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Research Article

Knowledge, Attitude, Practice, and Challenges in the Safe Handling of Cytotoxic Drugs: A Study of Nurses in Sri Lankan Cancer Units

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Abstract

Introduction: Cytotoxic drugs are used primarily for the treatment of cancer. Long-term occupational exposure to cytotoxic drugs is associated with various carcinogenic, teratogenic, and mutagenic effects in the human body. Nurses come into contact with cytotoxic drugs and related waste during their daily work in cancer care units. This study aimed to explore the level of knowledge, attitude, and practice in the safe handling of cytotoxic drugs among nurses working in two cancer units in Sri Lanka. It also examined the challenges they faced in ensuring safe handling practices.

Methods: In this cross-sectional descriptive study, a self-administered structured questionnaire was used to collect data from 90 nurses working in two cancer units at National Hospital Kandy and Base Hospital Tellipalai, Jaffna. Data analysis was performed using SPSS software (version 22.0). Spearman's rank correlation coefficient was used to find the correlation between knowledge, attitude, practice and demographic data. Fisher's exact test was used to determine whether there any association between knowledge, attitude, practice and demographic characteristics. In all analyses p-value <0.05 was considered as statistically significant

Results: Of the study participants (n=90), the majority were females (n=77,85.7%) and 87 were completed diploma-qualified (96.7%), and most of them did not receive formal training (n=76,84.4%) on the safe use of cytotoxic medicines. The majority of the participants had a high level of knowledge (n=69, 76.7%) and high attitude (n=74, 83.2%). However only one participant (n=1,1.1%) scored 'good' on practice in the safe handling of cytotoxic drugs. The main challenges affecting the study participants were the shortage of staff (n=84, 93.3%), high workload (n=83, 92.2%), shortage of PPE and other facilities (n=82, 91.1%), and lack of in-service training (n=78, 86.7%).

Conclusion: Nurses demonstrated high knowledge and good attitudes toward the safe handling of cytotoxic drugs, but practice levels were fair (59.6%). Regular training, adequate staffing, resource availability, and continuous professional development are essential for improving patient safety and nurse well-being.

***Keywords:** cytotoxic drugs, nurses, occupational exposure, knowledge, attitude and practice

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Introduction

Cancer is characterised by the uncontrolled proliferation of abnormal cells that exhibit genetic mutations, allowing them to bypass normal regulatory mechanisms. These cells can invade surrounding tissues and have the potential to metastasise, spreading to distant organs through the bloodstream or lymphatic system. Cancer is one of the biggest worldwide health problems, and the prevalence of cancer is increasing in both developed and developing countries every day [1]. In 2018, an estimated 9.6 million people died from cancer, making it the top cause of death worldwide [2].

Cytotoxic drugs are used primarily for the treatment of cancer [3]. Drugs have a long history of success in treating illness, and they have contributed to many of our medical breakthroughs. However, almost all medications have adverse effects when used by patients [4]. Meanwhile, health care professionals who handle some of these medications are at risk of occupational exposure and may have adverse consequences [5]. Even low levels of exposure to certain drugs can cause such harmful effects [5].

Occupational exposures to anticancer medications and related health concerns have been reported over a four period, with the first case recognised in the United States in the 1970s [5]. According to the National Institute for Occupational Safety and Health (NIOSH), approximately 5.5 million healthcare professionals are exposed to these medications in the workplace each year [4,5]. Most anticancer medications, particularly cytotoxic drugs, lack well-defined or easily measurable thresholds for safe exposure. As a result, even brief or minimal contact with these drugs can pose significant health risks to healthcare workers who handle them or work in environments where they are present. Inhalation, skin contact, or accidental ingestion of some cytotoxic drug can lead to adverse health effects [6,7]. To reduce occupational exposure, departments require specialised interior designs, personal protective equipment (PPE), and safety standards [8].

Occupational exposure to these substances has resulted in a variety of health outcomes in healthcare workers, including acute effects [9], cardiotoxicity [10], reproductive toxic effects [11], and chromosomal damage antecedent to cancer development (12). Nurses come into contact with cytotoxic drugs and related waste during their daily work in cancer care units. Especially the nurses in oncology units have a high risk of exposure to adverse effects of cytotoxic drugs. They may be exposed to these medications during preparation and /or administration of drugs, patient care activities, spill management, waste disposal, and handling of biological substances of patients [13].

Lack of knowledge, poor attitude, and unsafe practices increase the risk of developing cancer and fertility problems like reduced fertility, frequent miscarriages, genetic mutations and fetal abnormalities among the nurses who handle cytotoxic drugs [14]. With the recent rapid rise of cancer patients in Sri Lanka [15], it is important to assess the preparation of our health care professionals towards the safe handling of these cytotoxic drugs. Therefore, this study aimed to understand the current level of knowledge, attitude and practice regarding cytotoxic drug handling of nurses working in two oncology units in Sri Lanka. Accordingly, this study assessed the knowledge and awareness of cytotoxic drugs, as well as the use of personal protective equipment. Furthermore, the challenges faced by oncology nurses when handling cytotoxic drugs were assessed.

Methods

Study setting

This descriptive cross-sectional study was conducted among staff nurses working in the oncology units of the National Hospital, Kandy, and the Base Hospital, Tellipalai. The study participants were selected using the convenient sampling method.

Research instrument and material

A self-administered, pre-tested, structured questionnaire consisting of five sections was used to collect information on sociodemographic data, knowledge of safe handling of cytotoxic drugs, attitudes regarding cytotoxic drugs, practices of safe handling of cytotoxic drugs, and challenges faced by oncology unit nurses in the safe handling of cytotoxic drugs. Knowledge of specific cytotoxic drugs, use of PPE, procedural and safety protocols, supportive care, and its impact on health were assessed in the knowledge section. The third section addressed attitudes regarding cytotoxic drugs. This section contains the following aspects: willingness and comfort, safety prioritisation, job satisfaction, and perception of PPE, which were questioned to evaluate their attitudes. Procedures followed in the receiving, storage, and administration of cytotoxic drugs, as well as cleaning cytotoxic drug spills and disposing of cytotoxic drug waste, were assessed in their practices. The final section of the questionnaire was designed to identify the challenges faced by the oncology unit nurses in Sri Lanka when handling cytotoxic drugs. All the questions were closed-ended, and they were presented in all three languages (Tamil, Sinhala, and English) to avoid language-related barriers. Data collection was conducted from 1st to 25th February 2018,

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Ethical consideration

Ethical approval was obtained from the ethical review committee of the Faculty of Allied Health Sciences, University of Peradeniya. Permission to conduct the study in two oncology units was obtained from the directors and chief nursing officers of the National Hospital, Kandy, and Base Hospital, Tellippalai. The purpose, outcome, benefits, and procedure of the study were explained verbally and through an information leaflet, and written consent was obtained prior to the delivery of the questionnaire. The privacy of the participants was ensured at all times.

Statistical analysis

All the required entries were extracted and entered into a spreadsheet (Microsoft Excel, 2010) and analysed using Statistical Package for Social Science (SPSS) version 20. Demographic data was analysed using descriptive statistics. Scores for attitude, knowledge, and practice were developed based on the responses to the questionnaire and categorised according to the groups outlined in Table 1. The mean scores were compared using a t-test. Associations were assessed by the chi-square test. Spearman's rank correlation coefficient was used to find the correlation between knowledge, attitude, practice and demographic data. Fisher's exact test was used to determine whether there was any association between knowledge, attitude, practice and demographic characteristics. In all analyses, a P-value of <0.05 was considered statistically significant.

Table 1: Scoring system used to interpret the knowledge, attitude, and practice (KAP) on cytotoxic drugs

Aspect	Scores	Interpretation
Knowledge	80-100	High
	50-79	Moderate
	<50	Low
Attitude	>50	High
	<50	Low
Practice	75-100	Good
	50-74	Moderate
	<50	Poor

Results

Sociodemographic profile of the study participants.

This study included 90 participants, of whom 30 (33.3%) were recruited from Base Hospital Tellipalai and 60 (66.7%) were from National Hospital Kandy. Table 2 outlines the participants' sociodemographic characteristics. The majority were females (n = 77, 85.7%), of whom more than half were married (n = 50, 55.6%). In terms of their educational qualifications, the majority held a diploma in nursing (n = 87, 96.7%). Most of the study participants (n = 76, 84.4%) did not receive formal training on the safe handling of cytotoxic drugs.

Table 2: Overview of demographic characteristics

Variables	Classification	Number(n)	Percentage (%)
Hospital	N.H Kandy	60	66.7%
	B.H. Tellipalai	30	33.3%
Gender	Male	13	14.4%
	Female	77	85.6%
Marital status	Single	40	44.4%
	Married	50	55.6%
Education	Diploma	87	96.7%
	Bachelor's	3	3.3%
Work Experience	<1 year	22	24.4%
	1-5 years	49	54.5%
	>5 years	19	21.1%
Formal training	Received	14	15.6%
	Not received	76	84.4%
Time since last formal training	<1 year	3	3.3%
	>1 year	11	12.2%

N.H; National Hospital, B.H; Base Hospital

Knowledge of safe handling of cytotoxic drugs

Most participants (n = 69, 76.7%) demonstrated a high level of knowledge regarding safe handling of cytotoxic drugs. In contrast, some individuals had a moderate level of expertise (n = 19, 21%), while only a few had a low level of understanding (n = 2, 2.2%). The mean knowledge score of both hospital nurses was 83.89.

Attitude regarding cytotoxic drugs

The majority of participants (n=74, 83.2%) had a high attitude towards handling cytotoxic drugs, while only about 17.8% (n=16) had a low attitude. Table 3 summarises the attitudes of the nurses regarding different aspects of handling cytotoxic drugs. The mean attitude of both hospital nurses was 63.56.

Table 3: Attitude of nursing officers on handling cytotoxic drugs

Statements	Number of participants n (%)
Agreed to handle cytotoxic drugs without objection	24 (26.7%)
Afraid of the adverse effects of cytotoxic drugs	65 (72.2%)
Satisfied with their service in the cancer unit	69 (76.9%)
PPE must always be worn while handling	84 (93.3%)
Prioritise the safety of the patient	16 (17.8%)
Prioritise the safety of themselves	35 (38.9%)
Participants prioritised the safety of the patient and themselves	39 (43.3%)

Practice of safe handling of cytotoxic drugs

The majority of participants (n = 59, 65.5%) had moderate practice, while 33.3% (n = 30) had poor practice. Only one participant (1.1%) demonstrated good practice in the safe handling of cytotoxic drugs. The mean practice of both groups of hospital nurses was 51.03. A significant association was found between knowledge and practice. However, there was no association between knowledge and attitude, nor between attitude and practice.

Table 4 summarises the practices of the participants when handling cytotoxic drugs

Administration of cytotoxic drugs

Among the participants, 28.9% (n = 26) had poor practice in administering cytotoxic drugs, 67.8% (n = 61) had moderate practice, and only 3.3% (n = 3) had good practice. Most of the participants used PPE while administering cytotoxic drugs; the majority of them changed torn gloves immediately.

Cytotoxic spills and cleaning

In total, 16.7% (n = 15) of nurses demonstrated poor practice in cytotoxic spills and cleaning, 74.4% (n = 67) had moderate practice, and only 8.9% (n = 8) participants exhibited good practice regarding cytotoxic spills and cleaning. Among the participants, the majority used PPE when cleaning cytotoxic spills and washed their hands with soap and water immediately after cleaning cytotoxic spills.

Disposal of cytotoxic drug waste

Among the participants, 73.3% (n = 66) had good practice in the disposal of cytotoxic drug waste, 24.4% (n = 22) had moderate practice, and only 2.2% (n = 2) had poor practice. The majority of participants reported good practices, mainly using separate containers for collecting cytotoxic contaminated waste in the ward.

Challenges to the safe handling of cytotoxic drugs

The shortage of staff, high workload, shortage of PPE and facilities, lack of in-service training, and discomfort associated with wearing PPE were identified by the majority as factors that can hinder the safe handling of cytotoxic drugs (Figure 1).

There was a significant association between experience and knowledge. Although there was no association between knowledge, attitude, practice, and other demographic characteristics, there was a significant association between knowledge and practice. However, there was no association between knowledge and attitude, or between attitude and practice.

Discussion

Cytotoxic drugs are primarily used for the treatment of cancer. They are known to be highly toxic to cells, principally through their action on cell replication. Many have been proven to be carcinogens, mutagens, or teratogens. Patients receiving therapeutic doses of these drugs have exhibited a long list of acute and chronic adverse effects, including cancers [16].

Most of the adverse effects of cytotoxic drugs affect the reproductive system, where active cell division takes place. Among the possible reproductive side effects experienced by exposed nurses are infertility, abortion, and abnormalities in the fetus [17]. Studies have also been reported on the increased cancer risk among nurses actively handling cytotoxic drugs. Some individuals indicated the presence of genotoxic damage in their peripheral lymphocytes. On top of that, cases of contact dermatitis, skin local reaction, abdominal pain, headaches, hair loss and liver damage related to cytotoxic drug exposure were reported [16]. Therefore, nurses must possess adequate knowledge, a positive attitude, and proper practice regarding cytotoxic drugs.

In this study, only a few participants (15.6%) had been trained on the safe handling of cytotoxic drugs. This did not comply with the International Society of Oncology Pharmacy Practitioners (ISOPP) guidelines, which proposed that all healthcare workers who handle cytotoxic drugs be trained in the safe handling of cytotoxic drugs [18]. Findings from other studies present a mixed picture, with varying proportions of individuals undergoing training [16]. The results showed that 28 healthcare workers (63.6%) at Kenyatta National Hospital in Kenya received training on cytotoxic drug handling through workshops. This contrasts with findings from other studies, which

reported in-service training as the primary method. For instance, a study by Mutai et al. (2020) highlighted that in-service training was the most common approach for equipping healthcare workers with knowledge on cytotoxic drug safety [19] Textbooks and the internet serve as valuable sources of information for nurses, providing essential knowledge and reference materials for their practice [20].

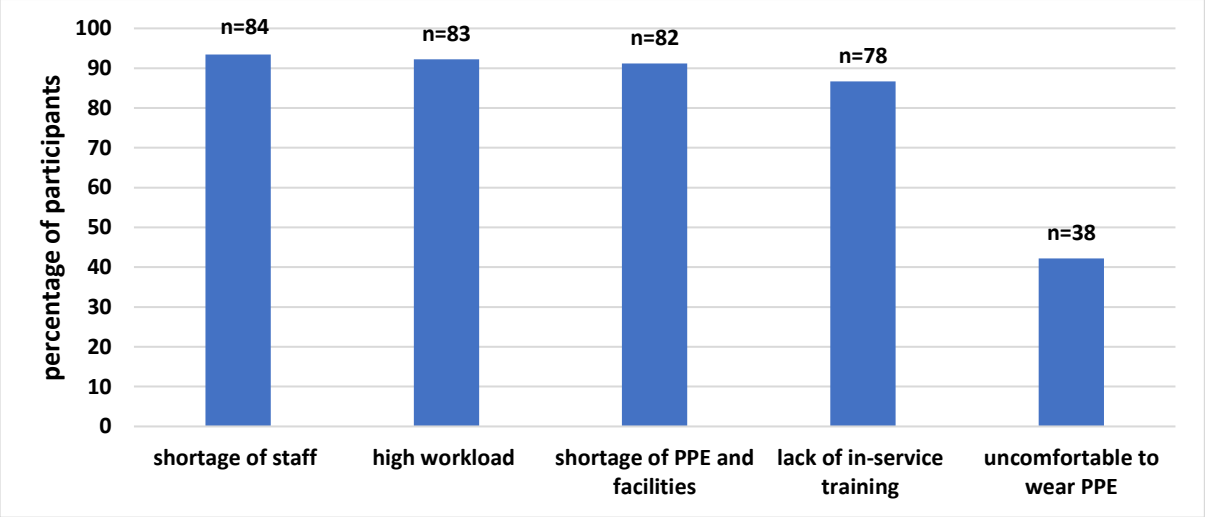

Figure 1: Challenges faced by nurses when practising safe handling of cytotoxic drugs

Table 5: Overview of comparisons between knowledge, attitude, practice and demographic characteristics

S.No	Variables	Classifications	Mean Knowledge	Mean Attitude	Mean Practice
01	Hospital	T.H. Kandy	83.00	65.00	51.03
		B.H. Tellippalai	85.67	60.67	51.04
02	Gender	Male	86.15	61.54	51.56
		Female	83.51	63.90	51.01
03	Marital status	Single	84.00	62.00	52.10
		Married	83.80	64.80	50.16
04	Educational qualification	Diploma	83.79	63.45	58.08
		Bachelor's degree	86.67	66.67	63.45
05	Experience	< 1 Year	76.36	64.55	50.30
		1-5 Years	86.53	62.45	50.94
		>5 Years	85.79	65.26	52.12
06	Formal training	Received	87.86	64.29	51.56
		Not received	83.16	63.48	50.93

The majority of our study participants demonstrated satisfactory knowledge of the safe handling of cytotoxic drugs (n = 69, 76.7%), with a mean score of 83.89. Knowledge on safe handling of cytotoxic drugs in our study cohort was higher compared to another study conducted in Turkey, which revealed unsatisfactory knowledge among nurses [21]. Similarly, another study conducted on two groups of nurses in Egypt also found fair to poor knowledge among the majority before they received training on the safety protocols [22].

Table 4: Practices of the nursing officers when handling cytotoxic drugs

Practice	Number of participants n (%)
Receiving and storage of cytotoxic drugs	
Wear PPE while receiving cytotoxic drugs	75 (83.3%)
Store other medicines and cytotoxic drugs separately during storage	88 (97.8%)
Label the cytotoxic drugs with the product identifier and hazard statement or signal word	75 (83.3%)
Do not store cytotoxic drugs in a biological safety cabinet	71(78.9%)
Participants had poor practice in receiving and storing cytotoxic drugs	26(28.9%)
Administration of cytotoxic drugs	
Wear PPE while administering cytotoxic drugs	80(88.9%)
Use separate gloves to handle cytotoxic and other drugs	69(76.7%)
Changed torn gloves immediately	85(94.4%)
Used PPE while handling the excreta of cancer patients who received cytotoxic drugs	77(85.6%)
Wash hands with soap and water immediately after handling excreta	87(96.7%)
Cytotoxic spills and cleaning	
Wear PPE when cleaning cytotoxic spills	83(92.2%)
Used cleaning reagents to clean cytotoxic spill areas	79(87.8%)
Washed their hands with soap and water immediately after cleaning cytotoxic spills.	90(100%)
Disposal of cytotoxic drug waste	
Used separate containers for collecting cytotoxic contaminated waste	90(100%)
Used a different identification symbol or label for the cytotoxic waste container	85(94.4%)
Used a separate sharp bin for disposing of cytotoxic contaminated sharp materials	66(73.3%)
Challenges to the practice of safe handling of cytotoxic drugs	
Shortage of staff	84(93.3%)
High workload	83(92.2%)
Shortage of PPE and facilities	82(91.1%)
Lack of in-service training	78(86.6%)
Discomfort of wearing PPE	38(42.2%)

Despite limited in-service training, only a small number of participants in our study showed poor KAP regarding handling cytotoxic drugs. The experience gained through daily practice, peer learning, and guidance from experienced colleagues and supervisors can help maintain high standards of practice. Furthermore, some nurses may have taken personal initiative to update their knowledge and skills through available resources, such as medical literature, online courses, and workshops, but without regular training. In the absence of formal, regular training and awareness sessions, practice may vary among nurses, leading to occasional lapses in safety protocols. Limited training may result in inadequate preparation for handling emergencies, such as cytotoxic spills, potentially compromising patient safety. Inadequate training on the use of PPE and safe handling techniques can increase the risk of occupational exposure to cytotoxic drugs, impacting nurses' health.

However, to address these issues, it is essential to implement regular training sessions, as this provides continuous professional development opportunities to ensure that all the ward nurses adhere to the updated protocols. These measures will facilitate the safe and effective handling of cytotoxic drugs, enhance the quality of care and well-being of health care staff.

In receiving and storage, 75 nurses (83.3%) reported wearing PPE when handling cytotoxic drugs, while 87 (96.7%) washed their hands afterwards. This is concerning, as studies indicate that the outside of drug vials may be contaminated with cytotoxic substances (24). Additionally, 75 nurses (83.3%) ensured proper labelling with a hazard product identifier. However, only 21.1% of nurses prepared cytotoxic drugs in a biological safety cabinet, a significantly lower rate than the 98.8% reported in a study from Cyprus [25]. This difference is likely due to the limited availability of biological safety cabinets in Sri Lankan hospitals.

The current study shows that all nurses use separate containers for collecting cytotoxic waste in the ward and use separate sharps bins for disposing of cytotoxic contaminated sharp materials (73.3%). This is of high concern since guidelines recommend the disposal of all cytotoxic drugs in an approved facility. One study reported that most of the staff (98.0%) were not aware of the segregation and disposal of biomedical waste [23]. Proper disposal of cytotoxic drugs is a critical concern, as guidelines mandate their disposal in

approved facilities to prevent environmental contamination and health risks. However, adherence to these guidelines remains a challenge. One study found that 98% of staff lacked awareness regarding the segregation and disposal of biomedical waste, highlighting a significant gap in knowledge and practice. This lack of awareness can lead to improper disposal, increasing the risk of exposure to hazardous substances. Strengthening training programs and ensuring the availability of appropriate disposal facilities are essential to improving compliance with safety protocols.

The challenges faced by nurses in cancer units—such as staff shortages, high workloads, PPE shortages, and lack of in-service training—have significant implications for both patient care and nurse well-being. When nurses are overworked and lack essential resources, patient safety may be compromised due to reduced time for monitoring, potential medication errors, and decreased adherence to safety protocols. Additionally, high stress levels and burnout can lead to fatigue, emotional exhaustion, and lower job satisfaction, ultimately affecting staff retention. Addressing these challenges through policy interventions, adequate staffing, resource allocation, and continuous professional development is crucial to ensuring high-quality cancer care and protecting healthcare workers from occupational hazards. Inadequate protective measures can lead to contamination and exposure to cytotoxic drugs for both patients and staff. Reluctance to consistently wear PPE leads to an increased risk of contamination and infection. This can lead to both direct health risks for staff, including skin contact or inhalation of toxic drug particles, and indirect risks for patients due to compromised hygiene and potential drug cross-contamination. Addressing these issues is essential to protect both staff safety and ensure optimal patient care, emphasising the importance of strict adherence to protective protocols and consistent training.

The study included nurses from two major hospitals, providing a broader perspective on the practices and challenges faced in different settings. The participants were selected from various geographical regions, including Kandy and Jaffna, representing both urban and rural areas of Sri Lanka. These factors provided an opportunity to include a diverse sample, enhancing the generalizability of the findings. Furthermore, the provision of questionnaires in three languages helped minimise the language barrier, which can hinder the accuracy of responses.

However, as this was conducted through a self-administered questionnaire, there was a potential for respondents to provide socially desirable answers rather than their genuine opinions.

Conclusions

Nurses at the National Hospital, Kandy, and Cancer Hospital, Tellippalai, demonstrated good knowledge and positive attitudes toward the safe handling of cytotoxic drugs; however, actual practice levels were moderate. Contributing factors included staff shortages, heavy workloads, limited PPE and facilities, inadequate in-service training, and discomfort with PPE. These challenges increase the risk of occupational exposure, stress, and burnout and compromise safety. The findings highlight the importance of regular training, curriculum enhancements, improved staffing, consistent PPE availability, and ongoing professional development. Improving PPE design for greater comfort may also promote adherence and enhance safety for both nurses and patients.

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