             |     |       |
| Age               |          |               |     |       |
| 20–30             | 740 (93.7) | 50 (6.3) | 1.02 (0.71–1.46) | 0.929 |
| 31–40             | 449 (97.2) | 13 (2.8)   |     |     |
| 41–50             | 61 (96.8)  | 2 (3.2)     |     |     |
| > 50              | 8 (100.0)   | 0 (0.0)     |     |     |
| Sex               |          |               |     |       |
| Male              | 57 (100.0) | 0 (0.0)    | 0.83 (0.46–1.48) | 0.521 |
| Female            | 1201 (94.9) | 65 (5.1)  |     |     |
| Education level   |          |               |     |       |
| College and below | 287 (94.7) | 16 (5.3)   | 1.01 (0.77–1.33) | 0.937 |
| Undergraduate     | 966 (95.2) | 49 (4.8)   |     |     |
| Postgraduate and above | 5 (100.0) | 0 (0.0)   |     |     |
| Marital status    |          |               |     |       |
| Single            | 444 (93.1) | 33 (6.9)   | 0.93 (0.70–1.25) | 0.650 |
| Married           | 795 (96.2) | 31 (3.8)   |     |     |
| Divorced          | 3 (100.0)   | 0 (0.0)    |     |     |
| Other             | 16 (94.1)   | 1 (5.9)    |     |     |
| Childbearing history |          |               |     |       |
| No                | 545 (93.3) | 39 (6.7)   | 1.18 (0.82–1.69) | 0.378 |
| Yes               | 713 (96.5) | 26 (3.5)   |     |     |
| Title             |          |               |     |       |
| Nurse             | 936 (94.4) | 56 (5.6)   | 1.48 (1.01–2.15) | 0.042 |
| Attending nurse   | 298 (97.1) | 9 (2.9)    |     |     |
| (Associate) chief nurse | 24 (100.0) | 0 (0.0)   |     |     |
| Role              |          |               |     |       |
| Clinical nursing  | 1004 (95.3) | 50 (4.7) | 0.93 (0.77–1.13) | 0.454 |
| Category                        | Frequency | Percentage | Odds Ratio | p-value |
|--------------------------------|-----------|------------|------------|---------|
| Nursing management             | 132       | (95.7)     |            |         |
| Other                          | 122       | (93.1)     |            |         |
| Work experience (years)        |           |            |            |         |
| < 5                            | 440       | (92.1)     | 0.95 (0.76–1.18) | 0.641  |
| 5–10                           | 478       | (96.6)     | 0.641      |         |
| 11–15                          | 202       | (96.2)     | 0.641      |         |
| 16–20                          | 74        | (100.0)    | 0.641      |         |
| > 20                           | 64        | (97.0)     | 0.641      |         |
| Underlying disease             |           |            |            |         |
| Yes                            | 75        | (97.4)     | 1.03 (0.71–1.50) | 0.859  |
| No                             | 1131      | (94.8)     |            |         |
| Unknown                        | 52        | (98.1)     |            |         |
| Place of work                  |           |            |            |         |
| Nondesignated hospital         | 828       | (94.2)     | 1.59 (1.36–1.85) | <0.001 |
| Designated hospital            | 107       | (96.4)     | 1.59 (1.36–1.85) | <0.001 |
| Shelter hospital               | 323       | (97.0)     | 1.59 (1.36–1.85) | <0.001 |
| Hospital department            |           |            |            |         |
| Isolation ward                 | 283       | (95.0)     | 1.07 (0.98–1.17) | 0.135  |
| General ward                   | 347       | (94.6)     | 1.07 (0.98–1.17) | 0.135  |
| ICU                            | 260       | (95.2)     | 1.07 (0.98–1.17) | 0.135  |
| Clinic and emergency department| 78        | (96.3)     | 1.07 (0.98–1.17) | 0.135  |
| Laboratory and imaging         | 20        | (95.2)     | 1.07 (0.98–1.17) | 0.135  |
| Other                          | 270       | (95.4)     | 1.07 (0.98–1.17) | 0.135  |
| Knowledge                      |           |            |            |         |
| Fail                           | 581       | (94.9)     | 1.24 (0.90–1.72) | 0.190  |
| Pass                           | 677       | (95.2)     | 1.24 (0.90–1.72) | 0.190  |

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| Attitude  | Dissatisfied | Satisfied |
|----------|--------------|-----------|
|          | 26 (81.3)    | 1232 (95.4) |
|          | 6 (18.8)     | 59 (4.6)   |
|          | 1.93 (1.52–2.46) | < 0.001  |