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## RESEARCH ARTICLE

# The Nurses' Knowledge and Compliance with Standard Precautions to prevent Healthcare-associated Infections

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### Abstract:

#### Background:

Nursing knowledge and compliance with standard precautions are important for preventing healthcare-associated infections (HAIs) and protecting nursing personnel and patients from exposure to infectious microorganisms.

#### Objective:

The study aimed to assess the nurses' knowledge of and compliance with standard precautions.

#### Methods:

This study used a cross-sectional design. A total of 302 nurses were recruited from three Jordanian hospitals. Data were collected through two structured questionnaires: Standard Precautions Knowledge Questionnaire and Compliance with Standard Precautions Scale. Pearson's correlation test was used to assess the correlation between nurses' knowledge and compliance with standard precautions.

#### Results:

The average knowledge score was 14.09 (SD=2.97), indicating a good level of knowledge regarding standard precautions. The average compliance score was 14.46. A significant positive and strong relationship was found between nurses' knowledge and compliance with standard precautions ( $r=0.77$ ,  $p<0.001$ ).

#### Conclusion:

Continuous monitoring and evaluation of standard precautions are required to maintain and enhance compliance among nurses.

**Keywords:** Nurses, Standard precautions, Knowledge, Compliance, Healthcare-associated infections, Hospital.

### Article History

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## 1. INTRODUCTION

Healthcare environments are considered to be one of the most hazardous occupational settings [1, 2]. Healthcare professionals regularly encounter biological hazards during their clinical practice, which exposes them to various microorganisms that can cause fatal infections [3]. Nurses, in particular, are extremely vulnerable to biological hazards as they deliver direct care to their patients [4].

Biological hazards in hospital environments include expo-

sure to blood-borne infections, such as human immunodeficiency virus (HIV), hepatitis B (HBV) and C (HCV) viruses, and cytomegalovirus from sharp objects and direct contact with body fluids [5 - 7]. Prüss-Ustün *et al.* [7] estimated that approximately 66,000 HBV, 16,000 HCV, and 1,000 (200-5,000) HIV infections are detected among millions of healthcare workers annually because of injuries that occur during the course of performing their duties [7]. The risk of contracting HIV, HBV, or HCV infection from needle stick injuries is estimated to be approximately 0.3%, 2-40%, and 2.7-10%, respectively [8].

HBV and HCV infections account for 40-65% of the

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infections in developing countries, while in developed countries, HCV accounts for 8–27%, and HBV accounts for <10% of infections due to immunization and personal protective equipment (PPE) [9]. These infections are also accompanied by serious consequences, including illness, disability, and even death [7, 9].

In order to prevent hospital-acquired infections, a set of standard precautions are recommended by the Centers for Disease Control and Prevention (CDC) that should be applied to each patient based on their diagnosis and infection status [10, 11]. The standard precautions are comprehensive and evidence-based guidelines for infection control, including hand hygiene, protective barrier usage, such as gloves and gowns, appropriate waste product handling and discarding, patient isolation based on the source of infection transmission, and proper discarding of sharp instruments, such as needles and plaid [12, 13].

Among these standards, hand hygiene is considered the most important [14, 15]. Nursing knowledge and compliance with standard precautions are important for the prevention of healthcare-associated infections (HAIs) and the protection of nurses and patients from exposure to infectious microorganisms. HAI is a new concept being used instead of hospital-acquired infections because many infections are associated with healthcare delivery, either during hospital admissions or in outpatient clinics [16]. The strict implementation and compliance with standard precautions effectively reduce occupational hazards [17, 18]. In particular, hand hygiene reduces infections by approximately 50% [19]. In contrast, poor compliance with standard precautions increases the risk of sharp injuries twice as much as when all precautions are followed [20].

Several studies have indicated that nurses lack knowledge regarding standard precautions [21 - 23]. Knowledge about standard precautions has been reported as a significant predictor for better compliance [24, 25]. Several studies have also reported a lack of or poor compliance with standard precautions among nurses [25 - 27]. Powers *et al.* reported less than one in five nurses to comply with standard precautions [28]. A study conducted among 247 nurses in Jordan showed that although most nurses (90%) had good knowledge about standard precautions, it was not enough to improve their compliance [29]. The current study aimed to investigate the nurses' knowledge and degree of compliance with standard precautions.

## 2. MATERIALS AND METHODS

This study adopted a descriptive, cross-sectional design. A simple random sample of 302 registered nurses who were willing to participate in the investigation and had at least one year-experience were included. The study was conducted at three military hospitals at Royal Medical Services. The study used data provided by the administration at the three hospitals. Then, an anonymized list of all registered nurses was created using computer software. The target population comprised all nurses working at Royal Medical Services. The study sample represented approximately ten percent of the target population. Data were collected through the following three structured

questionnaires: the socio-demographic data questionnaire, the standard precautions knowledge questionnaire [30], and the compliance with standard precautions scale (CSPS) [25]. The data questionnaires package was handed out to the participants. The researchers requested the contact numbers of eligible nurses from the head nurses, and then the participants were contacted to participate in the study after explaining the aims of the study. The participants filled out the questionnaires at the end of their shifts. Data were collected over a period of 1 month from December 15, 2018, to January 15, 2019.

### 2.1. Instruments

The socio-demographic data questionnaire was developed by the authors and included the following: age, gender, educational level, hospital, working department, working experience, and previous infection control training course.

The Standard Precautions Knowledge Questionnaire is a 19-item scale, with requires 'yes' and 'no' responses. The correct answer was awarded one point, and an incorrect answer was awarded 0; the maximum possible score was 19. The higher the score, the greater was the nurses' assumed knowledge about standard precautions. The test results were interpreted as follows: 16 – 19 was "very good knowledge," 12 – 15 was "good knowledge," 8 – 11 was "fair knowledge," and 0 – 7 was "poor knowledge". In a previous validation study, the Standard Precaution Knowledge Questionnaire exhibited an interclass correlation coefficient of 0.91 and a satisfactory Kappa index [31].

The CSPS is a 20-question tool evaluating compliance with PPE use, disposal of sharp objects and other biological waste, decontamination of spills and used articles, and prevention of cross-infection. The response was set on a 4-point Likert scale, which consisted of "never," "seldom," "sometimes," and "always." "Always" was assigned a score of one, whereas the other responses were assigned a score of zero. The total score ranged from 0 to 20, with higher scores indicating better compliance with the standard precautions. Items 2, 4, 6, and 15 were reverse-coded. A pilot study with 10 nurses was conducted to assess the clarity and readability of the instruments, the reliability and validity of the instruments, and the time required to complete the questionnaires. All questions in both questionnaires were clear and did not require any changes. The investigators determined that 20 minutes would be sufficient to complete both the questionnaires. The pilot study revealed Cronbach's  $\alpha$  of 0.88 for knowledge and 0.85 for compliance. Valim *et al.* [32], Cruz *et al.* [33], and Pereira *et al.* [34] established that CSPS exhibits good reliability with Cronbach's  $\alpha$  ranging from 0.61 to 0.89, which validates it.

### 2.2. Statistical Analysis

Assumptions of normality and linearity were checked for violations. Quantitative data are expressed as means, medians, and standard deviations (SD), whereas qualitative data are expressed as frequencies and percentages. Pearson's correlation test was used to assess the correlation between nurses' knowledge and compliance with standard precautions. The level of significance was set at  $p \leq 0.05$ . Data were analyzed using SPSS (version 25; Armonk, NY: IBM Corp.).

### 2.3. Ethical Consideration

Ethical approval for this study was obtained from the Royal Medical Services (Ref. # 1112019) on December 13, 2018, and the study was conducted according to the principles of the Helsinki Declaration of 1975, as revised in 2013. Each participant selected for this study was provided a written informed consent. The aim, risks, and benefits of the study were explained to the participants. The identifying information was kept strictly confidential in a password-protected computer. The right to participate in or quit the study at any time was guaranteed to the participants.

### 3. RESULTS

The average age of the participants was 30.9 (SD=4.24) years and the majority of them (196, 49%) were between the ages of 24 and 30. Of the 302 nurses, 166 (55%) were females, and the rest (45%) were males. The majority of the nurses (88%) had a bachelor's degree, 10.3% had a master's degree, and only 1.7% had a PhD. The average clinical experience was 7.28 years (SD=3.47). Furthermore, 73 nurses (24.2%) had attended an infection control training course (Table 1).

The mean knowledge score was 14.09 in the Standard Precautions Knowledge Questionnaire, while the mean compliance score was 14.46 in the CSPS. The cumulative

scores and distribution of the study participants' knowledge of the standard precaution knowledge questionnaire were estimated. A total of 127 participants (42.1%) scored within the range of 12 to 15 indicating "good knowledge," while 36.1% of the participants scored within the range of 16 to 19 indicating "very good knowledge." None of the study participants had a poor level of knowledge (Table 2).

The majority of the participants (75.2%) answered that invasive procedures increase the risk of nosocomial infection. Additionally, 69.3% answered that age (either advanced or young age) increases the risk of nosocomial infections. Around two-thirds (73.6%) of the participants answered that standard precautions aim to protect patients and healthcare workers. Around two-thirds (71.6%) answered that standard precautions should be applied to all patients. Approximately, 80% of the participants answered that hand hygiene should be performed before and after contact with a patient and between patient contacts. Most of the participants (80.2%) answered that gloves should be used when there is a risk of being cut, whereas 75.2% of the participants answered that gloves should be used when there is a risk of contact with blood or bodily fluids. Furthermore, 71.6% of the participants answered that masks, goggles, and gowns should be worn when there is a risk of splashes or spraying of blood and body fluids (Table 3).

**Table 1. Socio-demographic characteristics of the participants.**

Variables	N (%)
<b>Age (mean=30.9, SD=4.24)</b>	
24-30	148 (49)
31-37	130 (43)
38-44	24 (8)
<b>Gender</b>	
Male	136 (45)
Female	166 (55)
<b>Educational level</b>	
Bachelor	266 (88)
Master	31 (10.3)
Doctoral	5 (1.7)
<b>Hospital</b>	
KHMC	121 (40)
PRH	93 (30.8)
PHH	88 (29.2)
<b>Working department</b>	
Medical ward	54 (17.9)
Surgical ward	53 (17.5)
ICU	81 (26.9)
ER	69 (22.8)
Operation unit	45 (14.9)
<b>Years of experience (mean=7.28, SD=3.47)</b>	
1-5	137 (45.4)
6-10	95 (31.5)
11-15	53 (17.5)
16-20	16 (5.3)
21-25	1 (0.3)
<b>Previous infection control training course</b>	
Yes	73 (24.2)
No	229 (75.8)

**Abbreviations:** KHMC: King Hussein Medical Center, PRH: Prince Rashid Hospital, PHH: Prince Hashim Hospital, ICU: Intensive Care Unit, ER: Emergency Room.

**Table 2. Nurses' knowledge and compliance with standard precautions.**

	N (%)	Mean (SD)
-	-	-
Knowledge of standard precaution	-	14.09 (2.97)
Compliance with standard precautions	-	14.46 (3.02)
Categories of nurses' knowledge regarding standard precautions		-
Poor knowledge	0 (0)	
Fair knowledge	66 (21.8)	
Good knowledge	127 (42.1)	
Very good knowledge	109 (36.1)	

**Table 3. Nurses' response regarding knowledge of standard precaution.**

Statements	Correct Answer	N (%)
<b>1. Nosocomial infection</b>	No	197 (65)
a. The environment (air, water, inert surfaces) is the major source of bacteria responsible for nosocomial infection.		
b. Advanced age or very young age increases the risk of nosocomial infection.	Yes	210 (69.3)
c. Invasive procedures increase the risk of nosocomial infection.	Yes	228 (75.2)
<b>2. Precaution standards</b>	No	242 (79.9)
a. Include the recommendations to protect only the patients.		
b. Include the recommendations to protect the patients and the healthcare workers.	Yes	223 (73.6)
c. Apply for all the patients.	Yes	217 (71.6)
d. Apply for only healthcare workers who have contact with body fluid.	No	245 (80.6)
<b>3. When is hand hygiene recommended?</b>	No	243 (52.2)
a. Before or after contact with (or care of) a patient.		
b. Before and after contact with (or care of) a patient.	Yes	241 (79.5)
c. Between patient contacts.	Yes	244 (80.5)
d. After the removal of gloves.	Yes	223 (73.6)
<b>4. The standard precautions recommend the use of gloves</b>	No	231 (76.2)
a. For each procedure.		
b. When there is a risk of contact with the blood or body fluid.	Yes	228 (75.2)
c. When there is a risk of a cut.	Yes	243 (80.2)
d. When healthcare workers have a cutaneous lesion.	Yes	200 (66)
<b>5. When there is a risk of splashes or spray of blood and body fluids, the healthcare workers must wear</b>	No	193 (63.7)
a. Only mask		
b. Only eye protection	No	205 (67.7)
c. Only a gown	No	228 (75.2)
d. Mask, goggles, and gown	Yes	217 (71.6)

**Table 4. Pearson's correlation between nurses' knowledge and compliance with standard precautions.**

Variables	r	P-value
Knowledge of standard precautions	0.77	<0.001
Compliance with standard precautions	-	-

There was a significant positive correlation between the nurses' knowledge and compliance with standard precautions ( $r=0.77$ ,  $p=0.000$ ) (Table 4).

#### 4. DISCUSSION

The current study aimed to assess nurses' knowledge of and compliance with standard precautions. Currently, HAI remains a common issue encountered in healthcare settings worldwide. A nurses' up-to-date knowledge about standard precautions plays an important role in managing this issue. Moreover, compliance with these standards on a daily basis could decrease the infection rate among patients and healthcare

workers. This study was conducted in three hospitals in Jordan, and it revealed nurses to have a good level of knowledge about standard precautions, which is in agreement with another study conducted in Jordan [29]. These findings emphasize the importance given to these standards in the healthcare systems in Jordan.

The good level of knowledge was found to be consistent with compliance with standard precautions, which may be due to the strict monitoring by infection control personnel and nurses-in-charge. These findings contradict those of Suliman *et al.* [29]; they indicated that a good level of knowledge alone

was not enough to ensure compliance. In our study, approximately a quarter of the study sample had attended a training course on infection control, which may have improved their knowledge and compliance with standard precautions. Chan *et al.* [24] and Luo *et al.* [25] reported knowledge about standard precautions to be a significant predictor for better compliance. Some studies have identified a lack of knowledge about standard precautions among the nurses [23, 35 - 37].

In the present study, 79.9% of the nurses believed that the goal of standard precautions was to protect the patients, and 73.6% believed that they also protected healthcare workers. Approximately, 71.6% reported that standard precautions should be applied to all patients. A study conducted among 82 nurses in Brazil showed that 75.6% of nurses understood that standard precautions are protective measures; 11% believed that they protected professionals only, and 52.4% believed that they protected both patients and professionals. Furthermore, 9.8% believed that it was for protection against patients diagnosed with infectious diseases [37]. Siegel *et al.* [18] reported that standard precautions should be applied to all patients because the infective status of a patient is not always known.

Although nurses had a good level of knowledge about standard precautions, only 65% of the participants answered that the environment is not the only source of bacteria responsible for nosocomial infections. Therefore, knowledge about microorganisms requires more attention. Approximately, 79.5% of the participants answered that hand hygiene should be performed before and after contact with patients. This finding implies that standard precautions for hand hygiene are well-established in clinical practice. In contrast, Hessels *et al.* [38] reported that hand hygiene was performed only half of the times when indicated and was more often missed before contact with a patient than after.

Approximately, 71.6% of the participants answered that they should use masks, goggles, and gowns when there is a risk of splashes or spraying of blood and bodily fluids. This implies that PPE is well-recognized as an effective means for controlling infection and protecting patients and healthcare workers. In contrast, a study conducted by Jain *et al.* [39] revealed that less than half of the participants used PPEs for maximal protection, which put the healthcare workers at risk for blood-borne infections, such as hepatitis and HIV, through splashes or spraying of blood and bodily fluids.

Finally, our study showed a strong positive correlation between knowledge of and compliance with standard precautions ( $r=.77, p=.000$ ). This implies that infection control training courses and continuous education may improve knowledge of standard precautions and positively affect compliance. Knowledge about standard precautions and the availability of PPE have been determined as the main factors for compliance with standard precautions [25, 40].

## 5. IMPLICATIONS FOR NURSING

Infection control training courses and continuous education may improve knowledge of standard precautions and positively affect the compliance of nurses.

## 6. STRENGTH AND LIMITATIONS OF THE STUDY

The strength of this study was using random sampling of the participants to avoid selection bias. Whereas, the limitations of this study are that the recruitment of military nurses only and using self-reported questionnaires rather than actual observation of the compliance of nurses limited the generalization of the findings. The self-reported questionnaires might have led to recall bias.

## CONCLUSION

In conclusion, the nurses' knowledge of standard precautions was good in this study, and it translated into appropriate compliance in clinical practice. There was a positive relationship found between nurses' knowledge and compliance with standard precautions. Continuous monitoring and evaluation of the implementation of standard precautions are needed to maintain and enhance compliance among the nurses.

## LIST OF ABBREVIATIONS

<b>HAI</b> s	=	Healthcare-associated Infections
<b>HIV</b>	=	Human Immunodeficiency Virus
<b>HBV</b>	=	Hepatitis B
<b>PPE</b>	=	Personal Protective Equipment

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval for this study was obtained from the Royal Medical Services (Ref. # 1112019) on December 13, 2018.

## HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All procedures performed in studies involving human participants were in accordance with the 1975 Declaration of Helsinki, as revised in 2013.

## CONSENT FOR PUBLICATION

A written informed consent was provided by each participant selected for this study.

## STANDARDS OF REPORTING

STROBE guidelines were followed.

## AVAILABILITY OF DATA AND MATERIAL

The data and supportive information are available within the article.

## FUNDING

None.

## CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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Declared none.

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