

Knowledge and Practice on Safe Handling of Anticancer Drugs among Hospital Staff in Sri Lanka

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors contributed to the article equally, read and approved the final manuscript.

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ABSTRACT

Aims: Anticancer drugs are useful to treat cancers but can also harm healthy cells. Hospital oncology staff is exposed to these types of drugs due to lack of knowledge regarding proper handling. The aim of this study was to evaluate knowledge, practice, and challenges on safe handling of anticancer drugs among hospital oncology staff at hospitals in Sri Lanka.

Study design: A cross-sectional study was conducted.

Place: This survey-based study has been performed with the help of the hospital staffs employees from Teaching Hospitals from Kandy and Karapitiya, and National Cancer Institute from Maharagama, Sri Lanka.

Methodology: A self-administered questionnaire, containing standard methods to measure knowledge, practice, and challenges for safe handling of anticancer drugs, was used to collect data from 203 participants (17 Pharmacists and 186 Nurses).

Results: Out of 203 participants, 191 (94%) had adequate knowledge; 52 (25.62%) had special training on safe handling of anticancer drugs. 175 (86%) participants were poor on preparation practices and 199 (98%) participants were poor for cleaning practices from the total sample. There was no significant association between knowledge and practices regarding proper handling, protection, and preparation of anticancer drugs.

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Conclusion: Although pharmacists and nurses had adequate knowledge on safe handling of anticancer drugs, the standard level of safe handling practices, the knowledge on handling of anticancer drugs was not always applied within the standard level of safe handling practices. Therefore, proper trainings, guidelines, procedures, and Personal Protective Equipment are essential for enhancing safe handling practices.

Keywords: Anticancer drugs; safe handling; occupational exposure; pharmacists; nurses.

1. INTRODUCTION

Cancer is one of the major global health problems and the incidences of cancer are increasing in both developed and developing countries day by day [1]. Anticancer drugs are used to treat more than 1.1 million cancer patients worldwide each year [2]. Occupational exposures to anticancer drugs, their health risks have been reported over four decades and the first incidence was identified in the United States in the 1970s. According to the National Institute for Occupational Safety and Health (NIOSH), approximately 5.5 million healthcare workers are exposed to these types of drugs at the workplace annually [3,4]. Exposure to anticancer drugs can be happened in any step during storing, preparation, drug administration and waste handling [5-7].

Exposure to a tiny amount of certain anticancer drugs may be hazardous for workers handling or working near them due to no specific actions for most of the anticancer drugs [8-10]. Hence, special interior designs for departments, Personal Protective Equipment (PPE), and safety practices are necessary to minimize occupational exposure [11]. The Occupational Safety and Health Administration (OSHA) provides safety regulations for the preparation, administration, transportation, waste disposal, education, and training on anticancer drugs [1,3,4]. Furthermore, NIOSH also published "NIOSH Alert: Preventing Occupational Exposures to Antineoplastic and Other Hazardous Drugs in Healthcare Settings" to increase awareness among healthcare workers and their employers [12].

Cancer plays an important role in morbidity patterns of Sri Lanka and a total of 23105 newly diagnosed cancer patients were reported to government cancer treatment centers according to the National Cancer Control Program 2014 [2,13]. Trained staff for cancer treatments is not enough, and they perform their duties at a high risk without proper guidelines and policies for handling anticancer drugs. There was no standard research published on safe handlings of

anticancer drugs among oncology hospital staff in Sri Lanka. Therefore, this study was carried out to find the level of knowledge and practices of safe handling of anticancer drugs among oncology healthcare staff in government hospitals, barriers, and challenges for safe handling of anticancer drugs.

2. MATERIALS AND METHODS

This study was conducted cross sectional survey involving hospital oncology staff of Teaching Hospitals from Kandy and Karapitiya, and the National Cancer Institute from Maharagama, Sri Lanka in 2018. A convenient sampling method was used to collect data from all the pharmacists and nurses working at the cancer units during the study period. Written consent was obtained from the respondent before the data collection. Healthcare workers who were not directly exposed to anticancer drugs and those who were not available at the time of data collection were excluded from the study. Furthermore, the healthcare workers other than pharmacists and nurses at cancer units were also excluded from the study.

Before the study, the purpose and outline of the study were explained briefly to the participants by the investigator. After obtaining the consent, a structured, pre-tested self-administered questionnaire was used to collect data. The questionnaire was adapted from a previous study [14] and comprised with four major sections. The responses were collected by the investigator two weeks after the distribution of the question. During that time, only a reminder about the collection of the filled questionnaire was sent to the participants through the chief pharmacists and chief nursing officers of the hospitals.

Participants' socio-demographic data, knowledge, practice and, challenges for safe handling of anticancer drugs were obtained through the questionnaire consisting of both open-ended and close-ended questions and statements. Socio-demographic data of the participants was obtained from section one.

Section two contained three sub-sections to measure participants' knowledge on safe handling of anticancer drugs, chemotherapy exposure and their risks. Section three had sub-sections to investigate the practice of safe handling of anticancer drugs. Information on challenges for safe handling of anticancer drugs was obtained from section four. The questionnaire was pre-tested on 10 healthcare workers before the commencement of the research.

The R statistical software (v3.5.0) and MS Excel 2007 were used to analyze the data. Simple descriptive statistics including mean, percentage and standard deviations were computed to summarize the variables. Chi-square tests for association and goodness of fit were used to assess the significance among the knowledge, practice, and challenges. A 5% significance level was set to perform the entire hypothesis. All participants were required to answer the knowledge section and knowledge was assessed into two categories as adequate and inadequate. It was considered as an adequate level of knowledge if total marks were equal to or above 70 percent.

The practices were assessed into 3 categories as Good, Fair and Poor. All the participants were required to answer a set of questions according to their scope practices in the safe handling of anticancer drugs. A score of one point is given to a correct answer for each question. Finally, an average mark, X_{avg} was taken for practice part for each participant by dividing the total marks from the number of questions answered for that section (Good: $4.5 \leq X_{avg} \leq 5$, Fair: $3.5 \leq X_{avg} < 4.5$, Poor: $X_{avg} < 3.5$).

As this study involved human subjects, ethical approval was obtained from the Ethics Review Committee, Faculty of Allied Health Sciences, and University of Peradeniya, Sri Lanka. The study was commenced after obtaining the approval from the directors of each hospital.

3. RESULTS AND DISCUSSION

Although the recommended sample size was 200 for the study, 250 questionnaires were distributed, and 203 participants forwarded the completed questionnaires representing a very good response rate (81%). The mean age was 33.3 years (SD = 7.7) from the 23 years to 59 years age distribution. Moreover, most of the participants (87%) were female and most of the

participants (63%) were married. Nurses (186, 92%) represented the majority of the study sample and most of the participants (176, 87%) had received education up to diploma level. Furthermore, some of the participants (30%) had less than one year of experience in handling anticancer drugs (Table 1).

According to the responses, 8 pharmacists (47%) and 44 nurses (24%) had special training on anticancer drugs and it was represented as a small percent (26%) from the total sample size.

Most of the healthcare workers (94%, 191) scored adequate knowledge level (≥ 70) showing high awareness about anticancer drugs. However, statistically significant associations were not observed between the level of knowledge on anticancer drugs and various demographic characteristics (Table 2).

Practice in safe handling of anticancer drugs was evaluated as five major areas including receiving and storage, preparation, administration of drugs, cleaning, and disposal of cytotoxic waste. According to the analysis (Fig. 1), most of the participants (90%) were involved in the administration of anticancer drugs to patients. Preparation and compounding of anticancer drugs were performed mainly by pharmacists. For receiving and storing anticancer drugs, 147 (72%) participants labelled anticancer drugs with hazard product identifier and 146 participants (91%) segregated anticancer drugs from other drugs. Furthermore, 139 (87%) reported wearing PPE while receiving anticancer drugs. The preparation and compounding were performed by 72 participants and 63 (97%) respondents changed their gloves immediately when the gloves were torn during preparation. But only 32 (45%) respondents changed gloves every 30 minutes when handling anticancer drugs. Also, preparation of anticancer drugs inside a BSC was done by 26 (36%) participants and a designated room was used by 63 (88%) participants.

Among 186 nurses, 27 (15%) touched anticancer drugs with bare hands and 62 (34%) have reused PPE from the previous day's work when administering anticancer drugs. Moreover, many participants (82%) wore PPE during removal of the infusion system.

Furthermore, 16 participants (4%) had answered for the availability of a special cytotoxic spill kit for removing cytotoxic spills. However, most of

Table 1. Demographic characteristics of the study participants

Characteristics	Healthcare workers	
	Number (n)	Percentage (%)
Age category (Years)		
21-30	101	50
31-40	72	36
41-50	21	10
>50	9	4
Gender		
Male	27	13
Female	176	87
Marital status		
Single	76	37
Married	127	63
Education level		
Advanced level	10	5
Bachelors' degree	176	87
Diploma	16	8
Masters' degree	1	1
Cadre		
Pharmacist	17	8
Nurse	186	92
Department		
Surgical	10	5
Medical	101	50
Paediatric	6	3
Pharmacy	17	8
Other	69	34
Years of experiencing in handling anticancer drugs		
Less than 1 year	60	30
1-3 years	57	28
3-5 years	49	24
More than 5 years	37	18

the participants (92%) responded as using cleaning reagents for cytotoxic spillages. Demarcation of spill area before cleaning and cleaning from outside towards centre was performed by a considerable number of respondents (56% and 54 % respectively).

Participants showed a good level of practice in the disposal of anticancer drugs. Almost all the respondents (119, 99%) disposed of sharp disposal of anticancer drugs into a designated container and 111 respondents (93%) segregated waste before disposal. As well as most of the respondents have mentioned that they send cytotoxic waste to an approved facility for incineration and disposal to an approved place by the Central Environmental Authority (94% and 95% respectively). Many participants performed hand washing before and after using

PPE for each of the practices in handling anticancer drugs.

For safe handling of anticancer drugs, most of the healthcare workers (91%) used double gloves while some healthcare workers (28%) used chemo-resistant gloves. Interestingly, when broken down further, many respondents (84%) used normal gloves which are less safe. Also, 86% used surgical masks while 66% used N-95 masks for handling anticancer drugs (Fig. 3).

The high workload was reported as a major challenge for safe handling of anticancer drugs by a large number of participants (74%) while most of the participants considered lack of opportunity for training and unavailability of chemotherapy designated PPE as a challenge (24% and 12% respectively, Fig. 4).

Table 2. Association between levels of knowledge and demographic characteristics

Demographic characteristics	Knowledge level		P- value	Chi-square value
	Adequate knowledge (n)	Inadequate knowledge (n)		
Gender			0.22	1.51
Male	24	3		
Female	167	9		
Education level			0.87	0.73
Masters' degree	1	0		
Bachelors' degree	15	1		
Diploma	165	11		
Advance level	10	0		
Cadre			0.28	1.17
Pharmacist	17	0		
Nurse	174	12		
Years of experience in handling anticancer drugs			0.35	3.25
Less than 1 year	58	2		
1 to 3 years	55	2		
3 to 5 years	44	5		
More than 5 years	34	3		
Having a formal training			0.19	1.72
Yes	47	5		
No	144	7		

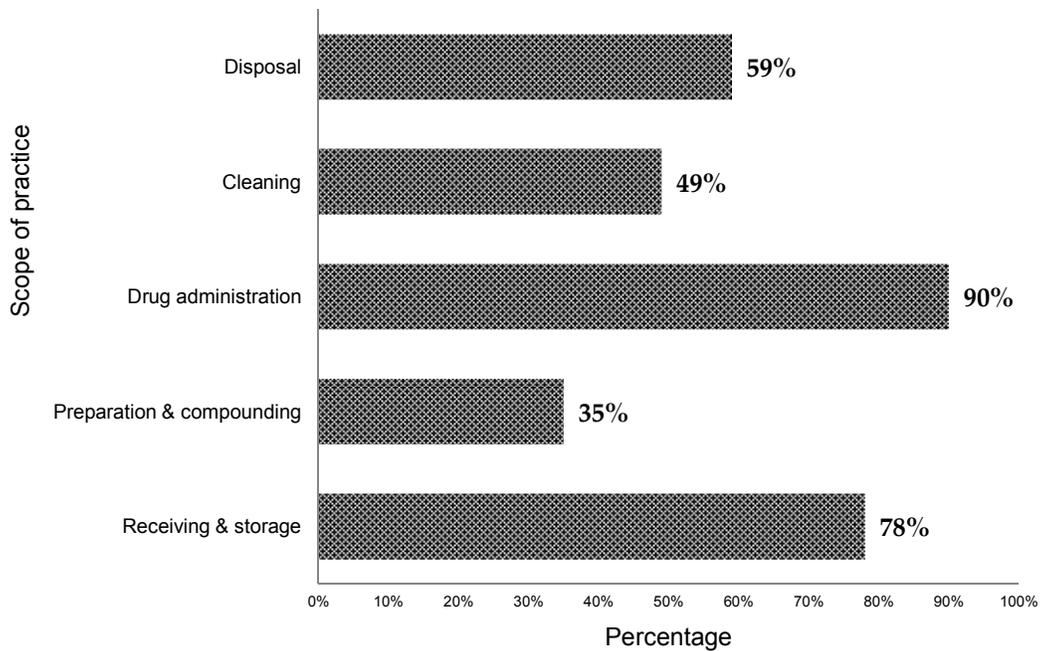


Fig. 1. Scope of practice of healthcare workers

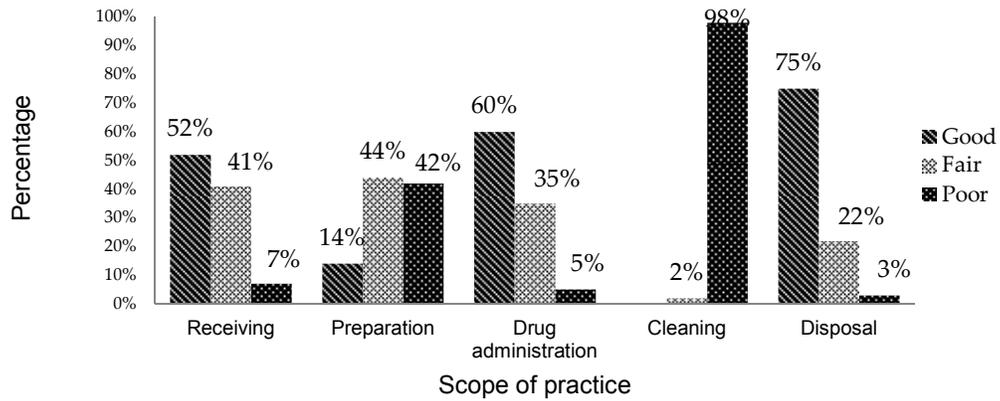


Fig. 2. Percentages of practice score for the scope of practices

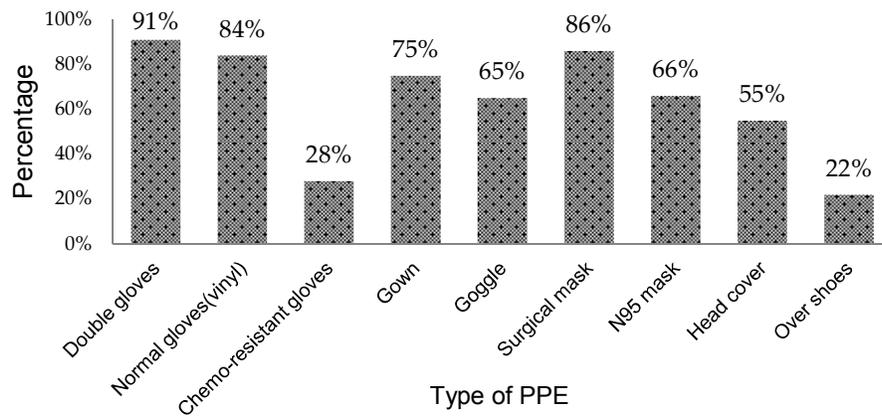


Fig. 3. Use of a different type of PPE

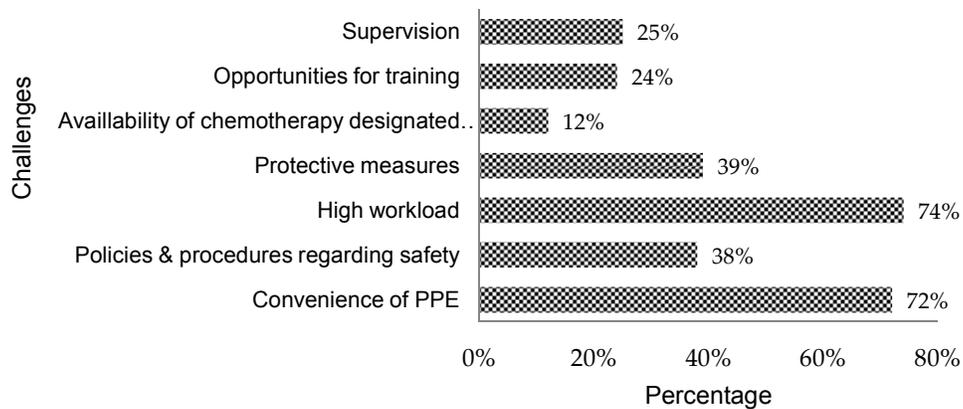


Fig. 4. Challenges reported by healthcare workers

Table 3. Association between demographic characteristics and practices

Characteristics	Practice score			P-value	Chi-square value
	Good n (%)	Fair n (%)	Poor n (%)		
Gender				0.03	6.82
Male	3 (1.48)	23 (11.33)	1(0.49)		
Female	51(25.12)	104 (51.23)	21(10.35)		
Education level				0.02	15.54
Masters' degree	0	0	1(0.49)		
Bachelors' degree	1(0.49)	14 (6.90)	1(0.49)		
Diploma	48 (23.6)	109 (53.7)	19 (9.36)		
Advance level	5 (2.46)	4 (1.97)	1(0.49)		
Cadre				0.004	11.10
Pharmacist	0	17 (8.37)	0		
Nurse	54 (26.6)	110 (54.2)	22 (10.8)		
Years of experience in handling anticancer drugs				0.14	9.56
Less than 1 year	21(10.3)	33 (16.3)	6 (2.96)		
1 to 3 years	17 (8.37)	36 (17.7)	4 (1.97)		
3 to 5 years	6 (2.96)	37 (18.2)	6 (2.96)		
More than 5 years	10 (4.93)	21(10.3)	6 (2.96)		
Having a formal training				0.13	4.04
Yes	13 (6.4)	37 (18.2)	2 (0.98)		
No	41(20.2)	90 (44.3)	20 (9.85)		

Table 4. Association between knowledge levels and practices

Knowledge level	Practice score			P-value	Chi-square value
	Good	Fair	Poor		
Adequate (n, %)	51(25)	119 (59)	20 (10)	0.84	0.33

There were significant associations between participants' educational level and profession with handling practices (Table 3). The pharmacists showed good handling practices than nurses and their handling practices have been improved with their educational levels. The male participants showed good handling practices than the female participants (Table 3).

Furthermore, there was no significant correlation between participants' knowledge and practices regarding the safe handling of anticancer drugs (Table 4).

In this study, 101 participants (49%) out of 203 participants were in between 21-30 age categories and many of the participants were female as well as most of them were married. Several studies have been undertaken on this topic had reported similar results under socio-demographic characters [15-18]. Hence, most of them are in their reproductive period, special consideration is very much important for them

when handling anticancer drugs. The majority of the study population (86%) had received education up to diploma level and there were few degrees and master's degree holders in this population. Most of the participants had less than 1-year of experience in handling anticancer drugs and many participants were there without having special training on safe handling of anticancer drugs. But a study conducted in Egypt had taken nearly half of the sample (48%) having more than 10-years of experience in handling anticancer drugs [18]. People who are handling anticancer drugs should have an adequate level of knowledge and training according to the national and international guidelines published on safe handling of anticancer drugs [19,20].

Although participants had shown a good level of knowledge on handling anticancer drugs, there was no significant correlation between demographic characters and their knowledge levels. On the other hand, studies done in Egypt, Nepal, and the USA had shown a significant

correlation between the knowledge levels of healthcare workers and training interventions [17,18,21].

Participants showed a considerable level of safe handling practices for drug receiving, administration, and waste disposal, but not for drug preparation and cleaning procedures. This could be due to poor attitude, work-related challenges. But almost half of the participants scored better under practice in handling anticancer drugs [14].

In here, participants labelled anticancer drugs with product identifier and those were stored apart from others as well. Generally, cytotoxic drugs can be identified by the purple colour symbol representing a cell in the late telophase. Those good practices are recommended by guidelines on anticancer drugs [5,6,19].

Preparation and compounding are the most cautious step in handling anticancer drugs. All the pharmacists who were involved in this step used BSCs and wore all the PPE which are designated for handling anticancer drugs. But there are no BSCs or designated rooms at wards, and due to these reasons, nurses performed their duties under pressure. Similar results were reported in a research study which was done in Pakistan which stated that a small number of registered nurses (9.3%) prepared chemo drugs inside a BSC [8].

In this study, masks, gowns from the previous day's works were reused by a considerable number of nurses (34%). Like this, another research had found that some of the study participants (18%) reused disposable gowns at the University Hospital of Minnesota [22]. Availability of specific cytotoxic spill kits for cleaning of cytotoxic spills was mentioned by a very small number of healthcare workers (4%) in this research. The similar results were reported in the research done in Massachusetts, USA [4]. But it is recommended by all the guidelines on cytotoxic drugs and it is compulsory when handling cytotoxic spills [6,19].

When disposing cytotoxic waste, almost all the participants disposed of sharp disposal into a designated container and sent cytotoxic waste to an approved place of incineration (95% and 94% respectively). Based on another study conducted in a hospital of France, most of the units (67%) disposed cytotoxic waste as infectious waste while some of the units (22%) disposed them as either infectious or domestic waste [23].

When considering the use of PPE, most of the respondents used double gloves (91%) and normal gloves (84%) which are less protective. However, chemo-resistant gloves which are the safest type for handling anticancer drugs were used by few participants (25%). Most of the healthcare workers (86%) used surgical masks which are less protective against vapours and particles of anticancer drugs and more than half of participants (66%) used N95 masks which are the safest mask type. Another research done in Nepal had mentioned that the usage of PPE among healthcare workers was increased with interventions [17].

But, as an overall view, there was no significant correlation between safety practices and demographic characters. As well as there was no significant correlation between the level of knowledge of the participants and their safety practices. When comparing this with other research, a significant correlation between safe handling practices and pre and post-guideline interventions was shown in the research done in Egypt [18]. Moreover, a statistically significant positive association had been shown between the level of awareness and safety practices in the research done by Jeong et al. [1].

4. CONCLUSION

The result of this study concluded that the level of knowledge on the safe handling of anticancer drugs among nurses and pharmacists is adequate. But, the standard level of safe handling practices of anticancer drugs was not performed, especially for drug preparation and cytotoxic waste disposal. The main challenges affecting healthcare workers were the unavailability of chemotherapy designated personal protective equipment, less opportunity for training, lack of supervision, and high workload.

Updated standard operating procedures and guidelines on safe handling of anticancer drugs should be readily available at the workplace and periodic in-service training programs should be conducted for all the health staff at cytotoxic units. Cytotoxic spill kits, chemotherapy designated PPE and BSCs should be provided adequately and a sufficient level of education should be provided. Continuous monitoring of healthcare workers' practices and job rotation among health staff needs to be performed to prevent long-term exposure for anticancer drugs.

This study did not assess the attitude and behavior of nurses and pharmacists. Also, this was a self-administered questionnaire and actual practices of nurses and pharmacists were not studied at the workplace. Therefore, further research could be performed to assess their attitude and behavior on safe handling as well as to compare their knowledge with actual practices. Although this study focused on nurses and pharmacists, other members of the healthcare team such as cleaning staff, technicians and attendants should be addressed in future studies.

CONSENT

Written consent has been obtained from the survey respondents.

ETHICAL APPROVAL

The study was conducted according to the guidelines of the Ethics Review Committee, Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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