Scientific Paper Entitled: Nurses' Knowledge Levels About Preventing Intravascular Catheter Infections. A Cross-Sectional Study

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Abstract

Background: This study aimed to assess the level of knowledge among nurses regarding the prevention of infections related to intravenous catheters.

Methods: The study involved junior and senior nurses (n=430) of government healthcare institutions in Riyadh city. Data collection was done using a 21-item questionnaire, which was distributed to the nurses to complete. The data analysis involved presenting categorical variables as number and percentage distributions, while numerical variables were summarized using means,

standard deviation, minimum, and maximum values. To compare knowledge scores based on the nursing level, and gender, the t-test was used as the parametric test assumptions were met in this case.

Results: The findings revealed that the average knowledge score among nurses regarding the prevention of intravenous catheter infections was 52.60. Gender did not have a significant impact on the nurses' knowledge scores. However, senior nurses had a higher mean knowledge score (59.8%) compared to junior nurses (40.2%).

Conclusion: The study demonstrated that nurses displayed a moderate level of knowledge (mean score of 52.60 ± 15.11) concerning the prevention of intravenous catheter infections.

Keywords: Intravenous Catheter, Infection, nurses.

Introduction

Intravascular catheters are frequently necessary for the treatment of individuals who are critically ill. They support the safe administration of intravenous fluid resuscitation, the safe administration of medications, and the monitoring of hemodynamic parameters in the treatment of patients with syndromes such as pulmonary hypertension, decompensated heart failure, septic shock, and cardiogenic shock. Intravascular catheters have advantages, but they can also act as entry points for systemic and localized bloodstream infections. Because of this, a lot of work has been done to lower the frequency of bloodstream infections via Intravascular catheters (1).

Intravenous catheter insertions are among the most often performed procedures on hospitalized patients, which leaves them vulnerable to both infectious and noninfectious problems (2). Depending on how severe the symptoms are, intravascular catheter problems are divided into minor and major categories. Catheter occlusions, unintentional removals, pain, and needle phobia—a dread of sharp catheters—are examples of minor problems. Major problems, on the other hand, include phlebitis, infection, extravasation, and even skin damage, which are typically more serious (3). Adult intravascular catheter use has been the

subject of published research using a variety of descriptive, correlational, and randomized controlled trial techniques (4,5).

According to a systematic review, the incidence of infection was 0.1-0.2/100 catheter days or 0.1-0.2/100 catheters (5). Others found that the frequency of phlebitis was 6.2%, the rate of leakage was 12.4%, and the rate of infiltration was 7.4%. They also came to the startling conclusion that the risk of phlebitis increased by 4.4 times when PIVC catheters were restarted (6). Furthermore, it has been discovered that the length of the patient's stay as well as the drug or infusion that they got via Intravascular catheters are directly linked to peripheral intravenous (IV) phlebitis (4).

In Saudi Arabia, A recent study sheds light on the prevalence of complications associated with Intravenous catheter insertion. The study, conducted on a cohort of recruited patients, found that 39.3% of them experienced complications related to Intravenous catheter insertion. In total, 273 instances of various complications were recorded, indicating an incidence rate of 32.4 per 100 catheters. Notably, phlebitis emerged as the most common complication, with a striking incidence rate of 17.6%, followed by pain (7.6%) (7).

Nurses' knowledge of evidence-based CVC care needs to be supported by the policies, procedures, and practices of their own ICU. Despite the publication of evidence-based recommendations, changes in practice often lag behind guideline dissemination (8). Another study surveyed 14 ICUs in Australia to determine whether clinical practice reflected the CDC guidelines and found significant discrepancies (9).

The occurrence of complications in these individuals is significantly impacted by the uneven adoption of evidence-based management. Apart from the standards established by the CDC, other available resources instruct bedside nurses on best practices for preventing complications. Nevertheless, there are variations in hospital protocols and nurses' comprehension of these best practices (10).

Study objectives

The purpose of the study was to evaluate nurses' knowledge of how to prevent IV catheter infections. Its specific goal was to find

out the extent to which nurses were aware of the protocols and practices required to avoid infections related to intravascular catheters. The objectives of the study included:

1- evaluating the general knowledge of nursing students about preventing intravenous catheter infections.
2- assessing nurses' knowledge of the ways that infections spread in medical environments.
3- examining the knowledge of nurses regarding the meanings and traits of infections connected to healthcare.
4- Analyzing the influence of factors such as gender and years of experience on nursing students' knowledge levels regarding intravenous catheter infections prevention.

Study Limitations:

- Geographical limitations: The study will be conducted in the Kingdom of Saudi Arabia.
- Time limitations: The study will be conducted in 2022.
- Human limitations: The study will be conducted on a sample of nursing staff in government hospitals in Riyadh.
- Subject limitations: The study is limited to investigating Nurses' knowledge levels about preventing intravascular catheter infections.

Materials and Methods

Study Design

This study employed a descriptive cross-sectional design.

Location and Time of the Study

The study was conducted at the government healthcare institutions in Riyadh City, Saudi Arabia spanning from January 2022.

Study Population and Sampling

The study population consisted of 665 junior and senior nurses. No sampling was performed, and the research was completed with the participation of 430 nurses who agreed to participate.

Data Collection Instruments

Data collection was carried out using a questionnaire developed by the researchers in accordance with the existing literature (Ulusoy et al., 2005). The questionnaire consisted of 21 items. The first three items gathered socio-demographic characteristics such as age, gender, and experience level of the nurses. The fourth item addressed the nurses' opinions on the routes of pathogen transmission, while the fifth item focused on their understanding of healthcare-related infections. The remaining items (6th to 21st) assessed the nurses' knowledge of intravenous catheters. Among these items, one was in a multiple-choice format, while the other 16 presented options of "true," "false," and "do not know."

Data Collection

Data were collected between March 2022. After informing the nurses about the research, they were provided with the questionnaire and asked to complete it.

Data Analysis

The collected data were coded and entered into the computer using the EPI data version 3.1 statistical package. Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 27.0 (IBM Corporation, Armonk, NY). The level of knowledge was assessed on a scale of 100 points, with the assistance of a statistical expert. The 100 points were divided among the 16 items in the questionnaire, resulting in 6.25 points allocated to each item. The data were summarized using number and percentage distributions for categorical variables and means, standard deviation, minimum, and maximum values for numerical variables. In terms of interpreting the data, t-tests were used to compare knowledge scores based on experience level and gender, as the parametric test assumptions were met.

Ethical Principles of the Study

The researchers obtained permission letters from the School of Nursing and the Ethical Review Committee, which were distributed to all departments involved in the study. Verbal consent was

obtained from the nurses after providing them with information about the research.

Results:

Among the included nurses, 27.4% (118) were male and 72.6% were female. In terms of Nursing experience, 59.8% (257) were senior nurses and 40.2% (173) were junior nurses. When asked about the most common way pathogens are transmitted from one patient to another in a hospital, 42.3% (182) responded with "contaminated hands of the employees," and 8.4% (36) responded with "inappropriate care given in the environment" **(Table 1).**

Table 2 displays the distribution of responses given by nurses regarding the definition of hospital infections. In response to the question "In your opinion, which of the following definitions is true for hospital infections?", 20.2% (87) of the nurses answered, "They are the infections that have been in the incubation period on admission, which develop after 48-72 hours." Additionally, 13% (56) responded with "They are the infections that spread from one patient to another and develop after 48-72 hours," 4.9% (21) replied with "These infections have symptoms during the hospital stay and develop after discharging the patient," while 61.9% (266) correctly responded with "They are the infections that were not in the incubation period during admission but develop 48-72 hours after hospitalization in the hospital or that can develop within 10 days after discharge."

Table 3 demonstrates the distribution of responses from nurses regarding the prevention of intravenous catheter infections. Out of the sixteen questions related to the prevention of intravenous catheter infections, ten questions were answered correctly by 50% (222) of the nurses, while less than 50% (187) answered six questions correctly. The question that received the most incorrect responses was "Catheters inserted for intravenous therapy in adult patients should be replaced at least after 48-72 hours," with 81.4% (350) providing an incorrect answer. On the other hand, the question that received the fewest incorrect responses was "Hand hygiene should be provided before the insertion of peripheral venous catheters," with only 3.7% (16) answering incorrectly.

Regarding the item "Infusion sets used to deliver lipid emulsions should be replaced within 24 hours following the start of the

infusion," 30% (129) of nurses responded with "I don't know," which was the most common answer. In contrast, only 1.6% (7) responded with "I don't know" to the item "Catheters inserted for intravenous therapy in adult patients should be replaced at least after 48-72 hours."

A statistically significant difference was observed between the average knowledge scores of nurses based on their experience level ($p<0.05$). There was no statistically significance difference between both genders **(Table 4).**

Table 1. Introductory characteristics of nurses included in the study (n=430)

Characteristics			
Gender	Male	118	27.4
	Female	312	72.6
Nursing experience	Senior level (more than 5 years)	257	59.8
	Junior level (less than 5 years)	173	40.2
What is the most common way of contagion of pathogens from one	Through air	79	18.4
	As a result of contact with contaminated material	133	30.9
	Through contaminated hands of the employees	182	42.3
		36	8.4

patient to another in a hospital	Through care provided in an inappropriate environment		

Table 2. Distribution of responses of nurses on the definition of healthcare-related

Infections.

In your opinion, which of the following definitions is true for hospital infections?

They are infections that have been in the incubation period on admission, which develop after 48-72 hours.	87	20.2
They are infections that spread from one patient to another and develop after 48-72 hours.	56	13
These infections have symptoms during the hospital stay and develop after discharging the patient.	21	4.9
They are the infections that were not in the incubation period during admission but develop 48-72 hours after hospitalization in the hospital or that can develop within 10 days after discharge.	266	61.9

Table 3. Distribution of Responses of Nurses to Questions Regarding the Prevention of Intravenous Catheter Infections

	Correct answers	True answers	
		n	%
Hand hygiene must be provided before inserting a peripheral venous catheter.	True	406	94.4
Catheters inserted for intravenous therapy in adult patients should be replaced at least after 48-72 hours.	False	350	81.4
The infusion of blood and blood products should be completed within a maximum of four hours.	True	309	71.9
Catheter insertion sites on the lower extremities bear a higher risk of infection than the upper extremities.	True	308	71.6
The infusion sets used to deliver blood and blood products should be replaced within 48 hours following the start of the infusion	False	288	67.7
Central venous catheters must be routinely replaced to prevent catheter-related infection.	False	275	64.0
Peripheral venous catheters can be replaced at intervals longer than 72-96 hours if finding a new peripheral venous vessel is problematic in adult Patients and if there are no symptoms of phlebitis or infection.	True	269	62.6
The antiseptic solution, applied before inserting the catheter, should be Allowed to dry.	True	249	57.9

It is not necessary to replace infusion sets and any associated connections at intervals shorter than 72 hours unless there is a catheter-related infection.	True	229	53.3
The infusion sets used to deliver lipid emulsions should be replaced within 24 hours following the start of the infusion.	True	228	53.0
When the povidone-iodine solution is used on the catheter entry, one must wait at least two minutes for the solution to dry.	True	222	51.6
Sterile gloves should be worn to insert peripheral venous catheters, and the catheter entry site may be re-palped after cleaning with an antiseptic solution.	False	216	51.6
Dressings of central venous catheters should be replaced every two days if gauze bandage is used, or every seven days if a sterile transparent cover Is used.	True	187	43.5
Routine replacement of peripheral venous catheters is not necessary in Pediatric patients unless complications develop.	True	163	37.9
Nonsterile gloves should be worn when fitting arterial or central catheters.	False	147	34.2
Solutions remained in single-dose ampoules or vials should be stored for later use.	False	88	19.1

Table 4. Mean Knowledge Scores of Nurses on the Prevention of Intravenous Catheter Infections

		N	Min.	Max.	Mean	SD	P value
Experience level	Senior Level Junior Level	257 73	12.50 12.50	87.50 87.25	57.0588 45.9884	3.64438 14.80846	t=7.970 p=.000
Gender	Female Male	312 118	12.50 18.75	87.50 87.25	52.1141 53.9025	15.45171 14.17899	t=-1.095 p=.274
Total score		430	12.50	87.50	52.6049	15.11794	

t*=t-test for independent groups

Discussion

Intravenous catheters are commonly used medical devices in patient treatment and monitoring (11). However, the increasing use of intravenous catheters has led to a rise in catheter-related infections (11), making them the primary cause of healthcare-associated infections.

Among the nurses, 42.3% correctly identified contaminated hands as the most common pathway for pathogen transmission between patients in a hospital (Table 1). These findings demonstrate that nurses possess knowledge about the routes of pathogen transmission. However, 57.7% of the nurses lacked sufficient knowledge in this area. To enhance the knowledge level of nursing nurses, it may be beneficial to allocate courses and conferences to topics related to the prevention of healthcare-associated infections and the transmission of microorganisms in their education.

Regarding the definition of healthcare-associated infections, 61.9% of nurses provided the correct response, stating that these infections either develop 48-72 hours after hospitalization or can manifest within 10 days after discharge (Table 2). These results indicate that a majority of nurses understand the nature and time frame of healthcare-associated infections. In a study by Mankan et al. (2015), 81.1% of nurses accurately described the definition of healthcare-associated infections (12). Similarly, in a study conducted by Artan et al. (2015) among healthcare workers and nurses in healthcare services vocational higher schools, 70.6% of the staff and 50.8% of the nurses provided correct responses to the definition of healthcare-associated infections (13,14)

Among the nurses, 81.4% (350) provided an incorrect response to the statement that catheters inserted for intravenous therapy in adult patients should be replaced after 48-72 hours, while 17% (73) answered correctly (Table 3). This high number of incorrect answers among the nurses may be attributed to the outdated literature that previously recommended the 48–72-hour replacement time for catheters (15). In a study by Mankan et al. (2015), 92.6% of nurses also provided an incorrect answer to this question.

The nurses had an average knowledge score of 52.6 regarding the prevention of intravenous catheter infections (Table 4). In comparison, the mean knowledge score of nurses in the study by Mankan et al. (2015) was 63.47. These findings indicate that nurses possess some knowledge about the prevention of intravenous catheter infections, but there is still room for improvement. In the United States, the Health Care Improvement Institute has introduced the concept of bundles, which are groups of best practices aligned with evidence-based guidelines for improving healthcare practices. These bundles, including hand hygiene, maximal barrier precautions during catheterization, chlorhexidine skin antisepsis, appropriate catheter site selection, and daily evaluation of central catheter necessity, have shown positive effects on patient outcomes. Given that nurses will work in various departments of hospitals, it is crucial to emphasize evidence-based, zero-risk studies focused on preventing catheter-related bloodstream infections due to their significant impact on mortality, morbidity, and cost (16).

There was no statistically significant difference in the mean knowledge scores of nurses based on gender (Table 4). However, a significant difference was observed in the mean knowledge scores among different years of experience. This result highlights the positive influence of education and a supportive learning environment on the acquisition and application of knowledge. It also suggests the presence of effective control mechanisms, potentially influenced by the teaching staff.

Conclusion and Recommendations

The nurses included in the study demonstrated a relatively high level of knowledge regarding intravenous catheter infections, with a mean knowledge score of 52.60. Gender did not have a significant impact on the nurses' knowledge scores. However, senior nurses had a higher mean knowledge score (59.8%) compared to junior nurses (40.2%).

To ensure that nurses receive comprehensive and up-to-date training on the prevention of healthcare-related infections and intravenous catheter infections, it is recommended to conduct qualitative and quantitative assessments of their training needs. Administrative supervision during their internship practice can also help identify areas that require further attention. Before starting the profession, nurses should undergo in-service training programs that focus on specific knowledge, attitudes, and practices aimed at preventing healthcare-related infections.

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