

# Nursing Students' Knowledge and Perception on the Prevention of Intravenous Catheter Infections in the West Bank, Palestine

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## ABSTRACT

**Introduction:** Intravenous catheter infections are a major cause of healthcare-associated infections, leading to increased morbidity, mortality, and healthcare costs. Nursing students, as future healthcare providers, play a critical role in infection prevention. This study assessed the knowledge and perception of Palestinian nursing students regarding intravenous catheter infection prevention.

**Methods:** A descriptive cross-sectional study was conducted among 180 nursing students from two universities in Palestine. Data were collected using a validated questionnaire assessing knowledge (10 items) and perception (13 items). Descriptive and inferential statistics were used to analyze the data. Independent t-tests and one-way ANOVA examined differences across gender, university, and academic year.

**Results:** The mean knowledge score was 8.87/10 (SD = 1.47), with 70.6% scoring above average. Key knowledge gaps included incorrect identification of appropriate cannula size (76.7%). The mean perception score was 7.01/13 (SD = 2.16), with 34.4% scoring below average. Misconceptions were found regarding catheter site dressing and disinfection methods. Female students and those from An-Najah National University scored significantly higher in both knowledge and perception ( $p < 0.05$ ). Perception scores improved with academic year, while knowledge scores showed no significant difference.

**Discussion:** Findings highlight a strong theoretical understanding but gaps in practical knowledge and perception, particularly in catheter site management. The study underscores the need for enhanced clinical training, standardized infection prevention curricula, and interactive learning strategies.

**Conclusion:** Despite strong knowledge, nursing students demonstrated gaps in perception and best practices for intravenous catheter infection prevention. Targeted educational interventions are recommended to bridge these gaps and improve patient safety.

**Keywords:** Nursing Students, Intravenous Catheter Infections, Infection Prevention, Knowledge, Perception

intravenous catheter infections (IVCIs) influence their clinical decisions and patient care outcomes.

Intravenous catheter infections are a major cause of healthcare-associated infections (HAIs) and contribute significantly to patient morbidity and mortality. These infections arise due to improper catheter insertion, inadequate hygiene practices, and prolonged catheter use, leading to complications such as phlebitis, bloodstream infections, and sepsis [1]. Preventing these infections requires adherence to evidence-based guidelines, proper hand hygiene, and meticulous catheter care. Nursing students, as future healthcare providers, play a critical role in infection prevention. Their knowledge and perception of

Studies have shown that nursing students worldwide demonstrate varying levels of knowledge and adherence to best practices for IV catheter management. A study in Spain found that students scored an average of 7.27 out of 15 points in their knowledge assessment, indicating gaps in their understanding of peripheral intravenous catheter (PIC) care [2]. Similarly, research in Ethiopia reported low adherence (41%) to CDC guidelines for IV catheter management [3]. These findings highlight the need for targeted educational interventions to improve nursing students' competencies in catheter-related infection prevention.

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Despite extensive research on IV catheter infections, limited studies have assessed Palestinian nursing students' knowledge and perception regarding catheter infection prevention. Understanding their competency levels is crucial for designing effective training programs and updating nursing curricula to enhance infection control practices. This study aims to assess nursing students' knowledge and perception of preventing IV catheter infections in Palestine, identify gaps in their understanding, and provide evidence-based recommendations to improve patient safety and healthcare outcomes.

### Statement of Problem

Intravenous catheter infections remain a significant public health challenge, contributing to prolonged hospital stays, increased healthcare costs, and severe patient complications, including sepsis and multi-organ failure. Peripheral intravenous catheters (PICs) are among the most frequently used invasive medical devices worldwide, with approximately 60% of hospitalized patients requiring intravenous therapy [1]. Despite their routine use, PICs are associated with a high risk of infection due to skin barrier breaches, improper insertion techniques, and inadequate maintenance. These infections increase morbidity and mortality, with studies linking bloodstream infections from catheters to a mortality rate as high as 25% [4].

Nursing students are vital in reducing these infections by mastering proper insertion techniques, aseptic practices, and ongoing catheter care. Their knowledge and perception of infection prevention directly influence their clinical decisions and adherence to best practices [5]. However, evidence suggests that knowledge gaps are widespread among nursing students globally. Studies in Spain, Italy, and Ethiopia revealed that many students lack a clear understanding of hand hygiene, catheter site preparation, and dressing management - key factors in infection prevention [2,5,3].

In Palestine, no existing research explores nursing students' knowledge and perception of intravenous catheter infection prevention. This gap is particularly concerning given the strain on the Palestinian healthcare system, where resource limitations and overcrowded hospitals may heighten infection risks [6]. Without an understanding of students' knowledge and perceptions, educators and policymakers cannot develop targeted interventions to address gaps. This oversight may result in nursing graduates entering the workforce without the necessary skills to prevent IV catheter infections effectively, perpetuating preventable patient harm.

Identifying and addressing these knowledge gaps is essential for several reasons. First, it supports the development of evidence-based nursing curricula tailored to the Palestinian context, ensuring students are equipped with up-to-date infection prevention strategies. Second, it helps clinical educators design practical simulations that enhance students' confidence and competency in IV catheter care. Finally, improving nursing students' knowledge and perception of infection prevention contributes to safer healthcare environments, reducing the burden of healthcare-associated infections (HAIs) on an already vulnerable healthcare system.

This study aims to bridge the research gap by assessing Palestinian nursing students' knowledge and perception of

preventing intravenous catheter infections. The findings will guide recommendations for enhancing nursing education and clinical training programs, ensuring future nurses are better prepared to safeguard patient health.

### Literature Review

Preventing intravenous catheter infections is a critical component of nursing practice, as these infections contribute to increased morbidity, longer hospital stays, and higher healthcare costs [1]. Nursing students, as future healthcare providers, must acquire both knowledge and a positive perception of infection prevention to ensure patient safety. However, research shows that nursing students often have gaps in understanding catheter-related infection prevention.

A multicenter study in Italy involving 1,056 nursing students found that many lacked essential knowledge about hand hygiene, catheter site care, and dressing management — with 33.5% unaware of proper handwashing procedures and 68.7% incorrectly believing antibiotic ointments should be applied to insertion sites [5]. Similarly, an Ethiopian study reported that only 41% of nursing students adhered to CDC guidelines on peripheral intravenous catheter (PIC) management, reflecting poor knowledge of aseptic techniques and site monitoring [3]. In Spain, a study of 675 nursing students revealed a higher average knowledge score (7.27 out of 15), with final-year students performing better than their junior counterparts, suggesting that clinical exposure strengthens knowledge [2].

Perception also plays a vital role in shaping students' behavior. The Health Belief Model (HBM) proposes that individuals' beliefs about susceptibility, severity, and benefits of preventive measures influence their actions. A Malaysian study found that students demonstrated strong awareness of infection prevention, with 100% recognizing the importance of patient identification and explanation before catheter insertion [7]. However, gaps emerged in aseptic line management, reflecting a disconnect between theory and practice. In Turkey, research on 736 nursing students showed that while 66.7% demonstrated adequate knowledge, only 43.9% supported routine catheter replacement—a misconception that could undermine infection control efforts [8].

Demographic factors such as gender, academic year, and clinical experience also influence knowledge and perception. A Swedish study found no significant gender differences in knowledge, though female students showed greater confidence in patient communication [9]. Meanwhile, studies in Italy and Nepal showed that senior students had significantly higher knowledge scores, attributed to increased clinical exposure [5,10].

Despite these global insights, no research to date explores Palestinian nursing students' knowledge and perception of intravenous catheter infection prevention. Given the unique challenges faced by Palestine's healthcare system; including resource constraints and overcrowding, understanding these students' competencies is crucial. This study aims to bridge that gap, providing evidence to guide curriculum improvements and ensure future nurses are well-prepared to prevent catheter-related infections.

## Framework

The framework for this study outlines how nursing students' knowledge and perception of intravenous catheter infection prevention are shaped by key demographic factors, including gender, academic year, and university affiliation. Understanding these relationships is essential for developing targeted educational strategies that improve student competency and clinical performance.

Several studies suggest that demographic factors influence nursing students' knowledge and perception. For example, senior students generally score higher on knowledge assessments due to greater clinical exposure and advanced coursework [2,10].

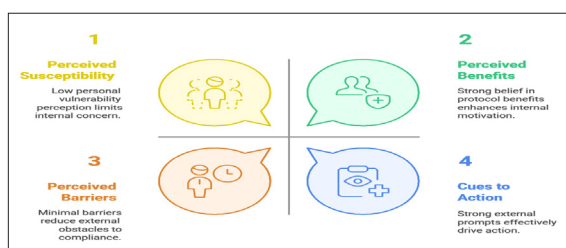
Gender differences have also emerged, with female students often demonstrating more positive perceptions of infection prevention, possibly linked to stronger communication skills and empathy [9]. Additionally, institutional differences in curricula and clinical training resources may contribute to varying knowledge levels between universities.

This study examines how these demographic factors influence nursing students' knowledge and perception of preventing intravenous catheter infections, providing a structured approach to understanding competency gaps and guiding educational improvements.

## Theoretical Framework

The Health Belief Model (HBM) serves as the theoretical foundation for this study, offering a structured way to understand nursing students' attitudes and behaviors regarding intravenous catheter infection prevention (Fig 1) [11]. Developed by the HBM posits that individuals' health behaviors are driven by their perceptions of:

- **Perceived Susceptibility:** How vulnerable students feel to contributing to catheter infections due to poor technique or knowledge gaps.
- **Perceived Severity:** How serious they believe catheter infections are in terms of patient harm and healthcare outcomes.
- **Perceived Benefits:** Whether students believe that following infection prevention protocols improves patient safety and reduces complications.
- **Perceived Barriers:** Challenges students face, such as lack of knowledge, inadequate clinical supervision, or time constraints.
- **Cues to Action:** External prompts, like clinical guidelines, instructor feedback, or real-world patient cases, that encourage students to apply infection prevention practices.



**Figure 1:** Factors influencing nursing students infection prevention practices.

By applying the HBM, this study explores how nursing students' knowledge and perception of infection prevention are influenced by their beliefs, barriers, and exposure to practical training. Understanding these elements can inform the design of educational programs that emphasize the severity of catheter infections, highlight the benefits of prevention, and address perceived barriers, ultimately promoting safer nursing practices.

## Methodology

### Design

This study adopts a descriptive cross-sectional design to assess nursing students' knowledge and perception of intravenous catheter infection prevention. The cross-sectional approach captures data at a single point in time, providing a snapshot of students' understanding and attitudes. This design is practical for evaluating large student populations and identifying knowledge gaps that can guide future curriculum improvements.

### Study Setting and Sample

The study was conducted at two Palestinian universities:

- Nablus University for Vocational & Technical Education (Ibn Sina College for Health Professions)
- An-Najah National University

### Sample Size

A total of 300 nursing students from second, third, and fourth academic years were invited to participate. The sample was selected using convenience sampling, targeting students available during data collection.

### Inclusion Criteria

- Nursing students enrolled in second, third, or fourth year of study.
- Students who completed clinical training related to intravenous therapy.

### Exclusion Criteria

- First-year students (due to limited exposure to intravenous procedures).
- Students who submitted incomplete questionnaires.

### Instruments

Data collection was performed using a self-administered questionnaire developed by the researchers, based on previous validated studies [5,2]. The questionnaire was divided into three sections:

1. **Demographic Data:** gender, academic year, and university.
2. **Knowledge Assessment:** 10 yes/no questions on peripheral intravenous catheter insertion and infection prevention. Each correct answer scored 1 point, totaling a maximum score of 10.
3. **Perception Assessment:** 9 multiple-choice questions and 4 yes/no questions assessing students' attitudes toward infection prevention. Responses were scored as 1 (positive perception) or 0 (negative perception), with a maximum score of 13.

**Pilot Test:** A pilot study was conducted with 20 nursing students to ensure clarity, reliability, and content validity of the questionnaire. Minor modifications were made to improve wording and layout based on student feedback.

### Data Collection

Data was collected during May 2023 using both paper-based and electronic questionnaires distributed to students during free periods. Researchers provided a brief explanation of the study's purpose and obtained verbal consent from each participant before they completed the questionnaire.

### Ethical Considerations

Ethical approval was obtained from the Institutional Review Board (IRB) of Nablus University for Vocational & Technical Education (Code No: Nrs. April,2023/5). Participants were informed about the study's purpose, their right to withdraw at any time, and were assured of anonymity and confidentiality. They were also made aware that data would be used strictly for academic purposes to improve nursing education and practice.

### Data Analysis

Data was analyzed using SPSS version 23. The analysis included:

- **Descriptive statistics:** Frequencies, percentages, means, and standard deviations to summarize demographic data, knowledge scores, and perception scores.
- **Inferential statistics:**
  - o **Independent t-tests:** to compare knowledge and perception scores by gender and university.
  - o **One-way ANOVA:** to compare scores among second-, third-, and fourth-year students.
  - o **Significance level:** p-values < 0.05 were considered statistically significant.

### Results

The study achieved a 60% response rate, with 180 nursing students completing the questionnaire. Three questionnaires were excluded due to incomplete responses.

### Participants' Demographics

The study included 180 nursing students, of whom 66.1% (n=119) were female and 33.9% (n=61) were male. More than half of the participants, 56.7% (n=102), were enrolled at An-Najah National University, while 43.3% (n=78) were from Nablus University for Vocational & Technical Education. Regarding academic year distribution, 39.4% (n=71) were second-year students, 30% (n=54) were third-year students, and 30.6% (n=55) were fourth-year students (Table 1).

**Table 1: Nursing Students' Demographics**

Characteristic	Frequency (n)	Percent (%)
<b>Gender</b>		
Male	61	33.9%
Female	119	66.1%
<b>University</b>		
An-Najah National University	102	56.7%
Nablus University for Vocational & Technical Education	78	43.3%
<b>Academic Year</b>		
Second Year	71	39.4%
Third Year	54	30%
Fourth Year	55	30.6%

The overall mean knowledge score was 8.87 out of 10 (SD = 1.47). Of the participants, 70.6% (n=127) scored above average, while 29.4% (n=53) scored below average. The highest individual score was 10/10, and the lowest was 4/10. The mean perception score was 7.01 out of 13 (SD = 2.16), with 65.6% (n=118) scoring above average and 34.4% (n=62) scoring below average (Table 2).

**Table 2: Nursing Students' Knowledge and Perception Scores**

Score Category	Mean (SD)	Minimum	Maximum	Below Average n (%)	Above Average n (%)
<b>Knowledge</b>	8.87 (1.47)	4	10	53 (29.4%)	127 (70.6%)
<b>Perception</b>	7.01 (2.16)	2	13	62 (34.4%)	118 (65.6%)

The highest-scoring knowledge items included: 97.2% (n=175) correctly identified the importance of self-introduction and patient identification before cannulation, 95% (n=171) recognized the importance of hand hygiene before insertion, and 92.2% (n=166) understood that aseptic technique reduces infection risk. The least correctly answered item was the appropriate cannula size (18G) for adults, which only 76.7% (n=138) answered correctly (Table 3).

**Table 3: Knowledge of Peripheral Intravenous Cannulation**

Knowledge Item	Correct Answer n (%)	Incorrect Answer n (%)
Self-introduction and patient ID before cannulation	175 (97.2%)	5 (2.8%)
Patient should be informed, and verbal consent obtained	171 (95%)	9 (5%)
18G cannula is suitable for adult cannulation	138 (76.7%)	42 (23.3%)
Factors influencing cannula choice include vein size and purpose	166 (92.2%)	14 (7.8%)
Cephalic and basilic veins are commonly used sites	141 (78.3%)	39 (21.7%)
Hand hygiene before cannulation reduces infection risk	171 (95%)	9 (5%)
Peripheral cannula should not remain for more than 72 hours	145 (80.6%)	35 (19.4%)
Aseptic technique reduces infection risk during insertion	166 (92.2%)	14 (7.8%)
Wearing gloves during cannulation is advisable	162 (90%)	18 (10%)
Skin preparation is required before cannulation	162 (90%)	18 (10%)



The perception results showed that 73.3% (n=132) of students agreed that peripheral venous catheters should be replaced routinely every 72–96 hours, and 75% (n=135) acknowledged the need for antiseptic handwashing before catheter insertion. However, there were misconceptions regarding catheter site management: 61.1% (n=110) incorrectly believed that polyurethane dressings should be used, and 57.8% (n=104) incorrectly recommended disinfecting the site with 10% alcohol (Table 4).

**Table 4: Perception of Peripheral Intravenous Cannulation**

Perception Item	Agree n (%)	Disagree n (%)
Replace PVCs routinely every 72–96 hours	132 (73.3%)	48 (26.7%)
Antiseptic handwash is required before PVC insertion	135 (75%)	45 (25%)
Aseptic technique should be used when connecting/disconnecting lines	110 (61.1%)	70 (38.9%)
Dressing on catheter site should be changed daily	106 (58.9%)	74 (41.1%)
Polyurethane dressing is recommended for insertion site	70 (38.9%)	110 (61.1%)
Site should be disinfected with 10% alcohol	76 (42.2%)	104 (57.8%)
Antibiotic ointment reduces infection risk at insertion site	39 (21.7%)	141 (78.3%)
Replace set within 24 hours when lipid emulsions are used	77 (42.8%)	103 (57.2%)
Replace infusion set every 96 hours (no lipids/blood products)	12 (6.7%)	168 (93.3%)
Routine replacement not necessary for pediatric patients	79 (43.9%)	101 (56.1%)
Multiple cannulation attempts increase risk of phlebitis/infection	155 (86.1%)	25 (13.9%)

The relationship between demographics, knowledge, and perception showed significant differences based on gender, university, and academic year. Female students had significantly higher knowledge ( $9.07 \pm 1.33$ ) compared to males ( $8.49 \pm 1.65$ ,  $p=0.012$ ), and they also showed a more positive perception ( $7.41 \pm 2.06$  vs.  $6.21 \pm 2.15$ ,  $p=0.000$ ). Students from An-Najah National University scored significantly higher on knowledge ( $9.11 \pm 1.29$ ) and perception ( $7.38 \pm 2.19$ ) than those from Nablus University ( $8.56 \pm 1.63$ ,  $p=0.013$ ; and  $6.51 \pm 2.04$ ,  $p=0.007$ ). Perception scores improved with seniority—fourth-year students scored  $7.76 \pm 2.27$ , significantly higher than second-year students ( $6.62 \pm 1.7$ ,  $p=0.007$ ), while knowledge scores did not significantly differ across academic years ( $p=0.515$ ) (Table 5).

**Table 5: Relationship between Demographics, Knowledge, and Perception**

Demographic	Knowledge Score (Mean $\pm$ SD)	p-value	Perception Score (Mean $\pm$ SD)	p-value
Gender				
Male	$8.49 \pm 1.65$	0.012	$6.21 \pm 2.15$	0.000
Female	$9.07 \pm 1.33$		$7.41 \pm 2.06$	
University				
An-Najah National University	$9.11 \pm 1.29$	0.013	$7.38 \pm 2.19$	0.007
Nablus University for Vocational & Technical Education	$8.56 \pm 1.63$		$6.51 \pm 2.04$	
Academic Year				
Second Year	$8.83 \pm 1.36$	0.515	$6.62 \pm 1.70$	0.007
Third Year	$8.74 \pm 1.51$		$6.74 \pm 2.41$	
Fourth Year	$9.05 \pm 1.57$		$7.76 \pm 2.27$	

## Discussion

This study assessed nursing students' knowledge and perception of preventing intravenous catheter infections (IVCIs) across two universities in Palestine. The results revealed notable strengths in student knowledge but also exposed key gaps in perception and practice. This discussion interprets the findings in relation to existing literature and highlights implications for nursing education and clinical practice.

### Knowledge of Intravenous Catheter Infection Prevention

The study found that 70.6% of students scored above average on knowledge, with a mean score of 8.87/10. This demonstrates a relatively high level of understanding compared to international studies. For instance, a Spanish study reported a lower average

score of 7.27/15 among nursing students [2]. The strong performance in this study may reflect the structured integration of practical training and infection prevention content within the Palestinian nursing curriculum.

Students showed particularly high knowledge of basic infection prevention principles, such as self-introduction and patient identification (97.2%) and hand hygiene (95%). These findings align with research in Malaysia, where nursing students demonstrated near-complete awareness of patient communication and hygiene protocols [7]. However, gaps emerged in technical knowledge, with only 76.7% correctly identifying the appropriate cannula size for adult patients — a potential weakness in clinical preparation.

The significant association between higher knowledge scores and female gender ( $p=0.012$ ) supports similar findings in Italy, where female students scored higher on infection prevention knowledge [5]. This may reflect gender-based differences in study habits or communication skills, but further exploration is needed to understand the root causes.

### Perception of Infection Prevention Practices

While knowledge scores were promising, perception scores revealed a more concerning picture. The mean perception score was 7.01/13, with 34.4% of students demonstrating a below-average perception of IV catheter infection prevention. This gap between knowledge and perception reflects a common trend in nursing education—understanding the "what" but undervaluing the "why" behind infection prevention practices [8].

Positive perceptions were strongest for fundamental practices like handwashing (75%) and recognizing the dangers of multiple cannulation attempts (86.1%). However, many students held misconceptions about more advanced infection control measures. For example, 61.1% incorrectly believed that polyurethane dressings should routinely cover catheter sites, and 57.8% endorsed disinfecting the insertion site with 10% alcohol, contradicting evidence-based guidelines. Similar misunderstandings were reported in Italy, where students demonstrated poor knowledge of dressing choices and antiseptic agents [5].

Gender differences were again significant, with female students reporting more positive perceptions ( $7.41 \pm 2.06$ ) than males ( $6.21 \pm 2.15$ ,  $p=0.000$ ). This aligns with studies suggesting that female students may be more empathetic and risk-aware in clinical settings [9].

### Impact of Demographics on Knowledge and Perception

The study revealed significant differences in knowledge and perception based on university affiliation and academic year. An-Najah National University students scored higher in both categories than Nablus University for Vocational & Technical Education ( $p=0.013$  for knowledge,  $p=0.007$  for perception). This may reflect differences in curriculum structure, clinical exposure, or faculty emphasis on infection prevention. Future research should investigate these disparities to ensure equitable education across institutions.

Academic year showed no significant effect on knowledge ( $p=0.515$ ), but fourth-year students demonstrated significantly more positive perceptions ( $p=0.007$ ). This supports findings from Spain and Nepal, where senior students' improved perceptions were linked to increased clinical exposure [2,10]. However, the lack of knowledge progression across academic years raises concerns about whether theoretical learning translates into retained practical competence.

### Strengths and Limitations

The study's strengths include a diverse sample across two universities, a validated questionnaire adapted from international research, and detailed statistical analysis of demographic influences. However, limitations should be acknowledged: convenience sampling may limit generalizability, self-reported data introduces potential response bias, unequal university

representation (more students from An-Najah National University) may skew results, and the cross-sectional design captures knowledge at a single point in time, limiting insight into long-term retention and skill development.

### Implications for Nursing Education and Practice

The findings highlight the need to bridge the gap between knowledge and perception. Nursing curricula should emphasize not only what infection prevention practices to follow but also why they are essential. Key recommendations include simulation-based training to reinforce practical infection prevention skills, interactive case studies that challenge student perceptions and address misconceptions, standardized infection prevention modules across universities to ensure consistency in education, and faculty development programs to ensure instructors model and reinforce evidence-based practices. Ultimately, preparing nursing students to prevent intravenous catheter infections requires more than knowledge—it demands cultivating a mindset where infection prevention becomes second nature.

### Conclusion

This study assessed nursing students' knowledge and perception of preventing intravenous catheter infections (IVCIs) across two Palestinian universities. The findings revealed a strong foundational knowledge of basic infection prevention practices, with 70.6% of students scoring above average on knowledge assessments. However, notable gaps emerged in students' perceptions and understanding of more advanced infection control measures, with 34.4% demonstrating below-average perceptions.

Female students and those from An-Najah National University consistently scored higher in both knowledge and perception, while fourth-year students showed improved perceptions—likely reflecting greater clinical exposure. However, the absence of significant knowledge differences across academic years suggests that theoretical learning may not translate effectively into sustained knowledge growth.

The results emphasize the need to strengthen nursing education by focusing on bridging the gap between knowledge and perception. Simulation-based training, interactive case studies, and standardized infection prevention curricula could help ensure nursing students not only understand best practices but also value and apply them consistently in clinical settings.

By equipping nursing students with both knowledge and the right mindset, nursing programs can better prepare future healthcare providers to prevent catheter-related infections, improve patient safety, and support stronger healthcare outcomes in Palestine and beyond.

### Recommendations

Based on the study findings, the following recommendations aim to improve nursing students' knowledge and perception of intravenous catheter infection prevention:

#### 1. Enhance Practical Training:

- o Implement simulation-based scenarios that mimic real-world catheter insertion and infection prevention challenges.
- o Increase hands-on practice opportunities in clinical placements to reinforce theoretical knowledge.

**2. Integrate Evidence-Based Guidelines into Curricula:**

- o Ensure all nursing programs adopt standardized infection prevention modules aligned with international best practices.
- o Regularly update course content to reflect current guidelines on catheter care, site preparation, and infection control.

**3. Target Perception Gaps**

- o Use interactive case studies and problem-solving exercises to address student misconceptions about catheter care.
- o Incorporate reflective learning sessions where students discuss barriers to infection prevention and explore solutions.

**4. Develop Faculty Capacity**

- o Provide instructor training programs on the latest infection prevention protocols to ensure consistent, evidence-based teaching.
- o Encourage faculty to model best practices during clinical demonstrations and assessments.

**5. Strengthen Cross-University Collaboration**

- o Promote knowledge-sharing between universities to align curricula and ensure all students receive equitable, high-quality infection prevention education.
- o Facilitate joint clinical workshops where students from different institutions can learn together and compare approaches.

**6. Promote Continuous Learning**

- o Integrate ongoing assessment and feedback to track students' progress and correct misconceptions early.
- o Encourage lifelong learning habits by providing access to infection prevention resources, research, and guidelines beyond graduation.

By implementing these recommendations, nursing programs can foster a more competent, confident, and proactive generation of nurses, better equipped to prevent intravenous catheter infections and ensure safer, more effective patient care.

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