Assessment of Emergency Nurses' Knowledge and Awareness Regarding Peripheral Intravenous Extravasation: A Cross-Sectional Study

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Abstract

Background: Nurses play a crucial role in ensuring patient safety during intravenous therapy. Awareness of vascular extravasation is essential for preventing tissue injury and promoting evidence-based care. Considering the clinical importance of intravenous injections, their potential complications, and the limited awareness among emergency nurses, this study aimed to assess the level of knowledge regarding vascular extravasation among nurses working in the emergency departments of Khatam-al-Anbia and Ali Ibn Abi Talib hospitals in Zahedan.

Methods: This cross-sectional descriptive study was conducted on 77 emergency department nurses from Khatam-al-Anbia and Ali Ibn Abi Talib hospitals in Zahedan during 2024–2025. Data were collected using a validated, researcher-developed questionnaire assessing six domains of extravasation knowledge. Statistical analysis was performed using SPSS version 24, and relationships between awareness scores and demographic variables were analyzed using the independent t-test, with the significance level set at $p < 0.05$.

Results: The mean age of participants was 34.4 ± 6.8 years, and 62.3% were female. The overall mean knowledge score was 34.2 ± 5.6 (range: 19–46) out of a maximum of 72, indicating a generally low level of awareness. In total, 61% of nurses demonstrated low awareness and 39% demonstrated moderate awareness, while none achieved a high level. The results showed a significant association between awareness scores and both educational level and participation in training courses ($p < 0.05$), whereas no significant relationship was found with age, gender, or work experience.

Conclusions: The findings indicate that a considerable proportion of emergency nurses possess inadequate knowledge regarding vascular extravasation. Structured and continuous training programs are strongly recommended to enhance awareness, improve prevention and management skills, and ensure safer intravenous practices in emergency settings.

Keywords: Extravasation, Nurses, Emergency Department, Awareness, Intravenous Therapy

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Introduction

Patient safety represents one of the core components of modern healthcare and serves as a key benchmark for system quality and efficiency. The World Health Organization emphasizes that safe medical care is inseparable from effective care delivery, as preventable adverse events continue to threaten patient well-being worldwide [1]. Among healthcare providers, nurses are the frontline guardians of patient safety, directly influencing both the quality and safety of clinical interventions [2]. Their competence, vigilance, and professional judgment play a crucial role in preventing iatrogenic harm, particularly during high-frequency procedures such as intravenous (IV) therapy [3].

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IV infusion is one of the most common and essential nursing procedures in both emergency and inpatient settings. Despite its routine use, it carries potential complications that can compromise patient safety, including infiltration and extravasation [4]. *Infiltration* occurs when non-vesicant fluids leak from the vein into the surrounding tissue, while extravasation refers to the leakage of vesicant or irritant agents, which may result in tissue inflammation, ulceration, or necrosis [5]. The severity of injury depends on factors such as the drug's osmolarity, concentration, and pH, as well as the volume and duration of exposure before detection [6].

Clinical manifestations of extravasation include pain, erythema, swelling, and decreased infusion flow, which, if unrecognized, can progress to severe tissue destruction and functional impairment [7]. Studies indicate that extravasation events, although preventable, remain frequent and are often associated with insufficient nursing knowledge or non-adherence to safety protocols [8]. Preventing these incidents requires both technical skill and awareness—recognizing early warning signs, maintaining continuous observation, and responding promptly with appropriate interventions [9]. These responsibilities place nurses at the core of patient safety systems, particularly in high-pressure environments such as emergency departments, where rapid decision-making and multitasking are essential.

Professional organizations such as the **Infusion Nurses Society (INS)** and **the Royal College of Nursing (RCN)** have long emphasized evidence-based guidelines for IV therapy to minimize the risk of extravasation [5,10]. Their recommendations include careful site selection, appropriate cannula sizing, regular monitoring, patient education, and thorough documentation. The integration of these standards into daily practice has been shown to significantly reduce IV-related complications [6]. However, multiple studies have reported gaps in nurses' adherence to these protocols, particularly in resource-limited settings where heavy workloads and staff shortages limit opportunities for continuous site monitoring [7,8].

Educational interventions and structured training programs have proven effective in closing these knowledge gaps. Research from Turkey and Saudi Arabia revealed that nurses who participated in targeted educational sessions demonstrated substantial improvement in recognizing early signs of extravasation and implementing preventive measures [7,8]. Similarly, in Iran, Alaee Karahroudy et al. [9] found that systematic auditing and ongoing education in neonatal intensive care units significantly enhanced nurses' performance and reduced extravasation-related complications. These findings highlight the universal need for continuous professional development to ensure that theoretical knowledge is effectively translated into clinical safety behavior.

From a humanistic perspective, nursing practice extends beyond technical competence—it encompasses empathy, accountability, and a proactive commitment to patient protection. In emergency settings, where time pressure and patient acuity often limit detailed observation, the nurse's ability to combine clinical awareness with compassionate care becomes a decisive factor in preventing harm [2,3,9]. Evaluating the current level of nurses' knowledge and awareness in this field not only identifies educational deficiencies but also serves as an indicator of the healthcare system's overall safety culture.

Therefore, the present study aims to assess the knowledge and awareness of emergency department nurses regarding peripheral intravenous extravasation in two tertiary hospitals in Zahedan, southeastern Iran. By identifying existing gaps and potential areas for improvement, the study seeks to contribute to the development of evidence-based educational programs, reinforce patient safety culture, and ultimately enhance the quality of care delivered in high-acuity environments.

Materials and Methods

Study Design

This study employed a descriptive cross-sectional design conducted between 2023 and 2024 (1402–1403 in the Iranian calendar). It aimed to assess the knowledge and awareness of emergency nurses regarding peripheral intravenous extravasation in two tertiary hospitals in Zahedan, southeastern Iran.

Study Population and Setting

The study population consisted of all registered nurses working in the emergency departments of Khatam-al-Anbia and Ali Ibn Abi Talib hospitals in Zahedan. Both hospitals are major referral centers affiliated with Zahedan University of Medical Sciences and provide emergency services to a large regional population.

Inclusion and Exclusion Criteria

Eligible participants included nurses with at least six months of work experience in the emergency department and direct involvement in intravenous (IV) therapy and medication administration. Nurses who were not directly involved in IV drug administration or patient infusion care were excluded from the study.

Sample Size and Sampling Method

A census sampling method was employed, and all eligible nurses who consented to participate were included. The final sample consisted of 77 nurses who met the inclusion criteria and agreed to complete the study questionnaire.

Data Collection Tool

Data were collected using a researcher-developed questionnaire designed based on a literature review and previous related studies. The questionnaire comprised two sections:

1. Demographic information – including age, gender, educational level, and years of experience in emergency and other wards.

2. Knowledge assessment – containing items related to the definition, risk factors, causative drugs, clinical signs, prevention, management, and treatment of peripheral intravenous extravasation.

Each correct answer was awarded one point, while incorrect or "I don't know" responses were scored as zero. The total score reflected the participant's overall knowledge level regarding extravasation management.

Validity and Reliability

The content validity of the questionnaire was evaluated by a panel of ten nursing and emergency medicine experts, who reviewed the items for clarity, relevance, and appropriateness. The Content Validity Ratio (CVR) and Content Validity Index (CVI) were calculated as 0.69 and 0.71, respectively, confirming acceptable content validity. To assess reliability, the questionnaire was administered to 30 nurses from similar hospital settings, yielding a Cronbach's alpha coefficient of 0.73, which indicated satisfactory internal consistency.

Study Procedure

Following approval of the study protocol by the Research Council and the Ethics Committee of Zahedan University of Medical Sciences, data collection commenced. After obtaining official permission from hospital administrators, participants were approached face-to-face and informed about the study objectives, confidentiality, and voluntary participation. Informed consent was obtained both verbally and in writing. Participants then completed anonymous self-administered questionnaires without providing personal identifiers. The completed questionnaires were coded and entered into SPSS version 24 for analysis.

Data Analysis

Data were analyzed using descriptive and inferential statistics in SPSS version 24. Categorical variables were summarized as frequencies and percentages, while continuous variables were reported as means, medians, and standard deviations. Associations between nurses' knowledge scores and demographic variables were examined using the independent t-test, with a p-value < 0.05 considered statistically significant.

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Ethical Considerations

This study was approved by the Research Ethics Committee of Zahedan University of Medical Sciences (IR.ZAUMS.REC.1402.227). Participation was voluntary, and all data were collected anonymously. The study adhered to the national ethical guidelines for research involving human participants in the Islamic Republic of Iran.

Results

A total of 77 emergency department nurses from Khatam-al-Anbia and Ali Ibn Abi Talib hospitals in Zahedan participated in the study. The mean age of participants was 34.4 ± 6.8 years (range: 23–45 years). The majority of nurses were female (62.3%), while 37.7% were male. Regarding age distribution, 35.1% were younger than 30 years, whereas 64.9% were 30 years or older.

The mean professional experience among

Table 1: Demographic characteristics of emergency nurses (n = 77)

Variable	Category	n (%) or Mean ± SD
Gender	Male / Female	29 (37.7%) / 48 (62.3%)
Age (years)	<30 / ≥30	27 (35.1%) / 50 (64.9%)
Mean age	34.4 ± 6.8 (23–45)	—
Work experience (years)	<10 / ≥10	57 (74.0%) / 20 (26.0%)
Mean experience	8.0 ± 6.1 (1–22)	—
Experience in non-ED wards	Yes / No	44 (57.1%) / 33 (42.9%)
Attended extravasation course	Yes / No	6 (7.8%) / 71 (92.2%)
Educational level	Bachelor / Master	63 (81.8%) / 14 (18.2%)

Table 2: Mean and standard deviation of nurses' knowledge scores in different domains of intravenous extravasation (n = 77)

Domain	Mean ± SD	Min–Max	% of achievable score
Definition of extravasation	2.4 ± 0.89	1–4	48 %
Drugs associated with extravasation	7.2 ± 2.5	3–15	42.3 %
Clinical signs of extravasation	4.9 ± 1.1	3–7	61 %
Prevention strategies	6.0 ± 2.7	1–13	46 %
Risk factors and vulnerable patients	6.2 ± 1.3	4–9	51.6 %
Management and treatment	7.3 ± 2.2	2–13	42.9 %

Table 3: Comparison of nurses' knowledge scores regarding intravenous extravasation by gender (n = 77)

Gender	n	Mean ± SD	Minimum	Maximum	*p*-value
Male	29	34.03 ± 4.5	19	46	0.83
Female	48	34.3 ± 5.8	19	46	—

participants was 8.0 ± 6.1 years (range: 1–22 years). Most nurses (74%) had less than 10 years of professional experience, while 26% had more than 10 years. More than half of the participants (57.1%) reported previous work experience in non-emergency wards, whereas 42.9% had worked exclusively in emergency departments.

Regarding educational background, the majority of participants (81.8%) held a bachelor's degree, while 18.2% had a master's degree. Only six nurses (7.8%) had attended a formal course or workshop related to intravenous extravasation or infiltration management, highlighting a notable educational gap among emergency nurses.

Overall, the demographic profile of participants reflected a predominantly young and moderately experienced workforce with limited exposure to specialized extravasation training. These characteristics are typical of emergency departments in high-demand settings, where staff turnover is frequent and continuing education programs may not be consistently implemented.

Knowledge and Awareness Scores

Table 2 presents the mean and standard deviation of nurses' knowledge scores across various aspects of peripheral intravenous extravasation. The results demonstrate a heterogeneous pattern of awareness across the six evaluated domains.

The highest mean score was observed in the domain of recognition of extravasation symptoms, with a mean of 4.9 ± 1.1 (out of 8), corresponding to 61% of the total achievable score. This finding indicates that most nurses were relatively familiar with the clinical manifestations of extravasation, such as swelling, erythema, and decreased infusion rate. The second-highest mean score was recorded in the domain of management and treatment of extravasation, with an average of 7.3 ± 2.2, representing 42.9% of the total attainable points. This suggests a moderate level of awareness regarding post-event interventions.

In contrast, the lowest mean score was recorded in the domain of knowledge about drugs associated with extravasation, with a mean of 7.2 ± 2.5 (equivalent to 42.3% of the maximum score). This finding highlights a considerable gap in identifying vesicant and irritant medications that pose a risk of tissue injury during IV infusion. Awareness in the domain of definition and general understanding of extravasation was also relatively limited, with a mean score of 2.4 ± 0.89 (48% of the achievable score).

Knowledge related to prevention strategies scored 6.0 ± 2.7 (46% of the total score), while awareness regarding risk factors and vulnerable patients was 6.2 ± 1.3 (51.6%). Collectively, these findings indicate that although nurses demonstrated a basic understanding of the clinical signs of extravasation, their knowledge was insufficient in preventive measures, pharmacologic risk awareness, and therapeutic management protocols.

Overall, the results highlight a moderate yet inconsistent level of awareness among emergency nurses. While clinical observation skills appear relatively strong, theoretical knowledge—particularly regarding high-risk medications and evidence-based management—remains limited. This underscores the need for targeted educational programs focusing on pharmacologic agents, early detection algorithms, and standardized management protocols to strengthen patient safety in intravenous therapy.

Comparison of Knowledge Levels by Gender

Table 3 presents the comparison of nurses' overall knowledge scores regarding intravenous extravasation by gender. The mean knowledge score among male nurses was 34.03 ± 4.5, while the mean score among female nurses was 34.3 ± 5.8.

Although female nurses obtained slightly higher

Table 4: Comparison of nurses' knowledge scores regarding intravenous extravasation by educational status (n = 77)

Educational level	n	Mean ± SD	Minimum	Maximum	*p*-value
Bachelor's degree	63	33.6 ± 5.7	19	40	0.045
Master's degree	14	36.9 ± 4.3	23	46	—

Table 5: Comparison of nurses' knowledge scores regarding intravenous extravasation by work experience (n = 77)

Work experience	n	Mean ± SD	Minimum	Maximum	*p*-value
<10 years	57	33.6 ± 5.9	19	45	0.13
≥10 years	20	35.8 ± 4.5	21	46	—

average scores than males, the difference was not statistically significant (p = 0.83) according to the independent t-test. This suggests that gender did not exert a meaningful influence on the level of awareness regarding extravasation-related concepts.

Overall, both male and female participants demonstrated comparable levels of knowledge, indicating that awareness gaps are systemic rather than gender-related. The absence of significant gender differences underscores the need for educational interventions targeting all nurses equally, with emphasis on institutional and training-related factors rather than demographic characteristics.

Comparison of Knowledge Levels by Educational Status

Table 4 illustrates the comparison of mean knowledge scores regarding intravenous extravasation based on nurses' educational status. The results revealed that nurses holding a master's degree achieved significantly higher mean scores compared with those holding a bachelor's degree.

Specifically, the mean knowledge score among bachelor-level nurses was 33.6 ± 5.7 (range: 19–40), whereas master's-level nurses scored an average of 36.9 ± 4.3 (range: 23–46). The difference between the two groups was statistically significant (p = 0.045) according to the independent t-test.

These findings suggest that higher educational attainment is positively associated with greater awareness of extravasation management. Nurses with postgraduate training may have benefited from broader exposure to evidence-based practices, pharmacologic knowledge, and advanced critical-care principles that reinforce intravenous safety.

The observed association underscores the importance of integrating advanced clinical education and continuing professional development into hospital nursing programs. Promoting postgraduate education and structured in-service training could enhance nurses' competencies in preventing and managing IV-related complications, thereby contributing to improved patient safety outcomes.

Comparison of Knowledge Levels by Work Experience

Table 5 summarizes the comparison of nurses' knowledge scores regarding intravenous extravasation based on years of professional experience. Nurses with more than 10 years of experience demonstrated a slightly higher mean score (35.8 ± 4.5) compared with those with less than 10 years of experience (33.6 ± 5.9). However, the difference between the two groups was not statistically significant (p = 0.13) according to the independent t-test.

These findings suggest that although clinical experience may contribute to incremental improvements in awareness, experience alone does not ensure adequate knowledge of extravasation management. The absence of statistical significance implies that experiential learning in emergency departments is insufficient without formal training or continuing education.

Given that nearly three-quarters of participants had fewer than 10 years of work experience, the results highlight the importance of structured educational reinforcement and evidence-based training rather than reliance on years of service alone. Continuous professional development programs that integrate experiential practice with theoretical updates could play a critical role in enhancing nursing competence and patient safety in intravenous therapy.

Comparison of Knowledge Levels by Age

Table 6 presents the comparison of nurses' knowledge scores regarding intravenous extravasation based on age group. Nurses aged 30 years and older achieved a slightly higher mean score (35.04 ± 4.6) compared with those younger than 30 years (32.6 ± 6.9). However, the difference was not statistically significant (p = 0.078) according to the independent t-test.

Although older nurses tended to perform better in terms of awareness, the lack of statistical

Table 6: Comparison of nurses' knowledge scores regarding intravenous extravasation by age group (n = 77)

Age group	n	Mean ± SD	Minimum	Maximum	*p*-value
<30 years	27	32.6 ± 6.9	19	42	0.078
≥30 years	50	35.04 ± 4.6	22	46	—

Table 7: Comparison of nurses' knowledge scores regarding intravenous extravasation by participation in educational courses (n = 77)

Participation in training courses	n	Mean ± SD	Minimum	Maximum	*p*-value
No	71	33.5 ± 5.1	19	42	0.001
Yes	6	42.6 ± 4.03	28	46	—

Table 8: Comparison of nurses' knowledge scores regarding intravenous extravasation by experience in non-emergency departments (n = 77)

Experience in non-emergency wards	n	Mean ± SD	Minimum	Maximum	*p*-value
No	33	35.2 ± 4.7	19	42	0.15
Yes	44	33.4 ± 6.1	21	46	—

significance suggests that chronological age alone does not substantially influence knowledge levels. The observed pattern may reflect a modest accumulation of experiential knowledge among older nurses; however, without a structured framework of education, this experience does not consistently translate into improved understanding or evidence-based practice.

These findings are consistent with previous literature indicating that knowledge gaps are more closely associated with access to ongoing education and institutional training rather than age or years of service. Therefore, continuous professional development programs that include nurses across all age groups are essential to ensure equitable skill enhancement and to sustain a culture of patient safety in intravenous therapy.

Comparison of Knowledge Levels by Participation in Educational Courses

Table 7 presents the comparison of nurses' knowledge scores regarding intravenous extravasation based on participation in educational or training courses. The findings revealed a statistically significant difference between the two groups (p = 0.001).

Nurses who had previously attended formal educational workshops or training sessions on extravasation management achieved a mean knowledge score of 42.6 ± 4.03, whereas those who had not participated in such programs scored considerably lower, with a mean of 33.5 ± 5.1. The observed difference of nearly nine points reflects the substantial impact of structured training on improving awareness and practical understanding of intravenous complications.

These results clearly indicate that educational interventions play a crucial role in enhancing nurses' knowledge of extravasation prevention, recognition, and management. The high level of awareness among trained nurses underscores the effectiveness of continuing professional education and highlights the need for routine institutional workshops, particularly in high-risk environments such as emergency departments.

Consistent with previous studies (Atay et al., 2021; Kahraman et al., 2020; Sisan et al., 2018), these findings emphasize that structured and repeated training can significantly reduce the incidence of IV-related complications and strengthen patient safety practices. Therefore, implementing standardized educational programs should be prioritized as a key component of nursing competency development policies.

Comparison of Knowledge Levels by Experience in Non-Emergency Settings

Table 8 compares nurses' knowledge scores regarding intravenous extravasation based on previous work experience in non-emergency departments. Nurses who had worked in non-emergency settings demonstrated a slightly lower mean score (33.4 ± 6.1) compared with those without such experience (35.2 ± 4.7). However, the difference between the two groups was not statistically significant (p = 0.15).

Although nurses with broader cross-departmental experience might be expected to possess higher procedural knowledge, these findings suggest that exposure to diverse clinical environments alone does not necessarily improve awareness of extravasation

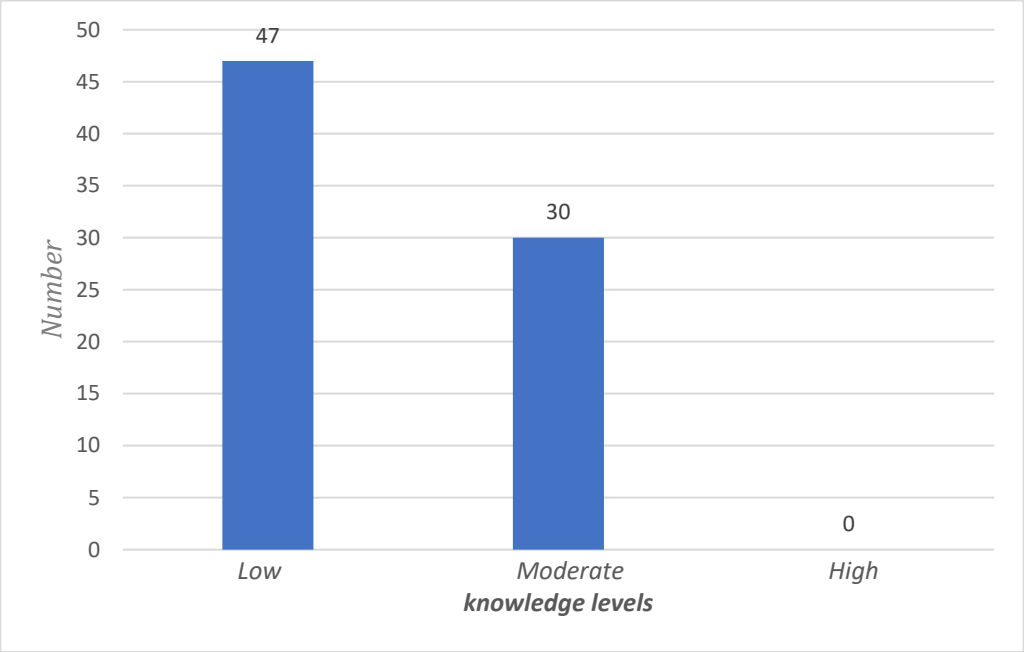

Figure 1: Distribution of knowledge levels among emergency nurses regarding intravenous extravasation

management. Emergency departments present unique procedural risks, and knowledge in this field appears to depend more on specific, targeted education than on general clinical exposure.

The lack of a significant association emphasizes that competency in IV therapy and extravasation prevention requires formal, context-specific training rather than reliance on accumulated experience across wards. Integrating emergency-oriented IV safety modules into general hospital orientation programs could therefore help standardize nurses' preparedness and strengthen patient safety across departments.

Overall, Knowledge Levels of Nurses

In this study, nurses' knowledge was evaluated across six domains related to intravenous extravasation:

1. Definition and general understanding,
2. Drugs associated with extravasation,
3. Clinical signs and symptoms,
4. Preventive strategies,
5. Identification of at-risk patients, and
6. Management and treatment approaches.

The overall mean knowledge score among participants was 34.2 ± 5.6 (range: 19–46), out of a maximum possible score of 72. Based on the 50% cut-off point (score = 36), nurses were categorized into three knowledge levels:

- **Low knowledge:** < 36 points
- **Moderate knowledge:** 36–54 points
- **High knowledge:** > 54 points

According to this classification, 47 nurses (61%) fell within the low-knowledge category, while 30 nurses (39%) demonstrated a moderate level of knowledge. Notably, none of the participants achieved a high knowledge level, indicating that overall awareness regarding intravenous extravasation was unsatisfactory among emergency department nurses in both hospitals.

The relatively low mean score reflects limited familiarity with preventive and pharmacological aspects of extravasation, despite moderate recognition of clinical signs. These findings emphasize the urgent need for structured and continuous educational programs to strengthen nurses' competencies in intravenous therapy and minimize patient risk.

Discussion

In this study, 77 emergency department nurses from Khatam-al-Anbia and Ali Ibn Abi Talib hospitals in Zahedan were evaluated regarding their knowledge of intravenous extravasation. The assessed domains included the definition of extravasation, drugs associated with it, clinical signs, preventive measures, risk groups, and management and treatment strategies. The overall mean knowledge score was 34.2 ± 5.6, with a range of 19–46.

According to the categorization, 61% of nurses had a low level of knowledge, while none achieved a high score. This indicates an overall insufficient

awareness among emergency nurses regarding the recognition and management of extravasation events. The findings are consistent with previous studies conducted by Bahrami et al. (2019) in Tehran [11] and Adly et al. (2020) in Egypt (12), both of which also reported moderate to low levels of awareness among nurses regarding IV-related complications. Similarly, Sisan et al. (2018) in Saudi Arabia [8] found that many nurses lacked sufficient knowledge of vesicant drugs, emphasizing the need for continuous training programs to prevent extravasation injuries. Given that nurses are the first line of defense in detecting and managing IV complications, their knowledge and competence directly affect patient safety and trust [13].

Several studies have identified repetitive and structured educational programs as the most effective strategy for improving awareness. Prakash et al. (2022) demonstrated that more than 70% of nurses initially had inadequate knowledge regarding extravasation, yet a structured educational program led to a statistically significant improvement in post-test scores [14]. In the present study, the highest awareness was observed in recognizing clinical signs of extravasation, whereas the lowest scores were related to knowledge of vesicant drugs. This partially contrasts with the results of Sharour et al. (2020) in Jordan [13], likely due to different study contexts and drug exposure, since Sharour's research focused on chemotherapeutic agents. Similarly, Ener et al. (2014) in the United States [15] found that nurses were generally better at identifying signs and symptoms than recognizing vesicant medications. These findings suggest that future training curricula should prioritize pharmacologic risk recognition in addition to symptom management.

In the current study, gender was not significantly associated with knowledge levels, while educational level showed a significant relationship, with master's-level nurses scoring higher than bachelor's-level ones. This aligns with Atay et al. (2021) in Turkey [7], who reported that nurses with higher education had more experience and awareness of extravasation management and recommended developing institutional protocols and periodic in-service training. Advanced education typically includes courses in pharmacology and drug-related adverse event management, as well as more frequent engagement with scientific literature and clinical guidelines [16].

A significant finding of this study was the positive impact of participation in training courses on knowledge scores. Nurses who had attended relevant educational programs exhibited markedly higher awareness ($p = 0.001$). This is consistent with Atay et al. (2022) [7], who reported that 74.5% of nurses had never received instruction on extravasation management during in-service programs, and those who did showed superior knowledge and performance. Prior research also indicates that hands-on, simulation-based training significantly enhances both cognitive and procedural competence, promoting sustained practice improvement [17].

The low knowledge observed in the current study may also stem from the broad range of vesicant drugs that nurses must remember, limited access to hospital drug protocols, and ongoing updates to pharmaceutical formularies, which are not always reflected in undergraduate curricula [18]. Similarly, Alaee et al. (2016) [9] in Tehran reported substantial deviations from standard care in managing high-grade extravasation cases, attributing the issue primarily to nurses' insufficient awareness of appropriate interventions.

Overall, these findings highlight that extravasation remains a critical safety challenge in intravenous therapy. Although sometimes minor, it can cause patient anxiety, erode trust, and lead to severe complications if not managed promptly [13]. Comprehensive prevention strategies—including continuous training, updated clinical protocols, and the use of high-quality IV equipment—are vital for minimizing risk and ensuring safe practice [16, 17].

Conclusion

The present study demonstrated that a large proportion of emergency nurses possessed inadequate knowledge regarding intravenous extravasation. Participation in targeted educational courses was the only factor significantly associated with higher awareness, while age and work experience alone had no meaningful impact. These findings underscore the necessity of structured, recurrent training and evidence-based educational interventions to bridge existing knowledge gaps and improve patient outcomes.

Higher education and formal workshops were identified as key predictors of improved knowledge, whereas mere professional tenure was not sufficient. Therefore, continuous competency-based education should be integrated into emergency nursing programs to reinforce safe IV practices and prevent extravasation-related injuries.

Recommendations

1. Implement regular **training programs** on vesicant drug handling and extravasation management for emergency nurses.
2. Develop and adopt **standardized clinical protocols** based on INS and RCN guidelines.

3. Conduct **periodic assessments** of nurses' knowledge with constructive feedback.

4. Extend similar studies to other departments such as hematology–oncology, NICU, and neonatal wards.

5. Integrate **simulation-based training** on extravasation management into continuing education.

6. Establish **annual competency evaluations** using validated assessment tools.

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Conflict of Interest

The authors declare no conflict of interest.

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Author Contributions

M.K, A.B. conceptualized the study, supervised data collection, and reviewed the final manuscript. **M.Z, H.S** performed statistical analysis and drafted the initial version of the manuscript. All authors read and approved the final version.

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