RESEARCH ARTICLE

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Knowledge and Attitudes of Safe Handling of Chemotherapy Drugs among Oncology Nurses at Teaching Hospital

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Abstract

Objective: This study aims to assess the knowledge and attitudes of oncology nurses at Jordan University Hospital in Jordan concerning the safe handling of chemotherapy drugs. **Methods:** A descriptive study was conducted utilizing a structured questionnaire, which was distributed to 106 nurses at Jordan University Hospital selected through stratified random sampling. The inclusion criteria focused on registered nurses with experience in handling chemotherapy drugs, including those involved in their administration, or disposal within the hospital. Nurses working in non-oncology departments, those with less than one year of experience, and those undergoing orientation programs were excluded from the study. **Result:** The results showed the oncology nurses possess inadequate knowledge about chemotherapy exposure and use of PPES, where knowledge about chemotherapy exposure scored mean 4.8 and SD 1.01 within possible score 1-12, while knowledge about use of PPEs scored mean 10.3 and SD 2.21 within possible score 7-24. Additionally, the analysis showed negative attitude of handling chemotherapy drugs among the oncology nurses, the scored mean was 21 out of a range of 15-50, with SD 2.8. **Conclusion:** The oncology nurses demonstrate insufficient knowledge and exhibit a negative attitude toward the safe handling of chemotherapy drugs. Consequently, there is a critical need to update national guidelines on safe handling practices and implement initiatives such as seminars, workshops, and training programs is essential to improve knowledge, foster positive attitudes, and promote safer handling practices among oncology nurses.

Keywords: Knowledge- attitude- safe handling- chemotherapy drugs- oncology nurses

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Introduction

Globally, cancer cases are on the rise. According to the latest estimates from the International Agency for Research on Cancer (IARC), there were approximately 20 million new cancer cases and 10 million cancer-related deaths in 2022. Projections indicate that by 2050, the number of new cancer cases could reach 35 million annually, representing a 77% increase from 2022 levels [1]. In Jordan, cancer has become the second leading cause of death, following cardiovascular diseases, and is a growing public health concern [2]. The number of newly diagnosed cancer patients in Jordan is also increasing, with 10,898 cases reported in a population of 9,903,798 in 2018. Among these 5,813 deaths were recorded, and an estimated 25,497 individuals were within the 5-year prevalence range [3].

With the rising incidence of cancer in Jordan, the use of chemotherapy is expected to grow significantly in the coming years [4]. Consequently, it is critical to address any potential health risks associated with the handling of chemotherapy drugs promptly and comprehensively [5]. The knowledge and attitudes of nurses administering chemotherapy drugs must evolve, particularly in response to increasing workloads and the need for safer handling protocols.

Chemotherapy drugs are known for their cytotoxic properties, necessitating careful handling to minimize exposure and contamination. Key measures for the safe handling of these drugs include the use of Personal Protective Equipment (PPE), preparation within safety cabinets, proper transportation, and safe disposal practices, among others [6]. Organizations such as the National Institute for Occupational Safety and Health (NIOSH), the American Society of Clinical Oncology (ASCO), and the Oncology Nursing Society (ONS) have emphasized the importance of adhering to established guidelines for the safe handling of chemotherapy drugs[6].

Occupational exposure to antineoplastic agents can occur due to insufficient control measures, lack of knowledge and skills in handling these drugs, and poor compliance with established guidelines. Exposure routes include skin absorption, direct skin contact, inhalation of drug particles, ingestion, drug preparation, drug administration, cleaning spills, handling patient waste, and transporting or disposing of hazardous materials, as

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well as needle-stick injuries [7]. Therefore, it is essential for nurses to possess adequate knowledge and training on the proper chemotherapy handling to prevent harm to both themselves and the general public.

In the literature, a review of safe chemotherapy handling practices across 53 healthcare facilities 15 from low-income countries, 26 from lower-middle-income countries, and 12 from upper-middle-income countries revealed substantial disparities and shortcomings in adherence to safe handling protocols. Facilities in low-income countries demonstrated a median safe practice level of 32%, significantly lower than those in middle-income countries (63%) and upper-middle-income countries (85%) [5]. These findings highlight the need for improved standards and training, particularly in lower-resource settings.

Regarding the level of knowledge about handling chemotherapy drugs, studies have reported varying outcomes. Kaur et al. found that 60% of participants had substantial knowledge regarding the safe handling of chemotherapy drugs [8], while another study indicated that more than half of the participants demonstrated adequate knowledge in this area [9]. In contrast, a study involving Egyptian nurses revealed low knowledge scores, which were attributed to a lack of training programs on safety measures for handling hazardous chemotherapy drugs [10]. Interestingly, despite this knowledge gap, Egyptian oncology nurses exhibited a strong positive attitude toward the safe handling of cytotoxic chemicals, with 63.6% achieving satisfactory overall scores related to safe cytotoxic drug handling [11]. Another study highlighted that while nurses had adequate knowledge (60%), their practical application of safe chemotherapy administration was unsatisfactory [12]. Conversely, in Palestine, significant gaps were identified in nurses' knowledge and practices concerning chemotherapy safety [13]. These findings underscore the critical need for nurses to receive comprehensive training on safety handling of chemotherapy.

Similarly, data collected in Jordan revealed that safe practices for handling chemotherapy drugs in various healthcare centers across the country were suboptimal. A study assessing the level of compliance with recommended handling practices in 15 Jordanian healthcare facilities found that compliance was unsatisfactory. Only 10.7% of the total sample demonstrated proper adherence to the recommended practices, particularly in the use of personal protective equipment (PPE) [14]. This highlights a significant gap in the implementation of safety protocols and underscores the urgent need for improved training and enforcement of guidelines to ensure the safe handling of chemotherapy drugs in Jordanian healthcare settings.

Moreover, the absence of a dedicated oncology unit or department for managing cancer patients exacerbates the challenges. Oncology nurses are dispersed across various departments within the hospital and are responsible for administering chemotherapy drugs in multiple settings. This leads to frequent movement of nurses and the transfer of patients between departments, significantly increasing the risk of exposure to chemotherapy drugs and the potential for intoxication among oncology nurses. This fragmented approach underscores the need for centralized oncology care and enhanced safety protocols to minimize risks. Given this context, this study deemed it essential to evaluate the knowledge and attitudes of Jordanian oncology nurses regarding the safe handling of chemotherapy drugs.

The aim of this study was to evaluate the knowledge and attitudes of oncology nurses at Jordan University Hospital in Jordan regarding the safe handling of chemotherapy drugs.

Materials and Methods

This study employed a descriptive, quantitative, cross-sectional design and was conducted at Jordan University Hospital across multiple departments over a six-month period in 2023. The accessible population consisted of 110 registered nurses who met the desired criteria. Using a sample size calculation formula at a 95% confidence interval and a standard error of 0.05, a total of 106 nurses were selected through stratified random sampling to ensure representation across various departments. The inclusion criteria targeted registered nurses who had experience handling chemotherapy drugs in the hospital and were involved in the administration, or disposal of these drugs. Nurses working in non-oncology departments, those with less than one year of experience, and those in orientation programs were excluded.

Approval for the study was obtained from the Institutional Review Board (IRB) and the scientific research ethics committee at the hospital. Data were collected using a structured, expert-validated survey questionnaire divided into four sections: demographic information (8 items), knowledge assessment (10 items on chemotherapy exposure, 8 items on personal protective equipment, and 6 items on nurses' attitudes toward handling chemotherapy drugs), and attitudes assessment (6 items) [15]. The questionnaires were distributed and collected by the researchers, with confidentiality and voluntary participation ensured.

The questionnaire's validity and reliability were tested among students at Jordan University Hospital, and reliability was assessed using SPSS version 22 [16]. A Cronbach's alpha score of 0.741 indicated good reliability for the knowledge, and attitudes sections of the questionnaire. Additionally, face validity was confirmed by an institutional committee comprising six senior researchers.

Results

Out of 110 distributed questionnaires, 106 were completed, resulting in a response rate of 96.4%, which is considered optimal for reliable data. Table 1 outlines the demographic characteristics of the participants. The mean age of the participants was 33 years, and the majority (64.2%) were married. Data were collected from 12 different wards, with the highest number of participants, 25 (23.6%), coming from the ICU. The largest proportion of participants, 35 (33.0%), had 6 to 10 years of work experience. Additionally, 57 participants (52.3%) reported

having attended chemotherapy administration courses (Table 1).

Knowledge Regarding Safe Handling of Chemotherapy Drugs

The majority of participants (81%) believed that chemotherapy drugs can enter the body through ingestion. In contrast, the smallest proportion, 23.6%, acknowledged that chemotherapy drugs cannot enter the body through skin contact with contaminated surfaces. Another notable finding was that 80.2% of participants believed chemotherapy exposure could occur through contact with spills and splashes, while 13.2% disagreed with this idea, and 6.6% were unaware of this risk (Table 2).

Table 3 reveals that 83% of participants are aware that eye protection and shoe covers are necessary during chemotherapy administration, while 12.3% disagree and 4.7% are unsure. Another significant observation is that 78.3% of participants recognize that polyethylene-coated gowns are more suitable than cloth gowns during drug administration, whereas 13.2% are unaware of this. Additionally, 75.5% of participants acknowledge that surgical masks provide protection against chemotherapy aerosols, 17% disagree, and 7.5% are uncertain. Further details regarding participants' knowledge about the use of personal protective equipment (PPE) are provided in Table 3.

According to Table 4, 60.4% of participants reported feeling confident while handling cytotoxic drugs, while 39.6% did not. Additionally, 75.5% believed that implementing safety measures makes their job more challenging. A notable 29.2% of participants indicated they could tolerate some level of improper practices among their peers, such as not using personal protective equipment (PPE), as long as they themselves adhered to correct practices. Furthermore, 17.9% expressed no concern about the long-term side effects of occupational exposure to cytotoxic drugs. The participants' attitudes toward the safe handling of chemotherapy drugs were further evaluated using a set of six questions, as detailed in Table 4.

Table 5 provides an overview of the descriptive statistical measures employed in the study, along with the observed results. These outcomes are evaluated against the anticipated range derived from the questionnaire. The findings reveal that participants demonstrate insufficient knowledge regarding (4.8±1.01) and in the utilization of PPEs (10.3±2.21). Additionally, the attitude score was notably low, with a mean of 21, falling within a possible range of 15 to 50. This suggests a lack of awareness and suboptimal attitudes among the participants in the areas assessed.

The Chi-square test was utilized to assess the association between the variables regarding to knowledge; the calculated Chi-square value was 32.232, with a corresponding probability value (p-value) of 0.020. Since this p-value is below the 0.05 threshold for statistical significance, it can be concluded that there is a significant association indicating that oncology nurses at the Jordanian University Hospital exhibit insufficient knowledge levels concerning the safe handling of

Table 1. The Participants' Socio- Demographic Characteristics

Variable	Frequency	%
Age	M=33 years old	
Gender		
Male	53	50
Female	53	50
Marital status		
Single	20	18.9
Married	68	64.2
Divorced	8	7.5
Widowed	10	9.4
Ward/ Department		
Pediatric/ Surgery	3	2.8
Pediatric/Medical	5	4.7
Medical/Surgical	24	22.6
Surgical Wards	19	17.9
Gynecological Ward	6	5.7
CCU	8	7.5
ICU	25	23.6
BURN	4	3.8
Out pt clinics	8	7.5
Neonate	1	0.9
OR & recovery	2	1.9
Emergency	1	0.9
Duration of nursing profession		
1-3	15	14.2
4-5	24	22.6
6-10	35	33
>10	32	30.2
Experience Caring for Cancer Patient		
<1	1	0.9
1-3	53	50
4-6	26	24.5
>6	26	24.5
Level of education		
Bachelors	97	91.7
Masters	8	7.5
Doctorate	1	0.9
Years of experience in caring for the cancer patients		
<1 year	28	25.2
1-3 years	46	41.4
4-6 years	24	21.6
>6 years	8	7.2
Training courses		
None	14	12.8
1	21	19.3
2	43	39.4
3	20	18.3
>3	8	7.3
Attended chemotherapy administration courses		
Yes	57	52.3
No	49	47.7

Table 2. Participants' Knowledge Regarding Exposure to Chemotherapy (N=106)

Variable	True (%)	False (%)	Do not know (%)
Chemotherapy can enter the body through breathing it in.	67.0	24.5	8.5
Chemotherapy can enter the body through ingesting it.	81.1	12.3	6.6
Chemotherapy cannot enter the body through skin contact with contaminated surfaces.	23.6	63.2	13.2
Chemotherapy can enter the body through contact with spills and splashes.	80.2	13.2	6.6
Chemotherapy gas and vapor in air can enter the body through skin and mucous membranes.	75.5	16.0	8.5
Chemotherapy can more easily enter the body through damaged skin.	76.4	15.1	8.5
Oral forms of chemotherapy do not have the potential to be absorbed.	35.8	49.1	15.1
Chemotherapy in liquid form can be absorbed through the skin.	71.7	19.8	8.5
Alcohol hand sanitizer is as effective as soap and water in removing chemotherapy residue.	18.9	70.8	10.4
Chemotherapy can enter the body through contaminated foods, beverages, or cosmetics.	66.0	20.8	13.2
Exposure to chemotherapy is not as harmful as people claim	17	78.3	4.7

Table 3. Participants' Knowledge Regarding the Use of Personal Protective Equipment in Safe Handling of Chemotherapy Drugs (N=106)

Question	True (%)	False (%)	Do not know (%)
A surgical mask provides protection from chemotherapy aerosols.	75.5	17	7.5
All types of gloves provide the same level of protection.	38.7	54.7	6.6
Double latex gloves provide full protection in cytotoxic drug preparation.	73.6	16	10.4
Polyethylene-coated gown is more appropriate than cloth gown during drug administration.	78.3	8.5	13.2
Disposable gowns for cytotoxic drug administration should be re-used for several days to reduce the hospital cost.	17.0	74.5	8.5
Eye protection and shoe covers are needed during chemotherapy administration.	83	12.3	4.7
I am given enough information on how to protect myself from chemotherapy exposure	67	24.5	8.5
My supervisor goes out of his/her way to make sure I am provided with proper fitting PPE	74.5	16	9.4
Chemotherapy spill kits are available in your workspace	71.7	16	12.3
During the most recent chemotherapy spill in your workplace, did you use the materials in the spill kit?	60.4	20.8	18.9

chemotherapy drugs (Table 6). Regarding to Attitude; the Chi-square test yielded a value of 30.314, with a probability value (p-value) of 0.032. As this p-value is below the 0.05 significance level, it can be concluded that there is a statistically significant association, indicating that oncology nurses at this hospital demonstrate positive attitude levels toward the safe handling of chemotherapy drugs (Table 6).

Discussion

Long-term occupational exposure to chemotherapy drugs is associated with a range of adverse health effects, including carcinogenic, teratogenic, and mutagenic consequences[9]. To mitigate these risks, it is essential for healthcare professionals to possess a high level of knowledge and maintain a positive attitude, as these factors are critical for ensuring adherence to safety protocols when handling chemotherapy drugs. This study aimed to evaluate the knowledge and attitudes of nurses regarding the safe handling of chemotherapy. The findings identified significant gaps in both knowledge and attitudes related to chemotherapy safety practices. The following sections delve deeper into the issues highlighted by this research.

In this study, it is noted that the Jordan University Hospital does not have a dedicated oncology department, primarily due to the high demand and influx of patients with various types of cancer. As a result, oncology nurses are required to administer chemotherapy drugs across

Table 4. Participants' Attitude on Safe Handling of Chemotherapy Drugs

Participants' thoughts about cytotoxic drug handling	Yes	No
I am feeling confident to handle cytotoxic drugs safely in the ward.	60.4	39.6
Applying safety measures make it harder to get my job done.	24.5	75.5
I am not worried about the long-term side effects of occupational exposure to cytotoxic drugs.	17.9	82.1
I can tolerate a certain level of improper practice, such as not using PPE, if I am too busy.	30.2	69.8
I can tolerate a certain level of improper practice among my peer, such as not using PPE, as long as I stick to the correct practice.	29.2	70.8
Reuse of disposable PPE makes me feel less protected	68.9	31.1

Table 5. Summary of the Descriptive Statistics of the Knowledge, and Attitude Scores

Variables	Mean (SD)	Observed scores	Possible scores
Knowledge about chemotherapy exposure	4.8 (1.01)	3-5	1-12
Knowledge about use of PPEs	10.3 (2.21)	9-15	7-24
Attitude of handling chemotherapy drugs	21.0 (2.8)	17-29	15-50

Table 6. Chi-Square Test on the Significance of the Participants' Knowledge Levels and Exhibit Positive Attitude Levels Regarding the Safe Handling of Chemotherapy Drugs

Knowledge	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	32.232a	80	0.020
Likelihood Ratio	36.155	80	0.097
Linear-by-Linear Association	4.743	1	0.002
N of Valid Cases	106		
105 cells (100.0%) have expected count less than 5. The minimum expected count is .07			
Attitude	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	30.314a	28	0.032
Likelihood Ratio	31.837	28	0.175
Linear-by-Linear Association	4.094	1	0.048
N of Valid Cases	106		
33 cells (82.5%) have expected count less than 5 The minimum expected count is 0.07			

multiple departments within the hospital. This diversity in operational environments has led to an evolution in the roles and responsibilities of oncology nurses over time, as they adapt to the varying demands and settings in which they provide care.

The majority of participants in this study were relatively young, with a mean age of 33 years. This age range represents the energetic and highly productive phase of a nurse's career. These findings align closely with those of a study conducted by Zayed et al. [11], which also reported a young participant demographic, with a mean age of 34.4 years. Another study revealed that 64% of nurses were between 22 and 29 years old, making them slightly younger than the participants in this study [17]. However, research by Abbasi et al. [18] indicated that age does not significantly influence the safe handling of chemotherapy drugs, suggesting that while age may reflect experience or energy levels, it is not a determining factor in adherence to safety protocols.

The majority of participants in this study were married (64.2%), outnumbering single, widowed, and divorced individuals, a trend consistent with findings from other studies. Over 50% of the nurses had completed a chemotherapy administration course, though comparisons with other studies reveal varying levels of training and certification among oncology nurses. For example, Kaur (2017) reported that only 44 (40.37%) healthcare workers had received training on the safe handling of chemotherapy drugs [8]. In terms of educational qualifications, all participants in this study held at least a bachelor's degree (91.7%), with 7.5% possessing a master's degree and 0.9% holding a doctorate. These figures align closely with those reported by Asefa et al., where 88% of participants had at least a bachelor's degree and 9% had a master's degree [17]. The sample size of this study, comprising 106 nurses, is larger than those of other comparable studies, such as those with 55 [11] and 77 [17] participants. This larger sample size enhances the reliability of the findings and strengthens the robustness of the results.

The oncology nurses at the Jordanian University Hospital demonstrate insufficient knowledge concerning chemotherapy exposure (4.8±1.01) and the use of Personal Protective Equipment (PPEs) (10.3±2.21). Knowledge was assessed using a questionnaire with a scoring range of 1–12, where a score below 6 was considered below average. The evaluation focused on two critical areas: understanding chemotherapy exposure and the proper use of PPEs in the safe handling of chemotherapy drugs. The observed inadequacy in knowledge may be linked to the limited level of training among oncology nurses at the Jordan University Hospital. This finding aligns with that of Asefa et al. [17], who reported a mean knowledge score of 7.82±2.22 out of 15, indicating room for improvement in this area.

The assessment of nurses' knowledge regarding exposure to chemotherapy drugs revealed that a significant proportion of respondents (65%) achieved a high score in this area. For example, 67% of the participants recognized that chemotherapy drugs can enter the body through inhalation, 81% acknowledged the risk of ingestion, and 80.2% understood that exposure could occur through contact with spills or splashes. However, despite this awareness, some nurses expressed that wearing Personal Protective Equipment (PPE) is not entirely effective, as they still feel vulnerable to risks even when using it. Additionally, they noted that wearing gloves can hinder their ability to palpate veins, which they perceive as a practical challenge in their workflow. These findings highlight a gap between theoretical knowledge and practical application, underscoring the need for improved

training and solutions to address these concerns.

A significant majority of respondents in this study (78.3%) demonstrated an understanding that exposure to chemotherapy drugs is as hazardous as experts emphasize and that hand sanitizers are effective in removing chemotherapy residues. This aligns with findings from previous studies, such as Nwagbo et al. [9], which revealed that more than half of the oncology nurses at the University College Hospital in Ibadan possessed adequate knowledge about chemotherapy exposure and effective methods for removing drug residues. Nwagbo and colleagues reported that nurses had a high level of chemotherapy knowledge, with an average score of 13.9 ± 2.2, and 70% of them recognized the necessity of gloves and gowns for safety [9]. Similarly, another study found satisfactory average knowledge scores of 19.05 ± 4.8 out of 26 [11]. Additionally, more than two-thirds (67.3%) of the nurses in that study achieved an acceptable knowledge score. These findings collectively highlight a generally positive level of awareness among nurses, though there remains room for improvement in certain areas of knowledge and practice [11].

Specifically, 75.5% of the respondents understood that surgical masks offer protection against chemotherapy aerosols, 73.6% recognized that double latex gloves provide full protection during the preparation of chemotherapy drugs, and 78.3% were aware that polyethylene-coated gowns are more suitable than cloth gowns during drug administration. However, these results contrast with those of Asefa et al. [17], where 90.9% of nurses affirmed that wearing full PPE including gowns, gloves, masks, goggles, head coverings, and shoe covers is mandatory. Furthermore, this study's findings diverge from those of Orujlu et al. [19], conducted across four hospitals in Urmia University, Ireland, which revealed that a majority of nurses lacked adequate knowledge about the importance of surgical masks in protecting against chemotherapy chemicals and aerosols. These discrepancies highlight variations in knowledge levels across different contexts and underscore the need for standardized training and education to ensure consistent adherence to safety protocols.

The inadequate knowledge levels observed among nurses in this study were anticipated, as a relatively small proportion of participants had received training programs on safety guidelines for handling chemotherapy drugs. This lack of training likely contributed to the gaps in knowledge and adherence to best practices. Additionally, the current guidelines for the safe handling of chemotherapy drugs at the institution are not aligned with the updated recommendations of the Oncology Nursing Society (ONS) [20, 21]. This discrepancy further exacerbates the issue, as outdated guidelines may not reflect the latest evidence-based practices, potentially compromising the safety of both healthcare workers and patients [21]. These findings underscore the urgent need for comprehensive training programs and the adoption of up-to-date. This study demonstrated that oncology nurses at Jordanian University Hospital exhibited unfavorable attitudes concerning the safe handling of chemotherapy drugs, with a score of 21 out of an anticipated range of 15-50. This result presents a contrasting perspective when compared to a parallel study conducted in Egypt, which evaluated the knowledge and attitudes of 55 oncology nurses. The Egyptian study found that nurses held a markedly positive attitude toward the safe handling of chemotherapy drugs [11]. A positive attitude is crucial for the safe handling of chemotherapy drugs [11]. However, a significant proportion of oncology nurses lack a positive attitude, leading to low adherence to the guidelines set by the Oncology Nursing Society [22] . Similarly, this study identified poor attitudes among nurses. This finding, however, contrasts with research conducted in Azerbaijan Province, Middle East, which revealed a positive attitude score among 54 nurses regarding the safe handling of chemotherapy drugs [19]. Similarly, another study found satisfactory average attitude scores of and 13.09 ± 3.07 out of 16 [11]. Such variations may be attributed to differences in institutional policies and practices.

A large proportion also reported that about 68.9% of the nurses indicated that the reuse of disposable PPE makes them feel less protected, which is consistent to the findings by Kyprianou et al. [23]. However, in a study conducted by Habiba, Eldin & Ibrahem, [24] nurses' perceived risks less than 25% associated with the handling of chemotherapy drugs, which is very low. Other relate study also showed that the attitude score was sufficient in only 60% of their nurses [8].

Moreover, this study highlighted those targeted interventions, such as in-service training and education, play a significant role in enhancing nurses' attitudes toward recognizing and implementing safe handling practices when administering chemotherapy drugs. Prior to the intervention, the study found that nurses often used personal protective equipment (PPE) inadequately, as they were unaware that exposure to patients' waste could pose risks associated with chemotherapy drugs. These findings are particularly significant in a large healthcare facility like this one, which treats a high volume of cancer patients in Jordan.

This study offers detailed insights into nurses' knowledge and attitudes, but it has some limitations. These include the use of self-reported data, online questionnaires, and the lack of direct interaction between the researcher and the nurses to provide additional information about the study. These factors could lead to potential errors. Additionally, the single-site design limits the ability to generalize the findings to all oncology nurses in other healthcare settings.

In Conclusion, this study found significant gaps in nurses' knowledge and attitudes about safely handling chemotherapy drugs. To improve workplace safety, these issues must be addressed. This shows the importance of updating national guidelines and providing detailed training programs to help nurses better understand and manage the safe handling of chemotherapy drugs

Author Contribution Statement

Concepts: Shamoun and Ahmad, Design: Ahmad, Literature review: Shamoun, Data acquisition: Ahmad, Data analysis: Shamoun, Statistical analysis: Ahmad,

Manuscript preparation, editing and review: Shamoun, Guarantor: Shamoun and Ahmad.

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Ethical Declaration

The researcher secured ethical approval from the research ethics committee at Jordan University Hospital to proceed with the study and administer the questionnaires to participants within the hospital premises.

Data Availability

Data are accessible upon request.

Conflicts of interest

The authors declare no conflicts of interest.

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