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KNOWLEDGE, ATTITUDES AND PRACTICES OF SAFE HANDLING OF CYTOTOXIC DRUGS AMONG ONCOLOGY NURSES IN TANTA UNIVERSITY HOSPITALS

By

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Abstract

Introduction: Occupational exposure to antineoplastic agents and safe handling of cytotoxic drugs (CDs) had gained a high concern among oncology nursing staff due to their potential health risks. Many organizations such as Occupational Safety and Health Administration (OSHA), Oncology Nursing Society and National Institute for Occupational Safety and Health (NIOSH) have recommended guidelines for safe handling of cytotoxic drugs. **Aim of work:** To assess the knowledge, attitudes, and practices (KAP) of oncology nursing staff working at Tanta University Hospitals towards the safe handling of CDs. **Materials and methods:** A cross-sectional study was conducted for 3 months (from February to April, 2018) at the Oncology department in Tanta University Hospitals, Egypt. A pre-designed questionnaire was used to assess nurses` KAP regarding safe handling of CDs. **Results:** A total of 55 oncology nurses participated in the study. The total KAP scores of nurses towards the safe handling of CDs were satisfactory among 63.6% of the studied group. The mean scores of responses for knowledge, attitudes, and practices were 19.05 ± 4.8 out of 26, 13.09 ± 3.07 out of 16, and 8.87 ± 1.35 out of 12, respectively. More than half of the nurses had previous training in the Oncology department. Defective use of personal protective equipments (PPE) during various steps of CDs handling was noticed. **Conclusion:** There was inadequate practice of safe handling of CDs and defective implementation of guidelines among the studied oncology nurses, necessitating more frequent in-service training and audit system to monitor and evaluate their performance after training.

Keywords: Cytotoxic drugs, Safe handling, Oncology nurses, Tanta University Hospitals, Knowledge, Attitudes and Practices.

Introduction

Health care workers (HCWs) in the field of medical oncology provide medical treatment for cancer patients using chemotherapy (Shambaugh et al., 2003). Chemotherapeutic agents in this field are known as cytotoxic drugs (CDs), anti-neoplastic drugs (ADs) and oncology drugs. They are used extensively in health care facilities to treat cancer patients (Boiano et al., 2014). CDs are hazardous to HCWs particularly nurses, clinical pharmacists and cleaners who may come in contact with these CDs during their daily work activities (Clapp et al., 2007 and Dabrowski et al. 2007).There are more than 11 million cancer cases diagnosed each year worldwide and are expected to rise to 16 million by the year 2020. Thus, the number of HCWs handling cytotoxic drugs is expected to increase with the increase in the number of new cancer cases requiring treatment with chemotherapeutic agents (Mistry et al., 2011).

Chemotherapy drugs are administered either by injection or orally. Occupational exposure to CDs may occur during (1) drug preparation and admixture (Connor et al., 1999; Fransman et al., 2004 and NIOSH, 2017), (2) During administration by intravenous (IV) routes, or during specialized procedures of administration such as intra-peritoneal, pleural or pericardial, and cerebrospinal fluid (CSF) routes…. (White et al., 1996; and Stuart et al., 2002). (3) Transport, and (4) during cleaning spills and waste disposal (Vyan et al., 2014). Thus significant amounts of CDs can be contaminated food absorbed via (i) inhalation of the powder and liquid aerosols, (ii) unprotected skin and mucus membranes, (iii) Oral exposure may occur from hand-to-mouth contact or ingestion of or drinks and (iv) needle stick injury (Harrison et al., 2006; Hedmer et al., 2008 and Mahdy et al., 2017).

Although guidelines for safe handling of CDs were introduced more than 20 years ago, contamination of both the working environment as well as the HCWs is still reported in several recent studies particularly in developing countries (Crauste-Manciet et al., 2005; Kopp et al., 2013 and Alehashem and Baniasadi, 2018). Lack of knowledge, economic and socio-cultural factors are major determinants of unsafe behavior

related to handling of CDs by HCWs (Waheida et al., 2015; and Alehashem and Baniasadi, 2018). An epidemiological study in 2016 determined the immediate and contributing causes of exposure of HCWs to anti-neoplastic drugs. These were classified into 4 categories for immediate causes such as: direct contact with CDs without personal protective equipments, needle stick injury, spills, and other unintended exposures; and 3 categories of contributing causes such as: lack of training, inadequate controls and poor communication (Hon and Abusitta, 2016).

Acute health hazards associated with occupational exposure to CDs include skin rashes, sore throat, cough, dizziness, headache, eye irritation, hair loss, and allergic reactions (Valanis et al., 1993). Chronic health effects in unprotected HCWs who handle these drugs without following safety measures include genotoxicity, mutagenicity, carcinogenicity, adverse reproductive outcomes such as: spontaneous abortion, infertility and poor neonatal outcome (Talamanca, 2006; Moga et al., 2011 and Mahdy et al., 2017) and organ toxicity such as bone marrow, liver, kidney, lung, and cardiac toxicity (Boiano et al., 2014). Several studies reported increased risks of leukemia and breast cancer among nurses handling CDs and not following safety guide lines (Skov et al.,1992 and Ratner et al., 2010).

Aim of work

To assess the knowledge, attitude, and practice (KAP) of oncology nurses towards the safe handling of cytotoxic drugs (CDs).

Materials and methods

Study design: A cross-sectional study.

Place and duration of the study: The study was conducted among adult Oncology department nurses, in Tanta University Hospitals, Egypt; for a period of 3 months (from February to April, 2018)

Study sample: The target group was all registered nurses (55 nurses) working in the adult Oncology department of Tanta University Hospitals. Inclusion criteria: All nurses who were involved in handling cytotoxic drugs with work experience equal to or more than one year at the same hospital. Exclusion criteria: Nurses who were not involved in handling of cytotoxic drugs, and those with work experience less than one year.

Study methods:

All study participants were subjected to the following:

1- Predesigned self-administered questionnaire sheet developed by Alehashem and Baniasadi (2018) was used for data collection. It consisted of four sections: the first section included some socio-demographic and occupational data of the studied nurses; the second section consisted of 13 items which measured the nurses' knowledge regarding protocols and guidelines for preparation, administration, waste disposal, and storage of CDs; the third section consisted of 8 items which were used to assess the participant's attitudes towards the importance of safe handling of CDs. The fourth section consisted of 12 items to assess the participant's practice in various steps of handling CDs.

Coding: Knowledge items required an ordinal response (NO=0, Somewhat =1, Yes =2), attitude item responses were (Disagree=0, Neutral=1, Agree=2), and responses to practice points were (NO=0, Yes=1). The KAP scores were calculated for each nurse based on their answers. The mean scores were calculated and a higher mean score indicated greater agreement with the statements.

Scoring: The knowledge score ranged from 0 to 26. Nurses who achieved ≥ 75% of the score (i.e. ≥ 20) were classified as having satisfactory knowledge, those who scored <75%were considered to have unsatisfactory knowledge.

Regarding the attitude, the score ranged from 0 to 16. Nurses who achieved ≥ 75% of the attitude score (i.e. ≥ 12) were considered to have a positive attitude, while score less than 75% was considered as a negative one.

For practice, the score ranged from 0 to 12. Nurses who obtained ≥ 75% of the score (i.e. ≥ 9) were classified as having adequate practice while those who achieved less than < 75% were classified as having inadequate practice.

Total KAP ranged from 0-54, nurses who achieved ≥ 75% of the total score (≥ 41) were classified as having a satisfactory KAP, while obtaining less than 75% was considered as an unsatisfactory KAP.

2. A performance observational checklist, which was developed by the researchers, after reviewing related literature, to assess the practice of the study participants and their compliance with guidelines while handling CDs,

and to assess their application of knowledge into the actual practice as hand hygiene and PPE utilization during the various steps of handling CDs.

Consent

Verbal consent was obtained from all study participants who accepted to participate in the study prior to distribution of the questionnaire sheet. No personal identifiers were incorporated into the sheet. Nurses were informed about the aim of the study, and that the collected data will be used for research purposes only.

Ethical approval

The Research Ethics Committee (REC) of the Faculty of Medicine, Tanta University approved the study protocol. Ethical considerations and confidentiality were guaranteed.

Data management

The collected data were coded, double-checked for completeness, and entered into Microsoft Excel data sheet, and then analyzed using SPSS software (version 25.0 for Windows; SPSS Inc., Chicago, IL, USA). Descriptive variables were expressed as frequency, percentages, and mean ± S.D. Pearson chi-square and Fisher Exact tests were used to test for association between categorical variables. Spearman's correlation analysis was done to determine whether any of the occupational factors significantly predicted the knowledge, attitude, and practice scores, and to test the correlation between these scores. The statistical significance level was set at $p \leq 0.05$.

Results

Table (1): Socio-demographic and occupational characteristics of the studied oncology nurses correlated with their total KAP score.

Mean total KAP score 41.36 ±8.7 (out of 52)						
Characters (No=55)		**Unsatisfactory KAP**		**Satisfactory KAP**		**r**
		%	**No**	**%**		**p**
No 20		36.4	35	63.6		
• **Age in years Mean ± SD (years): 34.38±9.5 - Range (years): 22-55**						
20-	34 (61.8%)	19	55.9%	15	44.1%	0.368 **0.006***
30-	13 (23.6%)	3	23.1%	10	76.9%	
40-55	8 (14.5%)	1	12.5%	7	87.5%	
• **Marital status**						
Unmarried@	16 (29.1%)	10	62.5%	6	37.5%	0.269 **0.047***
Married	39 (70.9%)	13	33.3%	26	66.7%	
• **Educational level**						
Bachelor degree	12 (21.8%)	1	8.3%	11	91.7%	0.798 **0.000****
Health Technical Institute	23 (41.8%)	2	8.7%	21	91.3%	
Nursing school	20 (36.4%)	20	100.0%	0	0.0%	
• **Years of experience**						
< 2 Year	2 (3.6%)	2	100.0%	0	0.0%	0.503 **0.000****
2<3 years	20 (36.4%)	13	65.0%	7	35.0%	
3-5 Years	8 (14.5%)	4	50.0%	4	50.0%	
>5 Years	25 (45.5%)	4	16.0%	21	84.0%	
• **Ever received any formal training regarding CDs handling**						
Yes	30 (54.5%)	8	26.7%	22	73.3%	0.336 **0.012***
NO	25 (45.5%)	15	60.0%	10	40.0%	

@Un-married including single, divorced, and widowed

*Statistically significant ** Highly statistically significant

Table (1) showed that a total of 55 nurses from the oncology department, participated in the present study; their mean age was 34.38±9.5 years, and all of them (100%) were females. More than two thirds of the respondents (70.9%) were married. Less than one quarter (21.8%) of participants had a Nursing Bachelor Degree. Nearly half of the participants (45.5%) had work experience more than five years. Only 54.5% of nurses had previous training on safe handling of CDs. Regarding the correlations of the total KAP score with participants` characteristics ; the results of Spearman test indicated that there were significant correlations between age, marital status, educational level, years of experience, and receiving training and total KAP score, as higher percentages of satisfactory KAP were found among the older age groups, Bachelor Degree holders, more than 5 years' experience, and those who received previous training (87.5%, 91.7%, 84.0%, and 73.3%, respectively, $p< 0.05$).

Table (2): The numbers and percentages of responses to the KAP items.

Knowledge items	NO		Somewhat		Yes	
	No	%	No	%	No	%
1. Anti-cancer drugs are cytotoxic	0	0	16	29.1	39	70.9
2. I am aware of all routes of exposure to CDs	11	20.0	23	41.8	21	38.2
3. I am aware of adverse health effects of exposure to CDs	12	21.8	20	36.4	23	41.8
4. I know the management of adverse health effects of CDs	2	3.6	23	41.8	30	54.5
5. I know guidelines and standards for safe preparation of CDs	0	0	12	21.8	43	78.2
6. I know safe administration of CDs	0	0	14	25.5	41	74.5
7. I know safe transport and storage of CDs	14	25.5	15	27.3	26	47.3
8. I have to use biological safety cabinet (BSC) for all preparations	16	29.1	23	41.8	16	29.1
9. I know correct use of BSC	16	29.1	23	41.8	16	29.1
10. I know the management of accidents in handling of CDs	11	20.0	23	41.8	21	38.2
11. I know all required PPE	0	0	0	0	55	100
12. I know how to use PPE correctly	0	0	0	0	55	100
13. I know safe CD waste disposal methods	0	0	10	18.2	45	81.8
Attitude items	**Disagree**		**Neutral**		**Agree**	
	No	**%**	**No**	**%**	**No**	**%**
1. Safe handling of CDs makes me sure that I am not at risk	7	12.7	14	25.5	34	61.8
2. Use of PPE in handling of CDs is essential	0	0	0	0	55	100
3. Handling of CDs in work overload condition is unacceptable	10	18.2	14	25.5	31	56.4
4. Adverse health effects of CDs exposure are worrying	0	0	15	27.3	40	72.7
5. I should handle CDs without hurry	0	0	10	18.2	45	81.8
6. I should pay attention to precautions in guidelines	0	0	0	0	55	100
7. I started my work in oncology with my willing	10	18.2	14	25.5	31	56.4
8. I wish to continue my work in oncology with my willing	4	7.2	20	36.4	31	56.4

Practice items	NO		Yes	
	No	%	No	%
1. I always prepare CDs in preparation room	14	25.5	41	74.5
2. I always prepare CDs in BSC	37	67.3	18	32.7
3. I never do risky behaviour (eat, drink, smoke,..) in preparation room	10	18.2	45	81.8
4. I don't store CDs in preparation room	7	12.7	48	87.3
5. I follow standard guidelines for handling of CDs	6	10.9	49	89.1
6. I always wear PPE during preparation of CDs	0	0	55	100
7. I always wear PPE during administration of CDs	0	0	55	100
8. I always wear PPE during transport and storage of CDs	8	14.5	47	85.5
9. I manage accidents as spills based on standard protocols	11	20.0	44	80.0
10. I record and report all accidents in handling of CDs	18	32.7	37	67.3
11. I consult clinical pharmacist about safe handling	23	41.8	32	58.2
12. I consult occupational medicine specialist about related health problems	48	87.3	7	12.3

Table (3): Knowledge, attitudes and practices grades of the studied nurses and their correlations.

No	%	No	%
Knowledge Grade [Mean Knowledge score 19.05 ±4.8 (out of 26)]			
Unsatisfactory		**Satisfactory**	
18	32.7	37	67.3
Attitude Grade [Mean Attitude score 13.09 ±3.07 (out of 16)]			
Negative		**Positive**	
15	27.3	40	72.7
Practice Grade [Mean Practice score 8.87 ±1.35 (out of 12)]			
Inadequate		**Adequate**	
35	63.6	20	36.4

Correlation				
	Knowledge		**Practice**	
Knowledge	**r**	**p**	0.041	0.767
Attitude	0.927	**0.000****	0.025	0.859

** : Highly statistically significant

Tables (2 and 3) showed the percentages of the responses to each KAP item, and the correlations between KAP scores. Concerning Knowledge: All nurses (100%) reported that they knew all required PPE, and how to use them correctly. The majority of them (81.8%) reported that they knew the safe method of disposal of CDs waste. In addition, the majority (78.2%) mentioned that they knew guidelines and standards for safe preparation of CDs, while only one third (29.1%) knew about using BSC during preparation of CDs. The mean score of responses for knowledge was 19.05 ±4.8. More than two-thirds (67.3%) of participants had a satisfactory knowledge grade. Concerning Attitude: All nurses (100%) agreed that the use of PPE in handling of CDs was essential, and that they paid attention to safety precautions. The majority of nurses agreed that they handle CDs without hurry, and that the adverse health effects of CDs exposure were worrying (81.8%, and 72.7%, respectively). Of the respondents, (61.8%) had a positive attitude towards safe handling of CDs. Concerning Practice: All nurses (100%) wore PPE during preparation and administration of CDs. The majority (89.1%) followed standard guidelines for safe handling of CDs. Only, near one-third (32.7%) always prepared CDs in BSC and 18.2% of nurses did some risky behaviours as eating or drinking in the preparation room. Other faulty behaviours were found, as one-fourth (25.5%) of nurses did not adhere to prepare CDs in the preparation room, one-third of them (32.7%) did not record and report all accidents during handling of CDs. Only 58.2% of them consulted the clinical pharmacist about safe handling, and the majority (87.3%) did not consult an occupational medicine specialist about related health problems. The mean score of responses for practice was 8.87 ±1.35, and only (36.4%) of participants had an adequate practice grade. The study showed that there was only a strong positive correlation between knowledge and attitude regarding safe handling of CDs ($r=0.927$, $p<0.001$), and respondents who had higher knowledge scores had better attitude scores.

Table (4): Association between knowledge, attitude and practices of nurses and their occupational characteristics.

Character	Knowledge				χ^2 p	Attitude				χ^2 p	Practice				χ^2 p
	No	%	No	%		No	%	No	%		No	%	No	%	
	Unsatisfactory		Satisfactory			Negative		Positive			Inadequate		Adequate		
Experience															
≤5 Ys	15	50.0	15	50.0	8.94	12	40.0	18	60.0	5.39	21	70.0	9	30.0	1.56
>5 Ys	3	12.0	22	88.0	**0.003**** 3	12.0	22	88.0		**0.020*** 14 56.0	11	44.0			0.283
Previous training															
Yes	3	10.0	27	90.0	15.49	2	6.7	28	93.3	14.13	16	53.3	14	46.7	
NO	15	60.0	10	40.0	**0.000**** 13	52.0	12	48.0		**0.000**** 19 76.0	6	24.0			3.03 0.082

* Statistically significant ** Highly statistically significant Ys: Years

Table (4) revealed that work experience more than five years was associated with higher percentages of satisfactory knowledge grade, positive attitude, and adequate practice (88%, 88%, and 44%, respectively), and the difference was statistically significant in knowledge and attitude ($p< 0.05$). Previous training was associated with higher percentages of satisfactory knowledge grade, positive attitude, and adequate practice (90%, 93.3%, and 46.7%, respectively), with a statistically significant difference concerning knowledge and attitude ($p< 0.05$).

Table (5): Use of PPE and hand washing during the different steps of CDs handling.

CDs handling steps / Measures		Preparation (No=12)		Administration (No =35)		Transport & store of CDs (No =5)		Cleaning of spills (No =5)		Waste handling (No =55)	
		%	No	%	No	%	No	%	No	%	
Use of PPE	Gloves	10	83.33	29	82.86	4	80.00	5	100.00	23	41.82
	Gown	7	58.33	9	25.71	2	40.00	3	60.00	10	18.18
	Mask	9	75.00	31	88.57	2	40.00	3	60.00	19	34.55
	Eye protector	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Hand washing	Before any step	10	83.33	27	77.14	2	40.00	0	0.00	0	0.00
	After any step	11	91.67	23	65.71	3	60.00	5	100.00	41	74.55

PPE: Personnel protective equipment CDs: Cytotoxic drugs

Table (5) revealed that gloves were the most commonly used PPE especially during cleaning of spills (100%), while eye protectors (Goggles) were totally not available. Defective pre-step hand wash was found except before preparation and administration steps (83.33%, and 77.14%, respectively).

Discussion

Cytotoxic drugs (CDs) result in disruption of the growth of both normal and diseased cells, and lead to toxic side effects for both patients receiving these drugs and health care workers involved in different steps of handling them such as preparation, administration, transport, cleaning of spills and handling of wastes. Nurses are the health care workers most exposed to the toxic effects of these drugs so they are in need for specialized knowledge, skills and attitude to ensure their own safety as well as patients' safety (Public Services Health and Safety Association, 2013 and Gazal et al., 2015).

Regarding knowledge about safe handling of CDs, the results of the present study indicated that about two-thirds (67.3%) of the nurses had a satisfactory level of knowledge (Table 1). This level is higher than the levels reported in previous studies done by Turk et al. (2004) and Alehashem and Baniasadi (2018) (58% and 52.5%, respectively), and much higher than Bolbol et al. (2016) who found that only 4% of nurses had adequate knowledge, but lower than the results of Sheikh study (2016) done at Kenyatta National Hospital units who found that 95.4% of health care workers handling CDs have adequate knowledge.

High levels of knowledge concerning the CDs and associated adverse health effects are extremely vital to improve nurses' compliance with safety measures (Elshamy et al., 2010).

As reported in the previous studies, training of nurses significantly enhances their knowledge (Turk et al., 2004; Kyprianou et al., 2010, Chaudhary; 2012, Shahrasbi et al.; 2014 and Alehashem and Baniasadi, 2018) the present study also showed significant correlation between knowledge scores and previous training of nurses (Table 1).

Concerning the attitude of nurses towards safe handling of CDs, the current study showed that the attitude score was positive in about three quarters of nurses (Table3) ,which is different from Alehashem and Baniasadi results (2018) which showed that the attitude score was sufficient in only 60% of their nurses. Also, there was a statistically significant association between nurses' attitude and their previous training (Table 4), which is consistent with the findings of Alehashem and Baniasadi , 2018.

Contrary to the findings about the level of nurses' practice of Alehashem and Baniasadi study in Iran (2018) and Sheikh study in Nairobi (2016), but in accordance with findings from the previous studies in Pakistan, Malaysia, and Nepal (Chaudhary et al., 2012; Khan et al., 2012 and Keat et al., 2013), the current study showed that the practice grade was generally inadequate and not strictly following the international standards (Table 3).

The current study showed that there was a strong correlation between attitude and knowledge regarding safe handling of CDs (Table 3). This is similar to other studies, which showed that increasing the knowledge levels of the nurses is important to improve their attitude (Ben-Ami et al., 2001 and Alehashem and Baniasadi, 2018).

Also, contrary to Alehashem and Baniasadi study (2018) who detected significant correlation between the scores of different sections (knowledge, attitude and practice), the current study did not find any significant correlation between knowledge and practice or between attitude and practice (Table 3), which is in agreement with Sheikh results (2016).

As regards wearing PPE, the present study found that gloves were the most commonly used PPE especially during cleaning of spills (100%), followed by wearing during preparation of CDs (83.33%) then during administration (82.86%) (Table 5). This is nearly similar to Al-Azzam et al. study (2015) who declared that 97.6% of nurses who were involved in preparation and administration of anti-neoplastic drugs in a Jordanian hospital wore double gloves, and is in line with Turk et al. results (2004) that 97.4% used them during CDs preparation. However, it differs from Elshamy et al. results in Mansoura University Hospitals, Egypt (2010), who reported that a lower percent of oncology nurses wore gloves throughout the different stages of CDs handling (28.6% during preparation and administration and 25.7% while cleaning up spills). Goggles (Eye protector) were used by 33% of the nurses included in Al-Azzam et al., study (2015), and in 5.3% of nurses of Turk et al. study (2004); our results were different, as eye protectors (Goggles) were not at all used during nursing care activity which is similar to Elshamy et al. findings (2010).

Concerning hand washing before CDs handling, the present study found it defective except before preparation and administration steps (83.33%, and 77.14%, respectively) (Table 5), which is nearly similar to results of Al-Azzam et al., (2015), who reported that 75.2% of the nurses included in their study were found performing good hand hygiene while handling CDs but it is different from Elshamy et al., (2010) who found that contaminated hands and poor hand washing while preparing and administrating CDs was detected in 51.4% of the studied nurses.

Conclusion and recommendations

It was clear from our study that the practice of the nurses while dealing with cytotoxic drugs (CDs) was mostly inadequate. Oncology is a branch of medicine which needs specialized, and efficient nursing work, so nurses employed for oncology work should be selected from those with high educational level, long experience and high performance. Raising the awareness of the nurses regarding safe handling of CDs is of marked importance. On-the-job training and supervision is also important. Pre-employment and ongoing refreshing training programmes are highly recommended for those nurses with involvement of the clinical pharmacists and occupational medicine specialists on the guidelines and safe practice methods especially the Occupational Safety and Health Administration (OSHA), National Institute for Occupational Safety and Health (NIOSH), and American Society of Hospital Pharmacist (ASHP): (1) protecting health care workers from health hazards associated with CDs exposure; and (2) keeping exposures As Low As Reasonably Achievable (ALARA) (Boiano et al., 2014).The guidelines for preventing occupational exposures to CDs cover (1) engineering solutions, (2) administrative controls and safe work practices through specified methods used to perform work tasks from shipping/receiving, transport and distribution, compounding, administration, and waste disposal, to specialized worker training (Boiano et al., 2014) and (3) use of specific personal protective equipments to minimize drug contact with the skin, eye or respiratory tract (Mahdy et al., 2017). In spite of the presence of these guidelines, several researchers found that guidelines are not being universally followed (Boiano et al., 2014).Thus, the guideline plan should be readily available and accessible to all HCWs (Occupational Health and Safety Ad-

ministration (OSHA), 2017). Nurses must be aware of the existing hazards and methods of safe handling practices of cytotoxic drugs because this benefits both patients and nurses. The higher the nurses' awareness, the more they adhere to the use of safety measures in their practices, and this, in turn, contributes to their sense of well-being (Mahdy et al., 2017).

Conflict of interest

Authors have declared that no conflict of interest exists.

References

1. Al-Azzam SI, Awawdeh BT, Alzoubi KH, Khader YS and Alkafajei AM (2015): Compliance with safe handling guidelines of antineoplastic drugs in Jordanian hospitals. J Oncol Pharm Practice; 21 (1): 3-9.
2. Alehashem M and Baniasadi S (2018): Safe handling of anti-neoplastic drugs in the university hospitals: A descriptive survey study among oncology nurses. Int J Cancer Manag; 11 (2): e6482.
3. Ben-Ami S, Shaham J, Rabin S, Melzer A and Ribak J (2001): The influence of nurses' knowledge, attitudes, and health beliefs on their safe behavior with cytotoxic drugs in Israel. Cancer Nurs; 24 (3):192-200.
4. Boiano JM, Steege AL and Sweeney MH (2014): Adherence to safe handling guidelines by healthcare workers who administer antineoplastic drugs. J Occup Environ Hyg; 11:728-40.
5. Bolbol SA, Hassan AA, El-Naggar SA and Zaitoun MF (2016): Role of occupational health and safety program in improving knowledge and practice among nurses exposed to chemotherapy at Zagazig university hospitals. EJOM; 40 (2): 219-35.
6. Chaudhary R and Karn BK (2012): Chemotherapy-knowledge and handling practice of nurses working in a Medical University of Nepal. J Cancer Ther; 3 (1):110–4.
7. Clapp RW, Howe GK and Jacobs MM (2007): Environmental and occupational causes of cancer: A call to act on what we know. Biomed Pharmacother; 61: 631–9.
8. Connor TH, Anderson RW, Sessink PJ, Broad-field L and Power LA (1999): Surface contamination with antineoplastic agents in six cancer treatment centers in Canada and the United States. Am J Health Syst Pharm; 56:1427–32.
9. Crauste-Manciet S, Sessink PJ, Ferrari S, Jomier JY and Brossard D (2005): Environmental contamination with cytotoxic drugs in healthcare using positive air pressure isolators. Ann Occup Hyg; 49: 619–28.
10. Dabrowski T and Dabrowska EA (2007): Cytostatic drugs and their carcinogenicity – occupational risk problem for healthcare workers. Wspotczesna Onkologia-Contemp Oncol; 11:101–5.
11. Elshamy K, El-Hadidi M, El-Roby M and Fouda M (2010): Health hazards among oncology nurses exposed to chemotherapy drugs. Afr J Haematol Oncol; 1 (3):70-8.
12. Fransman W, Vermeulen R and Kromhout H ((2004): Occupational dermal exposure to cyclophosphamide in Dutch hospitals: a pilot study. Ann Occup Hyg ; 48 (3):237–44.
13. 13.Gazal S, Georgeos M and Issa A (2015): Assessment knowledge and quality of nursing practices at chemotherapy management at Tishreen University hospital, Tishreen University. Tishreen Univ J Res Sci Stud - Hlth Sci Ser; 37 (1):197- 207.
14. Harrison BR, Peters BG and Bing MR (2006): Comparison of surface contamination withcyclophosphamide and fluorouracil using a closed system drug transfer device versus standard preparation techniques. Am J Hlth Syst Pharm; 63:1736–44

15. Hedmer M, Tinnerberg H, Axmon A and Jönsson BA (2008): Environmental and biological monitoring of antineoplastic drugs in four workplaces in a Swedish hospital. Int Arch Occup Environ Hlth; 81:899-911.
16. Hon C and Abusitta D (2016): Causes of health care workers; exposure to anti neoplastic drugs. An exploratory study. Canad J Hosp Pharm; 69: 216-23
17. Keat CH, Sooaid NS, Yun CY and Sriraman M (2013): Improving safety-related knowledge, attitude and practices of nurses handling cytotoxic anticancer drug: pharmacists' experience in a general hospital, Malaysia. Asian Pac J Cancer Prev; 14 (1):69–73.
18. Khan N, Khowaja K, Zulfiqar A and Ali TS (2012): Assessment of knowledge, skill and attitude of oncology nurses in chemotherapy administration in tertiary hospital Pakistan. Open J Nurs; 2 (2):97–103.
19. Kopp B, Schierl R and Nowak D (2013): Evaluation of working practices and surface contamination with antineoplastic drugs in outpatient oncology health care settings. Int Arch Occup Environ Hlth; 86 (1):47–55.
20. Kyprianou M, Kapsou M, Raftopoulos V and Soteriades ES (2010): Knowledge, attitudes and beliefs of Cypriot nurses on the handling of antineoplastic agents. Eur J Oncol Nurs; 14 (4):278–82.
21. Mahdy NE, Abdel Rahman A and Hassan HA (2017): Cytotoxic drugs safety guidelines: Its effect on awareness and safe handling practices of oncology nurses. J Nurs Hlth Sci; 6 (3): 22-33.
22. Mistry M, Parkin DM, Ahmad AS and Sasieni P (2011): Cancer incidence in the United Kingdom: projections to the year 2030. Br J Cancer; 105: 1795–803.
23. Moga M, Bigiu N and Nicolau A (2011): Occupational exposure to anticancer drugs and reproductive outcome. J Environ Protect Ecology; 12 (3A): 1509-20.
24. National Institute for Occupational Safety and Health (NIOSH) (2017): Preventing occupational exposures to antineoplastic and other hazardous drugs in healthcare settings. DHHS (NIOSH). Publication No. 2004-165. [On-line]. NIOSH 2004 [cited Oct 10, 2017]. Available from URL: http://www.cdc.gov/niosh/docs/2004-165/pdfs/2004-165.pdf
25. Occupational Health and Safety Administration (OSHA) (2017): OSHA technical manual: controlling occupational exposure to hazardous drugs, Section VI Chapter 2. OSHA.1999. (cited on Nov 11,2017). Available at URL:https://www.osha.gov/SLTC/hazardousdrugs/controlling_occex_hazardousdrugs.html
26. Public Services Health and Safety Association (2013): Safe Handling of Hazardous Drugs in Healthcare. Retrieved from https://www.pshsa.ca/wp-content/uploads/2013/11/PSHSA-Whitepaper-Safe-Handling-of-Hazardous-Drugs-in-Healthcare.pdf. accessed on 20 Feb.2017.
27. Ratner PA, Spinelli JJ, Beking K, Lorenzi M, Chow Y, et al (2010): Cancer incidence and adverse pregnancy outcome in registered nurses potentially exposed to antineoplastic drugs. BMC Nursing; 9:15.
28. Shahrasbi AA, Afshar M, Shokraneh F, Monji F, Noroozi M, et al. (2014): Risks to health professionals from hazardous drugs in Iran: a pilot study of understanding of healthcare team to occupational exposure to cytotoxics. EXCLI J; 13:491–501.
29. Shambaugh EM, Nayfield SG and Swenson TM (2003): Self-Instructional Manual for Tumor Registrars. Book Eight, Antineoplastic drugs. National Institute of Health, National Cancer Institute. NIH Publication No. 92-2441. 3rd Ed.
30. Sheikh YA (2016): Knowledge and practice on safe handling of cytotoxic drugs among health care workers at Kenyatta national hospital. A Dissertation submitted in partial fulfillment for the requirements of the award of degree of master of pharmacy in clinical pharmacy of the University of Nairobi.
31. Skov T, Maarup B, Olsen J, Rorth M, Winthereik H , et al. (1992): Leukaemia and reproductive

outcome among nurses handling antineoplastic drugs. Br J Indust Med; 49:855-61.

32. Stuart OA, Stephens AD, Welch L and Sugerbaker PH (2002): Safety monitoring of the coliseum technique for heated intraoperative intraperitoneal chemotherapy with mitomycin C. Ann Surg Oncol; 9 (2):186–91.
33. Talamanca IF (2006): Occupational risk factors and reproductive health of women. Occup Med; 56: 521-31.
34. Turk M, Davas A, Cicekliogluo M, Sacakliogluo F and Mercan T (2004): Knowledge, attitude and safe behaviour of nurses handling cytotoxic anticancer drugs in Ege University Hospital. Asian Pac J Cancer Prev; 5 (2):164–8.
35. Valanis BG, Vollmer WM, Labuhn KT and Glass AG (1993): Acute symptoms associated with antineoplastic drug handling among nurses. Cancer Nurs; 16:288–95.
36. Vyan N, Yiannakis D, Turner A and Sewell GJ (2014): Occupational exposure to anti-cancer drugs: A review of effects of new technology. J Oncol Pharm Practice; 20 (4): 278–87.
37. Waheida SM, Abd-ELgaffar SI and Atia GA (2015): Evaluation of handling practices of oncology nurses during chemotherapy preparation and administration in Menoufia oncology hospital. Int J Novel Res Hlth care Nurs; 2 (3): 107-19.
38. White SK, Stephens AD, Dowjat B and Sugar- baker PH (1996): Safety considerations in the use of intraoperative intraperitoneal chemotherapy. Cancer Treat Res; 82:311–6.