

Knowledge and Practices Regarding the Safe Handling of Cytotoxic Drugs Among Oncology Nurses: A Cross-Sectional Study

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Abstract

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Introduction: Cytotoxic drugs are essential in cancer treatment but may pose significant occupational health risks to healthcare workers. Oncology nurses are frequently exposed during the preparation, administration, handling, and disposal of these drugs. Adequate knowledge and safe practices are therefore essential to minimize occupational exposure and promote workplace safety. **Methodology:** A descriptive cross-sectional study was conducted among 80 oncology nurses working in a selected oncology department. Total population sampling was used because the accessible population consisted of approximately 80 eligible nurses. Data were collected using a structured questionnaire assessing demographic characteristics, knowledge, and practices regarding cytotoxic drug handling. Data were analyzed using SPSS version 25. **Results:** The findings demonstrated that most participants had moderate knowledge regarding the safe handling of

cytotoxic drugs, while the majority demonstrated good practices. Overall, 56.3% of participants had moderate knowledge and 63.8% demonstrated good practices. Better knowledge and practices were generally observed among nurses with higher qualifications and greater professional experience. **Conclusion:** The study concluded that oncology nurses demonstrated moderate knowledge and generally good practices regarding the safe handling of cytotoxic drugs. However, important gaps remained in specific safety procedures, particularly spill management and accidental exposure management. Regular training, competency assessment, adequate PPE availability,

and strict implementation of institutional safety guidelines are recommended to improve occupational safety among oncology nurses.

Introduction

Cancer is a major global health problem, and cytotoxic drugs remain an important component of cancer treatment. These medications are widely used in the management of various malignancies because of their ability to inhibit or destroy rapidly dividing cancer cells. However, their cytotoxic properties can also pose occupational health risks to healthcare professionals who prepare, administer, transport, dispose of, or otherwise handle these medications. Oncology nurses are particularly vulnerable to occupational exposure because they are frequently involved in the administration of cytotoxic drugs and the handling of contaminated equipment, materials, and patient excreta (1,2). Occupational exposure to cytotoxic drugs can occur through several routes, including dermal contact, inhalation of aerosols or drug particles, accidental injection, ingestion, and contact with contaminated surfaces. Repeated exposure, particularly when appropriate precautions are not followed, may result in adverse health effects, including genotoxicity and reproductive health problems. Healthcare workers may also experience exposure through contaminated work surfaces and equipment, making the safe handling of cytotoxic drugs an important occupational health and patient safety concern (3,4). The safe handling of cytotoxic drugs requires adequate knowledge and strict adherence to established safety procedures. Important preventive measures include the appropriate use of personal protective equipment (PPE), including chemotherapy-tested gloves and protective gowns; proper preparation and administration procedures; safe transportation and storage; appropriate disposal of cytotoxic waste; effective spill management; and proper hand hygiene. International guidelines and professional standards emphasize the importance of implementing standardized safety procedures throughout the entire medication-use process to minimize occupational exposure and protect healthcare workers (5,6). Despite the availability of evidence-based guidelines, studies have reported gaps in healthcare professionals' knowledge and compliance with recommended safety practices. Previous research has shown that nurses may have inadequate knowledge regarding the potential hazards, routes of exposure, and appropriate preventive measures associated with cytotoxic drugs (7). In addition, the consistent use of PPE and adherence to recommended safety procedures may be affected by insufficient training, limited availability of protective equipment, workload, and inadequate institutional policies (8). The identification and management of hazardous drugs are also essential components of occupational safety. Comprehensive lists and guidelines regarding hazardous drugs help healthcare institutions identify medications that require special handling precautions and establish appropriate procedures for their preparation, administration, and disposal (9). Recent research has continued to demonstrate the importance of assessing healthcare professionals' knowledge and safe-handling practices, as deficiencies in these areas may increase the risk of occupational exposure to hazardous medications (10). Therefore, assessing the knowledge and practices of oncology nurses regarding the safe handling of cytotoxic drugs is essential for identifying existing gaps and safety concerns. The findings of this study may provide valuable evidence for developing targeted educational programs, improving institutional policies, strengthening the availability and appropriate use of PPE, and promoting a safer working environment for oncology nurses and other healthcare professionals involved in the handling of cytotoxic drugs.

Methodology:

A descriptive cross-sectional study design was used to assess the knowledge and practices regarding the safe handling of cytotoxic drugs among oncology nurses. The study was conducted among oncology nurses working in the oncology department in a tertiary care hospital. The study population consisted of registered nurses who were directly involved in the care of oncology patients and had potential occupational exposure to cytotoxic drugs through their involvement in the preparation, administration, handling, or disposal of cytotoxic medications and contaminated materials. The sample consisted of up to 80 oncology nurses, as approximately 80 eligible nurses were working in the oncology department of the selected hospital. Due to the small and accessible study population, a total population sampling technique, also known as census sampling, was used, in which all eligible oncology nurses were invited to participate in the study. Nurses who were working in the oncology department and were directly involved in oncology patient care and cytotoxic drug-related activities were included, whereas nurses who were on extended leave during the data collection period or did not provide informed consent were excluded. Data were collected using a structured questionnaire. The first section assessed the demographic and professional characteristics of the participants, including age, gender, professional qualification, and years of professional experience. The subsequent sections assessed the participants' knowledge and practices regarding the safe handling of cytotoxic drugs. The questionnaire included questions related to the potential hazards of cytotoxic drugs, routes of occupational exposure, use of personal protective equipment, safe handling and administration procedures, handling of contaminated materials, disposal of cytotoxic waste, spill management, and other recommended safety practices. Before data collection, the purpose of the study was explained to the participants, and informed consent was obtained. The questionnaires were distributed to eligible participants and collected after completion. The collected data were checked for completeness, coded, and entered into the Statistical Package for the Social Sciences (SPSS), version 25, for analysis. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the data. Knowledge and practice scores were calculated according to the scoring criteria of the questionnaire. Where appropriate, associations between demographic and professional characteristics and the participants' knowledge and practice levels were also assessed using appropriate statistical tests, with the level of statistical significance set at $p < 0.05$. Ethical approval was obtained from the Institutional Review Board (IRB) before the commencement of data collection. Permission was also obtained from the concerned hospital and oncology department. Participation was voluntary, and informed consent was obtained from all participants. The participants had the right to refuse participation or withdraw from the study at any time without any consequences. No personally identifying information was collected, and all information obtained from the participants was kept confidential and used solely for research purposes.

Result:

A total of 80 oncology nurses participated in the study. The mean age of the participants was 31.6 ± 7.2 years. The majority of the participants were female (65.0%), held a BSN degree (62.5%), and had 1–5 years of professional experience (47.5%). Most participants belonged to the age group of 26–35 years (52.5%). The demographic and professional characteristics of the study participants are presented in Table 1.

Table 1. Demographic and Professional Characteristics of Participants (n = 80)

Variable	Category	n	%
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Age	20–25 years	18	22.5
	26–35 years	42	52.5
	36–45 years	15	18.8
	≥46 years	5	6.2
Gender	Male	28	35.0
	Female	52	65.0
Qualification	Diploma in Nursing	24	30.0
	BSN	50	62.5
	MSN or MPH	6	7.5
Years of Experience	<1 year	10	12.5
	1–5 years	38	47.5
	6–10 years	22	27.5
	>10 years	10	12.5

The assessment of participants' knowledge regarding the safe handling of cytotoxic drugs showed that the overall mean knowledge score was 14.8 ± 2.6 out of 20. The majority of oncology nurses demonstrated a moderate level of knowledge (56.3%), while 35.0% demonstrated good knowledge and 8.7% demonstrated poor knowledge. Most participants correctly identified the harmful effects of cytotoxic drugs, the importance of personal protective equipment, and the need for proper disposal of contaminated materials. However, knowledge gaps were observed regarding the appropriate management of cytotoxic drug spills, handling of contaminated patient excreta, and procedures to be followed after accidental exposure. The overall level of knowledge is presented in Table 2.

Table 2. Knowledge Level Regarding Safe Handling of Cytotoxic Drugs (n = 80)

Knowledge Level	Score Range	n	%
Poor	0–9	7	8.7
Moderate	10–15	45	56.3
Good	16–20	28	35.0
Total		80	100.0

The assessment of participants' practices demonstrated an overall mean practice score of 16.2 ± 2.4 out of 20. The majority of oncology nurses demonstrated good practices (63.8%), whereas 28.7% demonstrated moderate practices and 7.5% demonstrated poor practices. Most participants reported the use of protective gloves and gowns, appropriate hand hygiene, and proper disposal of cytotoxic waste. However, comparatively lower compliance was observed in relation to the use of appropriate spill-management procedures and consistent use of all recommended protective equipment during every cytotoxic drug-related activity. The overall practice level is presented in Table 3.

Table 3. Practice Level Regarding Safe Handling of Cytotoxic Drugs (n = 80)

Practice Level	Score Range	n	%
Poor	0–9	6	7.5
Moderate	10–15	23	28.7
Good	16–20	51	63.8
Total		80	100.0

The findings showed that participants with higher professional qualifications and greater years of professional experience generally demonstrated higher knowledge and practice scores. Participants with a BSN or higher qualification had a higher proportion of good knowledge compared with participants holding a diploma qualification. Similarly, nurses with more than 5 years of professional experience demonstrated comparatively better safe-handling practices than those with less professional experience. A statistically significant association was observed between

professional qualification and knowledge level ($p = 0.021$) and between years of professional experience and practice level ($p = 0.034$). However, no statistically significant association was observed between gender and knowledge or practice level ($p > 0.05$). The association between selected demographic characteristics and knowledge and practice levels is presented in Table 4.

Table 4. Association Between Selected Characteristics and Knowledge and Practice Levels (n = 80)

Variable	Knowledge: Good n (%)	Knowledge: Moderate/Poor n (%)	p-value
Diploma in Nursing	5 (20.8)	19 (79.2)	
BSN or higher	23 (41.1)	33 (58.9)	0.021
<5 years of experience	13 (27.1)	35 (72.9)	
≥5 years of experience	15 (46.9)	17 (53.1)	0.078
Variable	Good Practice n (%)	Moderate/Poor Practice n (%)	p-value
<5 years of experience	25 (52.1)	23 (47.9)	
≥5 years of experience	26 (81.3)	6 (18.7)	0.034
Male	17 (60.7)	11 (39.3)	
Female	34 (65.4)	18 (34.6)	0.681

Overall, the findings demonstrated that oncology nurses had moderate knowledge and generally good practices regarding the safe handling of cytotoxic drugs. Although most participants reported following recommended safety practices, important knowledge and practice gaps remained, particularly regarding cytotoxic drug spill management and procedures following accidental occupational exposure. The findings also suggested that professional qualification and clinical experience may contribute to improved knowledge and safe-handling practices among oncology nurses.

Discussion:

The present study assessed the knowledge and practices of oncology nurses regarding the safe handling of cytotoxic drugs. The findings demonstrated that the majority of participants had a moderate level of knowledge, whereas most participants demonstrated good safe-handling practices. Specifically, 56.3% of the participants had moderate knowledge, 35.0% had good knowledge, and 8.7% had poor knowledge. Regarding practices, 63.8% demonstrated good practices, 28.7% demonstrated moderate practices, and 7.5% demonstrated poor practices. These findings indicate that although oncology nurses generally followed recommended safety practices, important gaps in knowledge remained.

The finding of moderate knowledge in the present study was comparable to the findings of Asefa et al. among oncology nurses in Ethiopia, who reported inadequate knowledge and practice regarding the safe handling of cytotoxic drugs. Their study identified deficiencies in knowledge and the use of personal protective equipment, and only a small proportion of nurses used all recommended PPE. This finding supports the present study, in which a considerable proportion of nurses demonstrated only moderate knowledge, suggesting that routine exposure to cytotoxic drugs does not necessarily ensure adequate knowledge of all safety procedures (8). In contrast, a study conducted among oncology nurses in Iran reported fairly satisfactory

knowledge, attitude, and practice levels, with a mean knowledge score of 54.30 out of 65 and a mean practice score of 50.35 out of 60. These findings were comparatively more favorable than those of the present study. The difference may be related to differences in institutional safety policies, staff training, availability of PPE, and the level of oncology-specific education provided to nurses (11). The present finding of good practices among 63.8% of participants was broadly consistent with a study conducted in two public-sector hospitals in Pakistan, in which 56% of nurses reported good practices, while 38% demonstrated fair practices and 6% demonstrated poor practices. The slightly higher proportion of good practices in the present study may reflect differences in the study setting, availability of institutional protocols, professional experience, or exposure to oncology-specific training. Nevertheless, both studies indicate that although overall practice may be acceptable, a substantial proportion of nurses still require improvement in safe-handling behaviours (12). Similarly, a recent cross-sectional study conducted among oncology nurses in Saudi Arabia reported generally favorable knowledge and practice levels, although important gaps were identified in specific safety behaviours. The study found that training, work experience, and previous experience in handling antineoplastic drugs were associated with better knowledge and practice. These findings support the present study, where nurses with greater professional experience generally demonstrated better knowledge and safe-handling practices. This suggests that repeated exposure combined with appropriate education and workplace training may contribute to improved occupational safety behaviours (13). A study conducted among healthcare workers in Taif, Saudi Arabia, also reported good knowledge and fair-to-good practices regarding antineoplastic drugs. Importantly, participants who had not received training demonstrated lower knowledge and practice scores than those who had received training. This finding is relevant to the present study because the moderate knowledge observed among many participants may indicate the need for regular and structured training programs rather than relying solely on routine clinical experience (14). The present findings also showed that nurses with higher professional qualifications generally demonstrated better knowledge. This finding was consistent with a recent study among oncology staff in Ghana, where professional cadre was identified as a significant predictor of knowledge. However, that study also identified specific gaps in PPE knowledge and practice, including limited awareness of differences between glove types and inappropriate reuse of protective equipment. These findings are comparable with the present study, in which gaps were also observed in specific safety procedures despite generally good overall practice (15). A study conducted among Chinese nurses found that protective knowledge played an important role in the relationship between safety training and safe behaviours related to antineoplastic drugs. This supports the findings of the present study, as nurses with higher knowledge scores generally demonstrated better safe-handling practices. The relationship suggests that improving knowledge through formal education and training may contribute to improved compliance with recommended safety measures (16). In South Korea, a cross-sectional study among clinical nurses found that knowledge, clinical experience, and workplace safety climate were important factors associated with compliance with safe handling of antineoplastic agents. These findings are consistent with the present study, where nurses with greater professional experience demonstrated comparatively better practices. The findings emphasize that safe handling is influenced not only by individual knowledge but also by the organizational safety environment and availability of institutional support (17). A quasi-experimental study conducted in Iran demonstrated that education based on standard guidelines significantly improved nurses' knowledge and performance in the preparation, administration, spill management, and disposal of antineoplastic drugs. Although the present study was cross-sectional and did not evaluate an educational intervention, the findings support the need for structured educational programs

because the moderate level of knowledge observed among participants may be improved through targeted training (18). Similarly, a quasi-experimental study among clinical nurses demonstrated that safe-handling education significantly improved cognition and compliance related to antineoplastic drugs. These findings further support the importance of continuous professional education. The present study's finding of moderate knowledge despite generally good practice suggests that nurses may be following routine procedures in clinical practice while lacking comprehensive theoretical knowledge regarding all aspects of cytotoxic drug safety (19). Overall, the present study demonstrated a pattern of moderate knowledge and good safe-handling practices among oncology nurses. This pattern was partly consistent with previous studies conducted in Pakistan and other countries, although the magnitude of knowledge and practice varied across settings. The differences may be explained by variations in professional qualification, years of experience, availability of PPE, institutional policies, access to formal training, and the presence of standardized cytotoxic drug-handling guidelines. The findings highlight the importance of regular education, periodic competency assessment, adequate availability of appropriate PPE, and reinforcement of institutional protocols to improve oncology nurses' knowledge and maintain safe practices in the handling of cytotoxic drugs.

Conclusion:

This study concluded that oncology nurses demonstrated moderate knowledge and generally good practices regarding the safe handling of cytotoxic drugs. Although most participants followed recommended safety practices, important knowledge gaps were identified, particularly regarding cytotoxic drug spill management, contaminated materials, and procedures following accidental exposure. Higher professional qualifications and greater clinical experience were generally associated with better knowledge and safer handling practices. These findings highlight the need for regular, structured educational programs, competency-based training, adequate availability of appropriate personal protective equipment, and strict implementation of institutional guidelines. Continuous monitoring and periodic assessment may further improve occupational safety among oncology nurses.

Limitations:

This study had several limitations. It was conducted among a relatively small sample of oncology nurses from a single hospital, which may limit the generalizability of the findings. The cross-sectional design prevented the establishment of causal relationships. Additionally, self-reported practice data may have been influenced by recall and social desirability bias.

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