

Knowledge Regarding Intravenous Cannulation among Nursing Students at the School of Health Sciences of Purbanchal University, Gothgaun, Morang, Nepal

Pramila Sinha¹, Puja Sahu², Roshni Chaudhary²

¹Assistant Lecturer, ²Fourth-Year Nursing Students, Department of Medical-Surgical Nursing, Faculty of Medical and Allied Science, Purbanchal University, Gothgaun, Morang, Nepal

Corresponding Author: Pramila Sinha

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ABSTRACT

Background: Health care professionals, especially nurses who frequently use an IV cannula in the hospital setting, must have good knowledge, be well trained, and have experience in the insertion of this device. Improper use of this vascular access device can lead to many complications, such as extravasation, infiltration, inflammation, obstruction, phlebitis, infection, sepsis, and thrombophlebitis.

Objective: To assess the knowledge of intravenous cannulation and the association between knowledge levels and selected sociodemographic variables among BSc. Nursing students at the School of Health Sciences of Purbanchal University.

Methods: A descriptive cross-sectional study was designed. A total of 95 students were enrolled in this study, and a self-administered questionnaire was used to collect data. The χ^2 statistic was used to find the association between knowledge levels and the selected demographic variables.

Results: Of the 95 nursing students, none obtained 100% knowledge scores. More than half of the students (55.8%) had adequate knowledge, and 44.2% had inadequate knowledge about intravenous cannulation. A statistically significant relationship was observed between knowledge level and the academic year of the students ($P = 0.011$).

Conclusion: More than half of the nursing students had adequate knowledge about intravenous cannulation, while 44.2% of the students had inadequate knowledge that needed to be improved. A statistically significant relationship was observed between the knowledge level and academic year of the students, indicating that educational level significantly affected their knowledge.

Keywords: Intravenous cannula, Knowledge, Nursing students

INTRODUCTION

Nurses and midwives are the front-line health care providers in all hospital settings. They commonly use an important piece of equipment called a peripheral intravenous (IV) cannula, which is a small-bore hollow needle used to give the necessary IV fluids, medications, blood, diagnostic tests, and nutrition to the patient.^[1] Nearly 25 million people receive

intravenous treatment yearly worldwide through the IV cannula.^[2] However, the IV cannulation process must require a sterile technique because it enters the patient's vein. It is a common source of infection due to the migration of skin flora from the insertion site to the patient's bloodstream.^[3,4] Therefore, health care professionals, especially nurses who frequently use IV cannulas in the hospital setting, must have

sound knowledge, be well trained, and have experience in the insertion of this device.

Improper use of this vascular access device can lead to many complications, such as extravasation, infiltration, inflammation, tenderness over the cannula, obstruction, phlebitis, infection, sepsis, needle stick injury, and thrombophlebitis.^[3,5] A study reported that the rates of phlebitis, hematoma, infiltration, and extravasations were 21%, 12%, 7%, and 3.5%, respectively.^[6] Another study conducted in Pakistan reported that the rate of increased infection related to the IV cannulation procedure was approximately 12.94%.^[7] These complications can deteriorate the patient's health status, and patients may unnecessarily suffer from discomfort and increased health care costs. A study conducted in the United States reported that 30% of bacteremia in hospitals was associated with IV catheters.^[8] These problems occur due to poor knowledge and skill of IV cannulation. A study carried out in Bharatpur, Nepal, showed that most nurses had inadequate knowledge and unsatisfactory practice of IV therapy.^[1] Another study was conducted in nursing students in Ethiopia and reported that 59% of the students scored below the mean on peripheral venous catheter knowledge testing items.^[9]

To minimize the risk of IV cannulation complications, nurses must have to plan and perform nursing care with knowledge, attitude, skill, and confidence. At the same time, nurses must follow the guidelines for the use of sterile non touch techniques, cover the intubation site with sterile and transparent material, and provide a comfortable environment for the patient.^[3] However, very few studies have been conducted in Nepal to evaluate the knowledge of nursing students regarding IV cannulation.^[1,10] To reduce IV cannulation-related complications and hospital-acquired infections, the knowledge of the students must be adequate so that they provide adequate nursing care to the patients. Therefore, this study assessed the

knowledge of intravenous cannulation and the association between knowledge levels and selected sociodemographic variables among BSc. Nursing students at the School of Health Sciences of Purbanchal University.

MATERIALS AND METHODS

This study was a descriptive cross-sectional design conducted from June 2021 to January 2022. Purbanchal University School of Health Sciences, Gothgaun Morang, approved the proposal and permitted us to conduct this study. The study population included all 107 BSc. Nursing students who were studied in the second, third, and fourth academic years were invited to participate in the study. All first-year students were excluded from the study because they were recently admitted to BSc. Nursing programs and had no exposure to clinical procedures. Those students who were not willing to participate and did not give informed consent and who were involved in the pretest procedure of the questionnaire were excluded from the study. Finally, 95 students were enrolled in the study. Before starting the data collection procedure, the purpose of the study and the roles of the participants were explained and asked to sign an informed consent form. No incentive was given to the study participants. Personal identification information was not collected to maintain the confidentiality of the participants.

After reviewing the published literature^[4,9,10] and obtaining expert opinions from the nursing faculty, a self-report questionnaire was prepared and pretested with 10 students to correct ambiguities and inconsistencies. A finalized self-report questionnaire was administered to each participant and asked them to answer the questions. The questionnaire consisted of sociodemographic characteristics of the participants and their knowledge of the IV cannulation site, size, procedures, preparation, precautions, and complications. The questionnaire consisted of 19 closed-ended questions related to

knowledge of IV cannulation, which carried one score for the correct answer and zero scores for the incorrect answer. Therefore, the total score ranged from zero to 19. Based on the total score obtained by the students, the level of knowledge was determined as follows: inadequate knowledge ($\leq 75\%$ of the total scores, i.e., zero to 14 scores) and adequate knowledge ($>75\%$ of the total scores, i.e., 15 to 19 scores).^[1]

Statistical Analysis

All data were entered into Excel 2010 and analyzed using SPSS 20.0 version (SPSS Inc., Chicago, USA). To simplify the analysis, the variables were categories such as age group (19-21 or 22-24 years), religious group, ethnic group (Brahman/Chhetri and other castes), and total duration of clinical exposure (2-4 months and more than 4 months), as shown in Table 1 in the Results section. Descriptive statistics such as frequency, percentage, mean, and standard deviation were used to present the data. Inferential statistics, such as the chi-square test, were applied to find the association between the levels of knowledge and the selected sociodemographic variables of the study participants. Values of $P < 0.05$ and a confidence interval of 95% were considered statistically significant.

RESULTS

Of the 95 respondents, most of the students (40, 42.1%) studied in the third year of the BSc. Nursing subjects, followed by 37 (38.9%) in the second year and 18 (18.9%) in the fourth year. The mean age of the respondents was 21.12 ± 0.999 years. The proportion of followers of Hindu religions was 96.8%, and the Brahmin/Chhetri ethnicity was 64.2%. However, 76.8% of the students had only 2-4 months of clinical exposure to intravenous cannulation procedures (Table 1).

Table 1: Sociodemographic characteristics of the respondents (n = 95)

Variables	Category	Number (Percentage)
Academic year of study	2 nd year	37 (38.9)
	3 rd year	40 (42.1)
	4 th year	18 (18.9)
Age	19-21 years	64 (67.4)
	22-24 years	31 (32.6)
Religion	Hinduism	92 (96.8)
	Islam	2 (2.1)
	Christianity	1 (1.1)
Ethnicity	Brahmin/Chhetri	61 (64.2)
	Janajati	21 (22.1)
	Madhesi	7 (7.4)
	Dalit	1 (1.1)
	Muslim	2 (2.1)
Total duration of clinical exposure of cannulation procedures	2-4 months	73 (76.8)
	5-7 months	11 (11.6)
	8-10 months	9 (9.5)
	11-13 months	2 (2.1)
	No clinical exposure	0 (0.0)

Table 2: Knowledge regarding IV therapy and IV cannulation process (n = 95)

No	Variables	Number (Percentage)
1.	Meaning of intravenous therapy	
	a. A process of administration of fluid or medication directly into a vein	2 (2.1)
	b. A process of receiving either medication or nutrition directly to their veins through a tube called cannula	13 (13.7)
	c. The fastest way to deliver fluid and medication throughout the body	0 (0.0)
	d. All of the above	80 (84.2)
2.	Meaning of intravenous cannulation	
	a. A technique in which a cannula is placed inside a vein to provide venous assess	91 (95.8)
	b. A technique in which a cannula is placed inside the muscle to provide venous assess	1 (1.1)
	c. A technique in which a cannula is placed inside the subcutaneous layer of skin to provide venous assess	0 (0.0)
	d. None of the above	3 (3.2)
3.	Indication of intravenous cannulation	
	a. To administer drugs	94 (98.9)
	b. To measure urine output	1 (1.1)
	c. To administer laxative	0 (0.0)
	d. To measure volume of blood	0 (0.0)
4.	Incorrect statement about IV cannulation process	
	a. Nurse chooses intravenous site carefully so that patient's ability is not decrease	21 (22.1)
	b. A tourniquet must be applied and vein must be assessed	8 (8.4)
	c. Incidence of thrombophlebitis could be reduced by small size peripheral intravenous cannula	13 (13.7)
	d. Cold compresses are very helpful in dilating veins	53 (55.8)

Table 2 shows that 84.2% of the respondents gave the correct meaning of intravenous therapy, and 95.8% knew that intravenous cannulation is the process of inserting a cannula into a vein. More than half of the respondents (55.8%) responded that cold compresses do not help to dilate the veins, while 8.4% of the students did not know about the application of a tourniquet to access the vein site. Knowledge of the use of a small cannula to reduce thrombophlebitis was lacking in 13.7% of the students (Table 2).

Knowledge about the site and size of the cannulation showed that 100% of the

students knew that the vein was the site of insertion of the IV cannula. More than half of the students (60%) responded that the cephalic, basilic, and median cubital veins were the commonly used veins for IV cannulation; however, the most preferred vein to insert the cannula was the dorsal straight & thick vein. The majority of the respondents believed that the cannula commonly used for children under 5 years of age was 24G, and for the adult patients, it was 22G. In addition, 71.6% of the students knew that the preferred angle for inserting the cannula between the needle and the skin surface was 15-30° (Table 3).

Table 3: Knowledge regarding site and size of cannulation (n = 95)

No	Variables	Number (Percentage)
1.	Blood vessel used to insert intravenous cannula is	
	a. Vein	95 (100)
	b. Artery	0 (0.0)
2.	Most commonly used vein(s)is/are	
	a. Cephalic vein	15 (15.8)
	b. Basilic vein	6 (6.3)
	c. Median cubital vein	17 (17.9)
	d. All of them	57 (60.0)
3.	Most priorities vein while inserting IV Cannula is	
	a. Very thin vein	0 (0.0)
	b. Central vein	15 (15.8)
	c. Jugular vein	21 (22.1)
	d. Dorsal straight and thick vein	59 (62.1)
4.	Commonly used cannula size in child patient under five years aged is	
	a. 16G	10 (10.5)
	b. 18G	0 (0.0)
	c. 20G	5 (5.3)
	d. 24G	80 (84.2)
5.	Commonly used cannula size for adult patient is	
	a. 20G	45 (47.4)
	b. 22G	48 (50.5)
	c. 24G	1 (1.1)
	d. 26G	1 (1.1)
6.	The color of the 20G cannula is	
	a. Red	2 (2.1)
	b. Blue	1 (1.1)
	c. Pink	90 (94.7)
	d. Green	2 (2.1)
7.	Angel of insertion between needle & skin is	
	a. 15-30°	68 (71.6)
	b. 30-40°	16 (16.8)
	c. 40-50°	11 (11.6)
	d. 50-60°	0 (0.0)

More than two-thirds of the students (71.6%) knew that they should wash their hands before and after IV cannulation. The majority of the respondents (86.3%) responded that the lower extremities of diabetic patients, previously used veins or sclerotic veins, and veins in the arm of an AV fistula could not be used for cannulation. To disinfect the cannulation site, 45.3% of the students understood the

wipe procedure from the center to the periphery. However, 83.2% of the respondents believed that the IV cannula should be changed every 72 hours. Most students said that the blister was not seen at the insertion site as an early sign of phlebitis; however, swelling was the most common complication of venous cannulation (Table 4).

Table 4: Knowledge regarding preparation, precaution, and complication of IV cannulation process (n = 95)

No.	Variables	Number (Percentage)
	When need to wash hand while performing IV cannulation	
1.	a. Before and during intravenous cannulation	5 (5.3)
	b. During and after intravenous cannulation	16 (16.8)
	c. Before, during and after intravenous cannulation	6 (6.3)
	d. Before and after intravenous cannulation	68 (71.6)
	The proper way to disinfection skin is	
2.	a. Wipe the area from the center of the injection site to outward	43 (45.3)
	b. Wipe the area from top of the injection site to bottom	42 (44.2)
	c. Wipe the area from peripheral of the injection site to center	5 (5.3)
	d. Wipe the area from bottom to top	5 (5.3)
	Which article is not required for IV cannulation	
3.	a. Surgical Blade	95 (100)
	b. Intravenous cannula	0 (0.0)
	c. Gloves	0 (0.0)
	d. Spirit swab	0 (0.0)
	What measure should require during performing IV cannulation if cut injury already present in your hand	
4.	a. Use gloves	16 (16.8)
	b. Use band aid & gloves	78 (82.1)
	c. Use band aid	1 (1.1)
	d. No measures required	0 (0.0)
	Vein should be avoided for IV cannulation	
5.	a. Lower extremities of a diabetic patient	0 (0.0)
	b. Previously used veins and sclerotic veins	12 (12.6)
	c. Veins in the arm of AV fistula	1 (1.1)
	d. All of the above	82 (86.3)
	Necessarily changed IV cannula	
6.	a. Every 12 hourly	3 (3.2)
	b. Every 24 hourly	7 (7.4)
	c. Every 48 hourly	6 (6.3)
	d. Every 72 hourly	79 (83.2)
	Which is not the early sign of phlebitis	
7.	a. Warmth at the insertion site	0 (0.0)
	b. Edema	9 (9.5)
	c. Blister	75 (78.9)
	d. Erythema at the insertion site	11 (11.6)
8.	The common complication after cannulation	
	a. Swelling	92 (96.8)
	b. Headache	1 (1.1)
	c. Sweating	0 (0.0)
	d. Fever	2 (2.1)

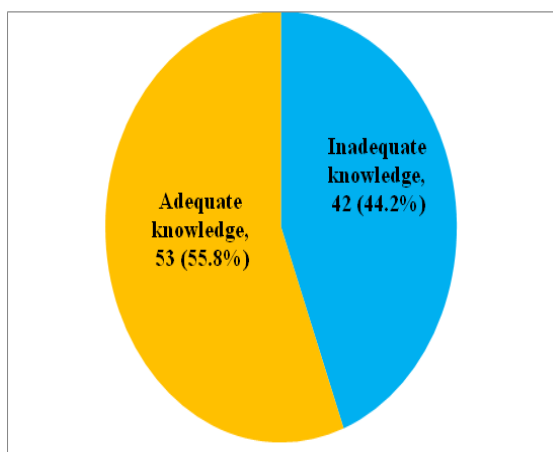


Figure 1: The overall level of knowledge regarding intravenous cannulation

Figure 1 shows the overall level of knowledge about intravenous cannulation. More than half of the students (55.8%) had

adequate knowledge, while 44.2% had inadequate knowledge on intravenous cannulation.

Knowledge of IV cannulation was more among third-year students (72.5%) than among second- and fourth-year students. The level of education or academic year was statistically significantly associated ($p=0.011$) with the level of knowledge about IV cannulation. However, there was no statistically significant relationship between the level of knowledge about IV cannulation and age, religion, ethnicity, or the total duration of clinical exposure to the cannulation procedure (Table 5).

Table 5: Association between the level of knowledge and the selected demographic Variables of the students (n = 95)

Variables	Adequate Knowledge n (%)	Inadequate Knowledge n (%)	χ^2 P-value
Academic year of study			
2 nd year	18 (48.6)	19 (51.4)	0.011
3 rd year	29 (72.5)	11 (27.5)	
4 th year	6 (33.3)	12 (66.7)	
Age			
19-21 years	40 (62.5)	24 (37.5)	0.058
22-24 years	13 (41.9)	18 (58.1)	
Religion			
Hinduism	52 (56.5)	40 (43.5)	0.413*
Others	1 (33.3)	2 (66.7)	
Ethnicity			
Brahmin/Chhetri	32 (52.5)	29 (47.5)	0.381
Others	21 (61.8)	13 (38.2)	
Total duration of clinical exposure of cannulation procedures			
2-4 months	42 (57.5)	31 (42.5)	0.533
5-13 months	11 (50.0)	11 (50.0)	
* Fisher's Exact Test			

DISCUSSION

The present study examines the knowledge of IV cannulation among BSc. Nursing students at the School of Health Sciences of Purbanchal University revealed that 55.8% of nursing students had adequate knowledge and 44.2% had inadequate knowledge. An Ethiopian study on nursing students reported that 59% of the students had scored below the mean score (poor knowledge) of peripheral venous catheter knowledge testing items.^[9] Another study conducted in Nepal reported that 50.9% of the staff nurses had inadequate knowledge of IV cannulation procedures.^[1] However, contrary to our findings, Osti et al. (2019) reported that 82.47% of staff nurses had adequate knowledge about the care and maintenance of peripheral intravenous cannulas.^[10] These differences explain the variation in the level of knowledge among nursing students and staff nurses, which could be due to years of experience and levels of education.

In our study, the influencing factor for the level of knowledge on IV cannulation was the academic year of the study (P=0.011), and adequate knowledge was more among the second and third year students, while the majority of fourth-year students had inadequate knowledge because the sample size of fourth-year students was small and they had not performed adequate clinical procedures of IV cannulation on patients during the COVID-19 pandemic

due to the closure of colleges in Nepal. However, Etafa et al. (2020) reported that the training and age of nursing students were statistically significantly associated with knowledge of peripheral venous catheters.^[9] The trained students were 2.9 times [AOR=2.9, 95% CI=(1.6, 5.1), p <0.001], and the students aged 20 to 29 years were 2.4 times [AOR = 2.4, 95% CI=(1.3,4.3), p=0.005] more knowledgeable about the peripheral venous catheter.^[9] Another study conducted in Nepal reported that senior nurses had inadequate knowledge compared to staff nurses because most senior nurses were in the administrative post, while junior staff nurses were involved in patient care.^[1] Furthermore, a study from India showed that participation in in-service education for peripheral venous cannulation and the numbers of cannula insertions per day were significantly associated with the knowledge of the staff nurses.^[11] These findings indicate that professional experience, in-service training, level of education, age, and professional designations significantly affect the knowledge of IV cannulation. However, the age and total duration of clinical exposure to cannulation procedures did not significantly affect the knowledge of nursing students in our study.

The results of this study revealed that the highest percentages of students had knowledge of the meaning of IV cannulation (95.8%) and IV therapy

(84.2%). However, 100% of the students knew that the vein was the main blood vessel used for the placement of the IV cannula, and more than half of the students (60%) responded that the cephalic, basilic and median cubital veins were the most preferred veins for insertion of the cannula. Qamar et al. (20217) also reported a similar finding in their study in which 65.4% of nurses knew that the cephalic, basilic, and median cubital veins were the most preferred veins for the insertion of the cannula.^[4] However, in our study, 84.2% of the students reported that a 24G cannula was preferred for pediatric patients, and 50.5% of the students said a 22G cannula for adult patients. Another study in Nepal by Osti et al. (2019) reported that 100% of nurses said 14 to 20 G is suitable in adult patients and 22 to 24 G in pediatric patients.^[10]

Students' knowledge about disinfecting the injection site showed that 45.3% of the students knew the technique of wiping the area from the center of the injection site outward. Contrary to our findings, Hossain et al. (2016) in Dhaka, Bangladesh, reported that only 3% of staff nurses used a circular motion moving from the center to the outside to disinfect the injection surfaces, while Irin Metilda Ruby et al.(2020) in India reported that 80.0% of staff nurses used a circular motion moving from the center to the outside to disinfect the surfaces.^[12,13] However, in our study, 44.2% of the students also said that they would wipe the area from the top of the injection site to the bottom because these students could show that this technique is frequently used by senior nurses in a hospital setting; however, this technique is not a good clinical practice for disinfecting the injection site.

Knowledge about the removal of the cannula showed that 83.2% of the students said the cannula should be removed every 72 hours. Similarly, another study conducted in Nepal reported that 87.0% of nurses knew about the replacement of the IV cannula within 72 hours.^[10] However,

Etafa et al. (2020) reported that a large percentage of nursing students (53.6%) did not know the correct period for the replacement of the IV cannula.^[9] This is because nursing students may not read repeatedly to acquire relevant knowledge, or nurse educators may not educate students about the duration of PVC replacement according to CDC guidelines.^[9] The latest updated CDC guidelines (2017) for the prevention of intravascular catheter-related infections-2011 also recommended that peripheral catheter replacement is not needed more frequently than every 72 to 96 hours to reduce the risk of infection and phlebitis in adults.^[14]

Hand hygiene is an essential part of the prevention of nosocomial infection during IV cannulation procedures. However, only 71.6% of the students correctly said that hand washes were needed before and after cannula insertion, which is higher than the study conducted on nursing students in Ethiopia (60.6%) and lower than the result revealed among nurses (98.5%) in Nepal.^[9,10] These high percentages of students correctly answered could be due to repeated teaching and reminding students about hand washing as the first step in preventing nosocomial infection in various nursing procedures.

Other findings in our study showed that most of the students (94.7%) correctly knew the color code of the 20G cannula, and 71.6% of the students said a 15 to 30° angle was needed to insert the needle into the skin surface. The majority of the respondents (86.3%) correctly said that the lower extremities of diabetic patients, previously used veins or sclerotic veins and veins in the arm of an AV fistula, could not be used for cannulation, and most of them knew the early signs of phlebitis.

A low level of knowledge could increase the risk and complications associated with the IV cannula and compromise patient safety. Nursing students must be knowledgeable and competent in all aspects of IV canalization. However, in our study, most of the students had adequate

knowledge, but 44.2% of the students still had inadequate knowledge of using the IV cannula. Therefore, our results could sensitize health care providers and educators to plan structured teaching programs, skill training, and continuous updating and improving the curriculum of nursing subjects. As a result, students' knowledge could be furnished and IV cannula-related risk managed properly. The important limitation of this study was the generalization of the findings because this study was conducted on a small sample size in a single nursing college. Therefore, further studies are recommended on a large population of nursing students to expand the knowledge on this topic and find the associated factors that affect nurses' knowledge and practice, which can help generalize the findings and enhance the quality of care for the patients. Another limitation was the cross-sectional design of the study, which determines the associations of sociodemographic factors with knowledge of IV cannulation but does not determine causal relationships.

CONCLUSION

More than half of the nursing students had adequate knowledge about intravenous cannulation, while 44.2% of the students had inadequate knowledge that needed to be improved. A statistically significant relationship was observed between knowledge levels and the academic years of the students, indicating that educational level significantly affected the knowledge of nursing students. However, other selected demographic variables, such as age, religion, ethnicity, and total duration of clinical exposure to cannulation procedures, did not significantly affect student knowledge about IV cannulation.

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