

## Factors affecting and strategies for safe handling of chemotherapy: A narrative review

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### Abstract

**Background:** Chemotherapy poses significant occupational hazards to healthcare professionals, particularly nurses, with exposure to cytotoxic drugs linked to severe health consequences such as cancer, infertility, and miscarriages. This review examines factors influencing safe chemotherapy handling and identifies strategies to minimize exposure risks.

**Methods:** A comprehensive literature search was conducted using databases and keywords like "chemotherapy," "safe handling," "hazardous drugs," and "nurses." Studies on individual and organizational factors influencing safe practices were included, while review articles and theses were excluded. The findings from multiple sources were synthesized to highlight key strategies for improving chemotherapy safety.

**Results:** Individual factors affecting safe handling include knowledge of chemotherapy hazards, self-efficacy in using personal protective equipment (PPE), and perceived risk of exposure. Organizational factors include workplace safety climate, clear policies and procedures, availability of PPE, workload, staffing ratios, managerial support, and comprehensive training programs.

**Conclusion:** Ensuring safe chemotherapy handling requires a multi-faceted approach addressing both individual and organizational factors. Key strategies include enhancing knowledge through education, promoting self-efficacy, fostering a positive safety climate, developing clear policies, ensuring adequate resources, optimizing staffing, providing managerial support, and implementing continuous training programs to improve safe practices.

**Keywords:** Factors; Strategies; Safe handling; Chemotherapy

### 1. Introduction

Chemotherapy, a cornerstone of cancer treatment, presents a significant occupational hazard for healthcare professionals, particularly nurses. Exposure to cytotoxic drugs can lead to severe health consequences, including cancer, infertility, and miscarriages [1]. Ensuring safe handling practices is crucial to protect both healthcare workers and patients. This narrative review examines the factors influencing safe handling of chemotherapy, drawing upon current research to highlight key considerations for improving practice and minimizing exposure risks. The review will explore the nature of cytotoxic drugs and their associated health hazards, delve into individual and organizational factors impacting safe handling practices, and discuss strategies for enhancing these practices.

Chemotherapy agents are designed to target rapidly dividing cells, including cancer cells. However, these drugs can also damage healthy cells, posing risks to healthcare workers who handle them. Exposure can occur through various routes,

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including inhalation, dermal contact, and ingestion [2]. Inhalation: When chemotherapy drugs are prepared or administered, they can release vapours or particulates that can be inhaled by healthcare workers. This is particularly concerning during drug preparation, as the process can generate aerosols. For instance, when vials are opened or syringes are filled, drug particles can become airborne, potentially posing a respiratory hazard. Dermal Contact: Direct contact with chemotherapy drugs through skin or mucous membranes can lead to absorption and potential systemic effects. This risk is heightened during drug preparation, administration, and handling of contaminated surfaces or waste. Handling chemotherapy vials, bags, or tubing, or coming into contact with spills or contaminated surfaces can lead to dermal exposure. Ingestion: Accidental ingestion of chemotherapy drugs can occur through contaminated surfaces or hands. This risk is particularly prevalent in situations where proper hand hygiene practices are not followed. Eating or drinking after handling chemotherapy drugs without washing hands can lead to ingestion.[2]

Exposure to chemotherapy drugs can lead to a range of health problems, including: Cancer: Studies have linked chemotherapy exposure to an increased risk of developing certain cancers, particularly leukemia [1]. The specific cancers associated with exposure vary depending on the drugs involved and the duration and level of exposure. The risk of developing cancer is higher for healthcare workers with prolonged or frequent exposure to chemotherapy drugs. Reproductive Issues: Chemotherapy can damage reproductive organs, leading to infertility and miscarriages [1]. The effects on fertility can be long-lasting and can vary based on the specific drugs, dosage, and individual susceptibility. The risk of reproductive issues is particularly concerning for women of childbearing age and men who handle chemotherapy drugs. Other Health Effects: Exposure can also cause skin irritation, respiratory problems, and other health issues [1]. These effects can range from mild, such as skin rashes, to more severe, such as respiratory distress. Exposure can also lead to gastrointestinal upset, fatigue, and neurological problems.

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## 2. Methods

This narrative review synthesized findings from multiple sources to identify key factors influencing safe handling practices. A comprehensive literature search was conducted using relevant databases, including PubMed, Scopus, and CINAHL. Search terms included "chemotherapy," "safe handling," "hazardous drugs," "nurses," and "occupational exposure." Studies focusing on individual and organizational factors influencing safe handling practices were included. Review articles, books, theses, and dissertations were excluded. The review focused on quantitative and qualitative studies published in peer-reviewed journals between 2010 and 2024. Data analysis involved identifying key themes and considerations for improving chemotherapy safety. Findings from multiple sources were synthesized to provide a comprehensive overview of factors influencing safe handling practices.

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## 3. Results

The review identified a range of individual and organizational factors that influence nurses' use of safe handling practices.

### 3.1. Individual Factors Influencing Safe Handling Practices

- **Knowledge and Awareness:** Nurses' knowledge of safe handling practices is a critical factor in minimizing exposure. Studies have shown that nurses with inadequate knowledge about chemotherapy hazards and proper handling techniques are more likely to engage in risky behaviors [3, 4]. For instance, nurses who are not aware of the potential risks associated with handling oral chemotherapy may not take necessary precautions, such as wearing gloves or using closed-system transfer devices.
- **Self-Efficacy:** Self-efficacy, or confidence in one's ability to perform a task, plays a significant role in safe handling practices. Nurses who feel confident in their ability to use personal protective equipment (PPE) are more likely to adhere to recommended procedures [5, 6]. For instance, a nurse who feels confident in their ability to properly don and doff gloves is more likely to wear them consistently during chemotherapy handling.
- **Perceived Risk:** Nurses' perception of the risk associated with chemotherapy exposure can also influence their behavior. Studies have shown that nurses who perceive a higher risk of harm are more likely to prioritize safe handling practices [5, 6]. A nurse who strongly believes that chemotherapy exposure poses a significant threat to their health is more likely to meticulously follow safety protocols, such as using a biological safety cabinet for drug preparation.

### 3.2. Organizational Factors Influencing Safe Handling Practices

- **Workplace Safety Climate:** The overall safety climate within a healthcare facility can significantly impact nurses' adherence to safe handling practices. A positive safety climate, characterized by strong leadership, clear

policies, and a culture of safety, promotes safer practices [5, 6, 9]. In a workplace with a strong safety climate, nurses are more likely to feel empowered to report unsafe practices, and management is more likely to prioritize safety initiatives.

- **Policies and Procedures:** Clear and comprehensive policies and procedures for handling chemotherapy are essential to ensure consistent adherence to safe practices. However, many institutions have policies that do not reflect current recommendations, leading to gaps in protection [5, 7]. For instance, policies may not adequately address the safe handling of oral chemotherapy, leading to inconsistent practices among nurses.
- **Resources and Availability of PPE:** The availability of adequate PPE, including gloves, gowns, masks, and eye protection, is crucial for safe handling. However, shortages of PPE and challenges in accessing essential equipment can pose significant barriers in resource-limited settings [1, 7]. In these settings, nurses may be forced to reuse PPE or compromise their safety due to limited resources.
- **Workload and Staffing Ratios:** Heavy workloads and inadequate staffing ratios can lead to rushed practices and increased risk of exposure. When nurses are under pressure, they may be less likely to adhere to all safety protocols [5, 8]. For example, if a nurse is responsible for a high number of patients and is short-staffed, they may be less likely to meticulously follow all steps of the safe handling procedures, increasing the risk of exposure.
- **Managerial Support:** Strong managerial support for safe handling practices is crucial. Managers who actively promote safety, provide adequate training, and monitor adherence to policies can create a more secure work environment [10, 9]. Managers who prioritize safety are more likely to invest in appropriate training, resources, and infrastructure to support safe handling practices.
- **Training and Education:** Comprehensive training and education programs on safe handling practices are essential for equipping nurses with the knowledge and skills to minimize exposure risks. Training should include hands-on simulations, practical demonstrations, and ongoing education to address evolving safety protocols [11, 12]. Training programs that incorporate realistic scenarios and practical applications are more effective in enhancing nurses' skills and knowledge.

### 3.3. Strategies for Enhancing Safe Handling Practices

The findings of this review highlight the need for a multi-faceted approach to enhancing safe handling practices. Strategies should address both individual and organizational factors represented in the table 1.

**Table 1** Strategies to Enhance the Safe Handling of Chemotherapy

Category	Strategy	Explanation
Improving Individual Practices	Knowledge Enhancement	Implementing regular education and training programs is crucial to ensure that nurses possess up-to-date knowledge of chemotherapy hazards, safe handling techniques, and current recommendations. These programs should be tailored to address specific knowledge gaps identified through assessments, ensuring that nurses are equipped with the most current information and best practices [3, 4].
	Promoting Self-Efficacy	Training should focus on building nurses' confidence in using PPE and following safe handling protocols. This can be achieved through hands-on simulations, role-playing exercises, and positive reinforcement. By providing nurses with practical experience and positive feedback, they can develop a sense of competence and self-assurance, leading to greater adherence to safe handling procedures [5, 6].
	Addressing Perceived Risk	Open communication and education can help nurses understand the real risks associated with chemotherapy exposure, encouraging them to prioritize safety. Sharing real-world examples of exposure incidents and their consequences, as well as providing information on the effectiveness of safe handling practices in minimizing risk, can effectively address any misconceptions and promote a greater sense of awareness [5, 6].
Strengthening Organizational Practices	Positive Safety Climate	Creating a culture of safety is paramount. This involves fostering open communication, promoting teamwork, and recognizing safe practices. Implementing mechanisms for reporting unsafe practices, providing regular safety updates, and recognizing nurses who consistently

		demonstrate safe handling behaviors create a supportive environment where safety is valued and prioritized [5, 6, 9, 13].
	Robust Policies and Procedures	Developing comprehensive policies and procedures that reflect current recommendations and ensure consistent implementation is essential. These policies should be regularly reviewed and updated to reflect changes in best practices and advancements in safe handling technology, ensuring that practices remain aligned with the latest safety standards [5, 8].
	Adequate Resources and PPE	Providing nurses with sufficient and readily available PPE, including closed-system transfer devices, is critical to minimizing exposure risks. This requires ongoing monitoring of PPE inventory and ensuring timely replenishment. Adequate resources and readily available PPE empower nurses to confidently adhere to safe handling protocols, reducing the likelihood of exposure [1, 8].
	Optimize Workload and Staffing	Ensuring adequate staffing levels and reasonable workloads is crucial to reduce pressure on nurses and promote adherence to safe practices. Implementing strategies such as flexible scheduling, cross-training, and workload management tools can help create a sustainable and manageable work environment, reducing the likelihood of rushed practices and potential exposure risks [5, 7].
	Effective Managerial Support	Managers play a vital role in promoting a culture of safety. They should actively advocate for safety, provide ongoing training, and monitor adherence to policies. Creating a clear expectation of safe handling practices, providing resources and support to nurses, and holding staff accountable for adherence to policies demonstrate a strong commitment to safety from leadership [10, 9].
	Continuous Training and Education	Implementing ongoing training and education programs is essential to keep nurses updated on safe handling practices, address emerging safety protocols, and reinforce best practices. These programs should be interactive, engaging, and relevant to the specific needs of the nurses and the institution. Continuous learning ensures that nurses remain informed about the latest advancements in safe handling techniques and are equipped to handle evolving challenges [11, 12].

#### 4. Discussion

The review highlights several individual and organizational factors that influence nurses' adherence to safe handling practices for chemotherapy agents. On an individual level, nurses' knowledge and awareness of chemotherapy hazards play a crucial role in minimizing exposure risks. Previous studies have demonstrated that inadequate knowledge is a significant barrier to the safe handling of chemotherapy agents [3, 4]. Nurses who lack awareness of the risks associated with oral chemotherapy, for instance, may neglect essential precautions such as wearing gloves or utilizing closed-system drug transfer devices [14]. Enhancing knowledge through regular, targeted training can significantly improve nurses' ability to follow safe handling procedures. In addition to knowledge, self-efficacy—nurses' confidence in their ability to safely handle chemotherapy—also impacts their behavior. Nurses who feel capable of properly using personal protective equipment (PPE) are more likely to adhere to safety protocols, underscoring the importance of building self-efficacy through hands-on training and role-playing exercises [5, 6]. Furthermore, nurses' perceived risk of harm from chemotherapy exposure influences their safety behaviors. Nurses who perceive higher risks are more likely to prioritize safe handling practices, indicating that addressing nurses' perceptions through education and case studies may lead to better safety outcomes [5, 6].

Organizational factors, such as workplace safety climate and policies, are also key determinants of safe chemotherapy handling. A positive safety climate, where strong leadership and a culture of safety are evident, can encourage nurses to report unsafe practices and adhere to safety protocols. Studies have shown that in environments with a positive safety culture, nurses are more likely to follow recommended safety practices [5, 6, 9]. Additionally, clear and comprehensive policies are essential to ensure consistent implementation of safe handling practices, yet many institutions still struggle with outdated or insufficient policies [5, 7]. Providing adequate resources, such as sufficient PPE and closed-system devices, is another critical factor. In resource-limited settings, shortages of essential safety

equipment can hinder nurses' ability to comply with safety guidelines, leading to increased risks of exposure [1, 7]. Furthermore, optimal staffing and manageable workloads are crucial for preventing rushed or incomplete safety procedures. Studies have shown that high nurse-to-patient ratios and heavy workloads contribute to unsafe practices, as nurses may prioritize speed over safety under pressure [5, 8]. Effective managerial support, including ongoing training, performance feedback, and clear safety expectations, plays a significant role in promoting a culture of safety. Managers who actively engage in safety initiatives, monitor compliance, and provide adequate resources contribute to creating an environment where safe handling practices are prioritized [10, 9].

To address these challenges, a multi-faceted approach is necessary. Individual practices can be enhanced by regular training programs focused on specific risks, such as the handling of oral chemotherapy, and by promoting self-efficacy through hands-on simulations. Organizational practices can be strengthened by fostering a positive safety climate, implementing robust policies, ensuring the availability of adequate PPE, optimizing staffing levels, and providing continuous managerial support. By addressing both individual and organizational factors, healthcare institutions can significantly reduce chemotherapy exposure risks for nurses and improve overall safety outcomes.

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## 5. Conclusion

Safe handling of chemotherapy is a critical aspect of patient care and healthcare worker safety. By understanding the factors influencing safe practices, healthcare organizations can implement comprehensive strategies to minimize exposure risks and protect both patients and healthcare professionals. Ongoing education, robust policies, adequate resources, and a strong commitment to safety are essential to create a work environment that prioritizes the health and well-being of all involved.

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

The authors have no conflict of interest to declare

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## References

- [1] Pergert P, Sullivan C, Adde M, Afungchwi GM, Downing J, Hollis R, Ilbawi A, Morrissey L, Punjwani R, Challinor J. An ethical imperative: Safety and specialization as nursing priorities of WHO Global Initiative for Childhood Cancer. *Pediatr Blood Cancer*. 2019;66(7). doi:10.1002/psc.28143.
- [2] Connell D. Fashionability and comfort: Designing chemotherapy uniforms to enhance the well-being of patients and oncology nurses. *J Text Sci Fashion Technol*. 2019;2(3):538. doi:10.33552/JTSFT.2019.02.000538.
- [3] Hosen M, Hasan M, Islam MS, Raseduzzaman M, Islam M, Islam M, Hossain MM, Nafiujjaman M, Nishat TR. Evaluation of knowledge and practice of handling chemotherapy agents by nurses: A multi-centre study in Bangladesh. *Int J Community Med Public Health*. 2019;7(12):4862-4869. doi:10.18203/2394-6040.ijcmph20194471.
- [4] Lee SG, Choi SY. Factors influencing compliance with safe handling requirements of anticancer agents by nurses in a tertiary hospital: A secondary publication. *J Clin Nurs Res*. 2024;8(1):1-8. doi:10.26689/jcnr.v8i1.6062.
- [5] Polovich M, Clark P. Factors influencing oncology nurses' use of hazardous drug safe-handling precautions. *Oncol Nurs Forum*. 2012;39(3). doi:10.1188/12.ONF.E299-E309.
- [6] Callahan A, Ames N, Manning M, Touchton-Leonard K, Yang L, Wallen G. Factors influencing nurses' use of hazardous drug safe-handling precautions. *Oncol Nurs Forum*. 2016;43(3). doi:10.1188/16.ONF.43-03AP.
- [7] Lin YS, Chang Y, Lin YC, Lou M. Factors influencing nurses' use of hazardous drug safe-handling precautions. *Oncol Nurs Forum*. 2019;46(1). doi:10.1188/19.ONF.E86-E97.
- [8] da Conceição A, Bernardo D, Lopes L, Miguel F, Bessa F, Monteiro F, Santos C, Oliveira B, Santos LL. Oncology pharmacy units: A safety policy for handling hazardous drugs and related waste in low- and middle-income African countries—Angolan experience. *ecancermedicalscience*. 2015;9:575. doi:10.3332/ecancer.2015.575.
- [9] Lin YS, Gau B, Liang JC, Chen HC, Shih FY, Lin YC, Lou M. Development and psychometric testing of the safety climate instrument suitable for nurses handling chemotherapy drugs. *J Adv Nurs*. 2022;78(2):612-622. doi:10.1111/jan.15257.

- [10] Abu-Alhaija DM, Bakas T, Shaughnessy E, Miller E. The factors that influence chemotherapy exposure among nurses: An integrative review. *Workplace Health Saf.* 2023;71(3):137-144. doi:10.1177/21650799221140583.
- [11] Topu S, Beer A, Ergr OA, Konyalolu S. Implementation and evaluation of safe handling precautions training for oncology nurses: An experimental design. *Nurs Health Sci J.* 2022;2(4):215-223. doi:10.53713/nhs.v2i4.215.
- [12] Prakash A, Farooq O, Durairaj S, Allsup D, Purva M. Training in safe administration of intrathecal chemotherapy: Is in situ simulation the answer? A pilot study. *BMJ Stel.* 2015;1(1):139. doi:10.1136/BMJSTEL-2015-000075.139.
- [13] Kline N. Promoting patient safety through the development of a pediatric chemotherapy and biotherapy provider program. *J Pediatr Oncol Nurs.* 2004;21(2):57-60. doi:10.1177/1043454204212001.
- [14] Huff C. Oral chemotherapy: A home safety educational framework for healthcare providers, patients, and caregivers. *Clin J Oncol Nurs.* 2020;24(1):22-30. doi:10.1188/20.CJON.22-30.