

1Marwa G. Abd – Elrazik, 2Amani S. Girgis, 3Lobna M. Gamal, 4Gehan A. Gamal – Eldein

1 Demonstrator of Medical Surgical Nursing,

2 Assistant Professor of Clinical Oncology,

3 & 4 Lecturer of Medical Surgical Nursing, Faculty of Nursing1, 3, 4 - Faculty of Medicine2, Minia University

Email of the corresponding author: mseif2000@yahoo.com

Abstract

Introduction: Widespread use of chemotherapeutic drugs in the treatment of cancer can lead to higher health hazards among nurses who handle and administer such drugs, so they should know how to protect themselves from the effects of chemotherapy. **Aim of study:** was to evaluate the effect of implementing Safety Handling Protocol for Chemotherapy (SHPC) on nurses' knowledge and practical skills. **Research design:** A Quasi – experimental research design was utilized to carry out this study. **Setting:** this study was conducted at Minia Oncology Center. **Subjects:** all available nurses (50) who are working in outpatient and inpatient chemotherapy department. **Tools:** three tools were designed by researcher and utilized; Arabic administered questionnaire, structured observational checklist and safe handling chemotherapy protocol (booklet). **Results:** nurses had poor knowledge regarding safe handling chemotherapy. The mean score of total nurses knowledge statistically improved from $(12.9 \pm 4.8$ to 25.4 ± 2.0 & 22.7 ± 2.8 respectively) in pre, immediately, and after 2 months of implementing (SHPC) with p value (.0001**). Nearly all nurses have unsatisfactory practical skill level before implementing (SHPC) which significantly changed after implementing it (90%, 18%, 20% respectively) with p value (.0001**). **Conclusion:** the results of this study revealed significant improvement of nurses' knowledge, and practical skills among the nurses handling chemotherapeutic drugs after implementing (SHPC). **Recommendations:** health care professionals who are responsible for handling chemotherapeutic drugs should be adherent to implementation of (SHPC).

Key word: Chemotherapy Drugs, Risks, Safety, Safety Handling Protocol for Chemotherapy, Nurses' Knowledge and Practice

Introduction

Cancer is a generic term for a large group of diseases characterized by the growth of abnormal cells that can then invade adjoining parts of the body and/or spread to other organs. Cancer has many anatomic and molecular subtypes that each requires specific management strategies (1). Most drugs defined as hazardous drugs (HD) are cytotoxic agents mainly used in chemotherapy for their actions on killing cancerous cell (2). Long-term occupational exposure to cytotoxic drugs is associated with various carcinogenic, teratogenic and mutagenic effects (2, 3, 4).

A major advantage of chemotherapy is its ability to treat widespread or metastatic cancer whereas surgery and radiation therapy are limited. The risk of contamination with anticancer agents can occur at many points as, for example, in its manufacturing, transport, distribution, reception and storage. However, generally, the occupational activities, which present the greatest potential for chemotherapy exposure, are the preparation and administration of chemotherapeutic agents, spills, cleaning and handling the excreta of patients (5).

Exposure may result from direct contact via skin or mucous membrane as eyes (e.g. splashes), and through indirect contact by touching surfaces that have been contaminated. Inhalation of droplet aerosolization mainly because of inappropriate hygienic behavior such as eating, drinking or smoking during preparation, administration or disposal of cytotoxic drugs (CDs) in contaminated areas. Less likely routes of exposure include needle stick injuries (6).

Exposure to chemotherapy drugs is associated with many adverse outcomes for occupationally exposed

individuals including but not limited to contact dermatitis; chromosomal abnormalities; fetal loss; infertility; preterm births; and an overall increase in one's personal risk for cancer (7). Pregnant nurses are at particular risk for chemotherapy exposure risks and their exposure is associated with an increased risk of spontaneous abortion (8).

Although the previous studies documented the side effects of antineoplastic drugs (ANDs) on exposed persons, healthcare workers often do not adhere to safe work practices (9, 10). This could be related to the lack of nurses' knowledge about routes of exposure and adverse health effects induced by antineoplastic drugs. Knowledge and attitude of nurses regarding chemotherapy exposure may affect their adherence to safety measures; previous studies have reported that there is a gap between nurses' chemotherapy knowledge and their behavior during work with antineoplastic drugs (11).

International safety guidelines for cytotoxic drug handling have been available for more than two decades. For examples, guidelines from US developed by the National Institute for Occupational Safety and Health (NIOSH), the Occupational Safety and Health Administration (OSHA), the Oncology Nursing Society (ONS) and the American Society of Hospital Pharmacists (ASHP) are well-accepted worldwide (3). Several recent publications have documented the ongoing failure of employers to adopt, or consistently use, recommended safety practices for handling HDs (9, 12, 13).

These guidelines recommend the application of hierarchy of control technologies to mitigate workplace hazards, which include engineering controls, administrative controls, work practice controls, and personal protective

equipment (PPE) (9). All healthcare workers who work with antineoplastic drugs (ANDs) have been advised to adhere to these safety guidelines (14).

Significance of the Study

Exposure to chemotherapeutic drugs at the workplace is a significant occupational health hazards.

Aim of the Study

The aim of this study is to:

Evaluate the effect of implementing (SHPC) on nurses' knowledge and practical skills about safe handling chemotherapy.

Materials and Method

Research design:

A Quasi- experimental research design was be utilized to achieve the aim of the present study.

Setting:

The study was conducted at Minia Oncology Center in outpatient and inpatient chemotherapy departments. It affiliated by Ministry of health.

Study subjects:

Subjects of the study consisted of (50) nurses working at the chemotherapy department.

Exclusion Criteria:

Nurses who are not willing to participate in the study.

Tools:

Three tools were developed by the researcher after literature review. Tools were reviewed by a panel of five experts, four in the field of medical surgical nursing and one in the field of community health nursing, Faculty of Nursing, Minia University for validity testing.

Tool I: Arabic administered questionnaire for nurses it included three parts:

Part I: Nurses' Socio-demographic Data such as age, sex, marital status, habits, educational level, years of experience as oncology nurse and previous training about safe handling of chemotherapy.

Part II: Medical Data covers the past and present health hazards for nursing members that related to exposure to chemotherapeutic agents.

Part III: Knowledge Questionnaire to assess nurses' knowledge about safe handling chemotherapy: data from this tool was collected three times, before, immediately after and two months later of implementing protocol to evaluate the effect of this protocol on nurses' knowledge: It consists of (30) closed questions covered the following area:

- Cancer definition and methods of treating cancer.
- Chemotherapy definition, mechanism of action, and routes of administration.
- Methods, signs & symptoms of exposure to chemotherapy hazards.
- Safe handling chemotherapeutic during (administration, extravasation, disposal and spill.)

Tool II: Structured observational checklist: data from this tool was collected before implementing the protocol, immediately after implementing it and two months later to evaluate the effect of this protocol on nurses' practical level. It consisted of four areas:-

- Nurse's practical skills before administering chemotherapeutic drugs (work area, transport and storage of chemotherapy drugs).
- Nurse's practical skills while administering chemotherapeutic drugs.
- Nurse's practical skills during disposal of chemotherapy drugs waste.
- Nurse's practices in dealing with a chemotherapeutic agent spillage.

Tool III: Safe Handling Chemotherapy Protocol (Booklet) regarding preparation, administration, disposal, and spills management. This tool was designed on learning needs of nurses at the pre assessment phase.

Scoring system:

For knowledge part: each right answer was given one score. While the scoring system of the observation checklist was as follows: each observed item, scored as either done completely = 2 or done incompletely = 1 or not done = 0. The sum of the total practices were calculated and transferred to percentage, then these scores were further classified as unsatisfactory level (less than 60%) and satisfactory level (> 60 %).

Validity and Reliability:

Content Validity of tools were tested by a jury of 5 experts, (4) of them specialized in the field of medical surgical nursing and (1) of them specialized in the field of community health nursing, Minia university to test for tools clarity, completeness and comprehensiveness. The experts reviewed the tools for its content and modifications were considered.

Reliability of tools was tested by using alpha cronbach test.

Pilot Study:

Pilot study was carried out on (5 nurses) to test feasibility, clarity, and applicability of the study tools. Results of the pilot study were considered.

Ethical consideration:

- Informed oral nurses' consent was obtained after explanation of the study aim.
- Nurses' were informed that their participation was voluntary, their privacy and right to withdraw from the study was respected.
- The anonymity, Security and confidentiality of collected data were ascertained.

Data Collection process: include the following stages:

Tools (I, II, III) were developed and were modified by the researcher based on extensive review of the relevant literature. Tools were tested by a jury of 5 experts, (4) of them specialized in the field of medical surgical nursing and (1) of them specialized in the field of community health nursing, Minia university to test for tools clarity,

completeness and comprehensiveness. The experts reviewed the tools for its content and modifications were considered. Assessment of nurses' knowledge and practical skills about safe handling chemotherapy through distribution of knowledge questionnaire to each participant to fill it and observing each nurse's performance during administration, removal of IV chemotherapy, disposal and dealing with chemotherapy spills. Distribution and implementation of safe handling protocol for chemotherapy (SHPC) with clarification. Reassessment of nurses' knowledge and practical skills about safe handling chemotherapy immediately range (one day to one week) after distributing (SHPC) protocol. Reassessment of nurses' knowledge and practical skills about safe handling chemotherapy two months later of distributing it to evaluate the gain and retention of knowledge and changes of their practice after implementation of the protocol.

Statistical Analysis:

Results

Table (1): Distribution of Socio-demographic Data of Nurses among Study Group (n = 50)

Personal data	No.	%
Gender		
Male	8	16.0
Female	42	84.0
Total	50	100.0
Age / years		
20 – 30	32	64.0
31- 40	18	36.0
Total	50	100.0
Mean ± SD	23.6±10.1	
Residence		
City	19	38.0
Village	31	62.0
Total	50	100.0
Education		
Secondary Nursing School	27	54.0
Technical institute of Nursing	8	16.0
Bachelor's degree in Nursing	12	24.0
Diploma in Nursing	3	6.0
Total	50	100.0
Marital status		
Single	13	26.0
Married	37	74.0
Total	50	100.0
Pregnant		
Yes	2	4.8
No	40	95.2
Total	42	100.0
Lactating		
Yes	4	9.5
No	38	90.5
Total	42	100.0

The raw data collected was coded and entered into statistical package for social scientists (SPSS) version (20) software data sheet (15), data was then cleaned and verified using the primary source document (tool I or II). Statistical analysis was performed using SPSS version 20 where descriptive statistics were generated for categorical and continuous variables.

The association between quantified qualitative variables was assessed using Pearson's

Chi square test (x²). The exact tests (Fisher test) were used as alternative when the smallest of the expected numbers in any of the cells being less than 5. Probability (P-value) is the degree of significance, less than 0.05 was considered significant. The smaller the P-value obtained, the more significant is the result (*), less than 0.001 was considered highly significant (**). Correlation coefficient (r) was calculated between continuous variables.

Personal data	No.	%
Habits		
Smoker		
Yes	1	2.0
No	49	98.0
Total	50	100.0
Years of experience/ years)		
1 – less than 5 yrs.	18	36.0
5-10 yrs.	8	16.0
>10 yrs.	24	48.0
Total	50	100.0
Mean ± SD	5.96±4.6	
Previous attending course in safe handling of chemotherapy		
Yes	4	8.0
None	46	92.0
Total	50	100.0

Table (1) shows that, the majority of studied nurses were females (84%), and more than half (64%) aged between 20 to 30 years old, married (74%), lived in village (62%). Most nurses were not pregnant (95.2%) or lactating (90.5%), not smoker (98%) and don't previously attend

training about safe handling chemotherapy (92%). About half of them had graduated from secondary nursing school and have more than 10 years of experience in oncology center (54% and 48% respectively).

Table (2): Frequency Distribution of Nurse's Knowledge about Methods of Exposure to Chemotherapy Hazards in Pre, Immediately Post and after 2Months of Implementing Safe Handling Chemotherapy Protocol (n = 50)

Items	Correct Answer						Fisher test	P – value
	Pre (n= 50)		Immediate (n=50)		After 2 Months (n=50)			
	No.	%	No.	%	No.	%		
1. Common methods of exposure to chemotherapy hazards among nursing personnel?	19	38.0	43	86.0	34	68.0	X ² = 25.521	.001**
2 Exposure to chemotherapy hazards can occurs?	19	38.0	39	78.0	35	70.0	X ² = 19.015	.001**
3. Avoid\decrease exposure to of chemotherapy hazards?	37	74.0	46	92.0	40	80.0	5.691	.058 NS
4. Avoid exposure to chemotherapy hazards?	29	58.0	43	86.0	41	82.0	X ² = 12.342	.002**
5. Wrong exposure during the preparation and administration of chemotherapy cause hazards to nurses?	35	70.0	48	96.0	45	90.0	14.808	.001**
6. Harmful effects that can be caused by the wrong exposure to chemotherapy?	23	46.0	42	84.0	39	78.0	19.628	.001**
7. High risk Person for health Problems in wrong Handling?	31	62.0	42	84.0	39	78.0	6.837	.03*

X², p: and p values for chi square test

NS = not significant

* = statistically significant P ≤ 0.05

**= high statistically significant P – value ≤ 0.01

Table (2) exhibits that there was statistical significant differences improvement of nurse's knowledge in

nearly most questions about methods of exposure to chemotherapy hazards between Pre, immediately posts and

after 2 months of implementing safe handling chemotherapy protocol (SHPC).

Table (3): Mean Scores of Nurses Regarding (Cancer, Chemotherapy and Safe Handling Chemotherapy, and Total Knowledge Level) in Pre, Immediately Post and after 2 Months of Implementing Safe Handling Chemotherapy Protocol (n = 50)

Knowledge	Score allotted	Pre	Immediate	Post 2 months	F	P – value
		Mean ± SD	Mean ± SD	Mean ± SD		
Cancer	(2)	1.0 ± .0	1.9 ± .2	1.8 ± .4	225.821	.0001**
Chemotherapy	(7)	4.2 ± 1.4	6.4 ± .9	6.0 ± 1.1	54.136	.0001**
Safety handling	(21)	8.6 ± 3.8	17.0 ± 1.7	14.8 ± 2.3	127.639	.0001**
Total knowledge	(30)	12.9 ± 4.8	25.4 ± 2.0	22.7 ± 2.8	187.900	.0001**

**= high statistically significant P – value ≤ 0.01

Table (3) demonstrates that there were highly statistical significant differences improvement of Mean nurses knowledge Scores (Mean ± SD) regarding (cancer,

chemotherapy and safe handling chemotherapy, and of total knowledge) in pre, immediately post and after 2 months of implementing safe handling chemotherapy protocol.

Table (4) Relation between Nurses' Practices in Pre, Immediately and Post Two Months after Implementing Safe Handling Chemotherapy Protocol (n = 50)

Items	Pretest		Immediate		After 2 months		Fisher	P-value
	No.	%	No.	%	No.	%		
During procedure (administration of chemotherapeutic drugs)								
Unsatisfactory	50	100.0	41	82.0	41	82.0	10.227	.006**
Satisfactory	0	.0	9	18.0	9	18.0		
Post procedure (removal IV chemotherapy and disposal)								
Unsatisfactory	26	52.0	3	6.0	4	8.0	38.017	.000**
Satisfactory	24	48.0	47	94.0	46	92.0		
Total practice level								
Unsatisfactory	45	90.0	9	18.0	10	20.0	49.743	.0001**
Satisfactory	5	10.0	41	82.0	40	80.0		

**= high statistically significant P – value ≤ 0.01

Table (4) exemplify that, there were statistical significant differences improvements between nurses'

practices in pre, immediately and post two months after implementing safe handling chemotherapy protocol.

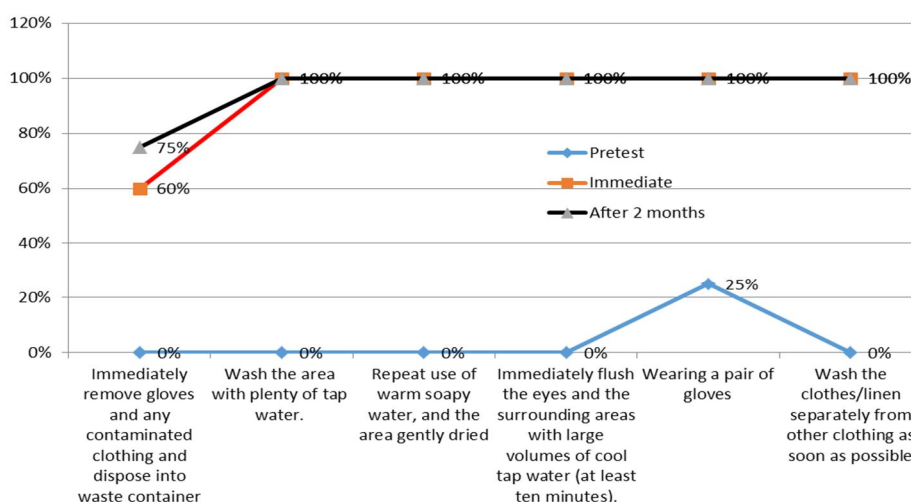


Figure (1) Distribution of Nurses' practices (completely done steps) Regarding Dealing with a Chemotherapy Spillage on Nurses' Skin, Eyes and Clothes'/Bed linen among Study Group Pre, Immediately and Post Two Months after Implementing Safe Handling Chemotherapy Protocol

Figure (1) illustrates that before implementing the Protocol 0% of nurses were appropriately dealing with chemotherapy spillage on the nurses' skin, dealing with chemotherapy splashes into nurses' eyes, which increase significantly immediately and after 2 months of implementing safe handling chemotherapy protocol. The

Discussion

This study aimed to evaluate the effect of implementing safe handling protocol for chemotherapy (SHPFC) on nurses' knowledge and practical skills. Knowledge is critical to safe nursing practices in all settings, but it is especially significant when a knowledge deficit of the nurse practices threatens personal safety or the safety of the patient. Past research suggests that chemotherapy may have unintentionally compromised the oncology work setting for more than thirty years (16). An extensive review of comprehensive standards associated with hazardous drug administration and the use of personal protective equipment (PPE) may be necessary to determine if policies and regulations need to be updated to correspond with current evidence (17).

The demographics of this study agree in many aspects with those of many other studies done among nurses. In terms of gender, majority of the participants in this study were females; similar to that of Hassan MA., (2014) (18), Orujlu, et al (2015) (11), MM Mohsen, ME Fareed (2013) (19). Polovich (2010) (20) supported study findings and mentioned that, the majority of nurses were female. This reaffirms the notion that nursing is still predominantly female dominated profession (21).

Concerning the level of education, majority of the nurses in this study had diploma in nursing. This was in agreement with other studies done by Abd Al-Magid, (2012) (22) and Hassan MA., (2014) (18) where majority of nurses are diploma holder. Chaudhary R. et al (2012) (6) study however revealed that the majority of the studied nurses had university degree. S Rizalar et al (2012) (23) consistent with study results and clarified that the majority of nurses in Turkey are graduates of bachelor degree. In this study, it is notable that, approximately three- thirds of studied nurses did not attend previous training courses in safe handling of chemotherapy. Al-Attar (2015) (24) cleared that most of nurses had not attended training sessions regarding chemotherapy precautions in oncology units (95%). Moreover, this finding is comparable to MM Mohsen, ME Fareed (2013) (19) who concluded that the majority of both groups did not be trained previously about chemotherapy. The vast majority of nurses were females, aged between 20 to 30 years old, married, diploma holder, have more than 10 years of experience in oncology center, lived in village, were not pregnant or lactating, not smoker and do not previously attend training about safe handling chemotherapy.

The current study further clarifies that, before implementing safe handling chemotherapy, about half of nurses were unaware of exposure methods to chemotherapy hazards, type of these hazards and how to avoid it, which increase significantly after implementation of the protocol. This is corroborated with, Chaudhary and Karn, (2012) (6) study, their results show that the staff handling the cytotoxic drugs (CDs) does not have a satisfactory level of knowledge regarding the risk factors. This result is in support of the findings of Bolbol SA, et al., (2016) (25) study who

figure also cleared that in pre implementing the protocol nearly all nurses not wear gloves or wash clothes separately that contaminated with chemotherapy. While this increase significantly (100%) immediately and post two months after implementing safe handling chemotherapy protocol.

presented that, nurses highlighted to the lack of periodic training regarding the use of PPE and risks in different workplaces. This lack of knowledge on preventive measures is of concern because it increases the health workers' risky behavior (25).

These findings were similar with those of Chen et al,(2013) (26) who reported that mean score for chemotherapy exposure knowledge was increased from 5.7 to 8.6 out of 15 which was still proportionally lower than that of US nurses (10.9 out of 12) (20). More fundamentally, however nurses need more education about chemotherapy in nursing school and through in-hospital continuing education. In this respect Kosgeroglou et al. (2006) (27) who added that the overall high rates of adherence to safety guidelines are consistent with the higher level of awareness of hazardous related to chemotherapy. In contrary to current study results Orujlu, et al, (2015) (11) who reported that the majority of nurses in their study were aware of routes of exposure to antineoplastic drugs (ANDs). However, the establishment of systematic training programs could increase its level.

Furthermore, the finding of the present study show that, the Safe Handling Chemotherapy Protocol had led to the improvement of Mean nurses knowledge Scores (From 12.9 ± 4.8 to 25.4 ± 2.0 and to 22.7 ± 2.8 respectively) regarding (Total knowledge) in pre, immediately post and after 2 months of implementing safe handling chemotherapy protocol respectively.

Abd Al-Magid, (2012) (22) Ala attar (2015) (24) and Mohsen, et al, (2013) (19) supported the results of recent study and reported that there is a great improvement in knowledge score after application of standards. High knowledge levels among the nurses are important to improve their adherence to the safety measures and to elevate their sense of well-being though knowledge alone may be insufficient to ensure the complete precaution use (3, 19, 20). In the same line Abbasi, K., (2016) (28) who reported that, overall, the findings of nurses' knowledge assessment reflect the effectiveness of education and training, which has been claimed as a useful tool to improve the nurses' knowledge on cytotoxic drug handling. Hospitals and clinics must provide safe handling education and training to improve the knowledge of staff and to demonstrate the organizational support (7).

Moreover, the present study demonstrates that there was improvement in nurses' skills (during procedure, post procedure and total practices) after implementing the Safe Handling Chemotherapy Protocol. In accordance to our study results, Mohsen, et al (2013)(19) and Hassan, et al (2014) (18) reported that there was significant improvement of total nurses' practice score after educating them with the chemotherapy safety protocol, also mentioned that each organization and profession must set standards and objectives to guide staff and practitioners in performing safe and effective care.

The current study clears that, before implementing safe handling chemotherapy protocol, there is poor nurses'

practice related to dealing with chemotherapy spillage on nurses' skin, clothes/bed linen and splashes into nurses' eyes, which differ significantly in positive way after implementing of the protocol. This is related partially in the present study to unavailability of some supplies (chemotherapy spill kits) and decrease awareness of proper dealing with chemotherapy spillage. In the same line Alattar (2015) (24) who mentioned that a lack of education and the inconvenience of safety equipment may prevent many nurses from taking appropriate precautions for themselves.

In this respect Abd Al-Magid, (2012) (22) stated that, the level of nurse's performance regarding (management of chemotherapy spill) improved immediately in most items, and the supplies were a barrier to carry out the steps such as (obtain drug spill kit). In agreement with current findings Hassan MA., (2014) (18) agree with finding of the present study and reported that inadequate level of practice on post procedure (not done) toward safe handling chemotherapy included repeat use of warm soapy, wash the clothes/linen separately. In the same direction Rizalar, S., (2012) (23) and reported that Forty-eight percent of nurses have experienced spillage of drug and found that only few nurses had proper actions in case of contamination.

In other similar studies, nurses reported the availability of spill kits in their workplace (9, 29) which is opposite to results of the present study. For better management of spills in the accidental release, the presence of suitable kit is necessary and is recommended for the studied hospitals.

Conclusion:

Overall, the results of this study indicate a significant improvement of knowledge, and practices among the nurses handling chemotherapy drugs after Safe Handling Chemotherapy Protocol (booklet).

Recommendations

Based on the findings of the present study:

Health care professionals who are responsible for handling chemotherapeutic drugs should be adherent to implementation of (SHPC).

Reference

[1]. Al-Rawi R. New Genetic Approach in Early Detection of Cancer. *J Mol Biomark Diagn.* 2016; 7(292):2.

[2]. Elshamy K, El-Hadidi M, El-Roby M, and Fouda M. Health hazards among oncology nurses exposed to chemotherapy drugs. *African Journal of Haematology and Oncology.* 2010; 1(3).

[3]. Kyprianou M, Kapsou M, Raftopoulos V, Soteriades ES. Knowledge, attitudes and beliefs of Cypriot nurses on the handling of antineoplastic agents. *European Journal of Oncology Nursing.* 2010;14(4):278-82.

[4]. Bouraoui S, Brahem A, Tabka F, Mrizek N, Saad A, Elghezal H. Assessment of chromosomal aberrations, micronuclei and proliferation rate index in peripheral lymphocytes from Tunisian nurses handling cytotoxic drugs. *Environmental toxicology and pharmacology.* 2011;31(1):250-7.

[5]. ASHP - ASHP Guidelines on Handling Hazardous Drugs. *Am J Health-System Pharm* [Internet]. 2006 June [cited 2014 June 02];63:1172-93. Available from: http://www.ashp.org/s_ashp/docs/files/bp07/prep_gdl_hazdrugs.pdf.

[6]. Chaudhary R and Karn K: CDs Knowledge and Handling Practice of Nurses Working in a Medical University of Nepal. (2012). *Journal of Cancer Therapy*; 3:110-114. Available online from: <http://www.SciRP.org/journal/jct>

[7]. Polovich M, Clark PC, editors. Factors influencing oncology nurses' use of hazardous drug safe-handling precautions. *Oncol Nurs Forum* 2012; 39(3), 299-309. <http://dx.doi.org/10.1188/12.ONF.E299-E309>

[8]. Lawson, C. C., Rocheleau, C. M., Whelan, E. A., Hibert, E. N. L., Grajewski, B., Spiegelman, D., & Rich-Edwards, J. W. Occupational exposure among nurses and risk of spontaneous abortion. (2012) *Am J Obs Gyne*, 206, 327.

[9]. Boiano JM, Steege AL, Sweeney MH. Adherence to safe handling guidelines by health care workers who administer antineoplastic drugs. *J Occup Environ Hyg* 2014; 11(11):728-40. <http://dx.doi.org/10.1080/15459624.2014.916809>

[10]. Hon C-Y, Teschke K, Shen H. Health care workers' knowledge, perceptions, and behaviors regarding antineoplastic drugs: Survey from British Columbia, Canada. *Journal of occupational and environmental hygiene.* 2015;12(10):669-77.

[11]. Orujlu S, Habibzadeh H, Sakhvidi MJZ, Hajaghazadeh M. Knowledge, Attitude, and Performance of Oncology Nurses Handling Antineoplastic Drugs in Hospitals of Urmia University, Iran. *International Journal of Occupational Hygiene.* 2016;8(1):14-21.

[12]. Connor, T. H., DeBord, D. G., Pretty, J. R., Oliver, M. S., Roth, T. S., Lees, P. S., & Clark, J. C. Evaluation of antineoplastic drug exposure of health care workers at three university-based US cancer centers. *Journal of occupational and environmental medicine.* 2010;52(10):1019-27.

[13]. Polovich M, Martin S [2011]. Nurses' use of hazardous drug-handling precautions and awareness of national safety guidelines. *Onc Nur Forum* 38(6):718-726.

[14]. Al-Azzam SI, Awawdeh BT, Alzoubi KH, Khader YS, Alkafajei AM. Compliance with safe handling guidelines of antineoplastic drugs in Jordanian hospitals. *Journal of Oncology Pharmacy Practice.* 2015; 21(1):3-9.

[15]. Pituch, Keenan A, and James P Stevens. *Applied multivariate statistics for the social sciences:*

- Analysis with SAS and IBM's SPSS. Routledge, (2015).
- [16]. Hazen, S., Smith-Idell, C. &Howlett, K. Putting safe handling of hazardous drugs into practice. In B. Faiman & T. Dolan (Eds.), *Spotlight on Symposia from ONS 35th Annual Congress 2010*; (21-22). San Diego, CA: Oncology Nursing Society.
- [17]. Walton, A.L., Mason, S., Busshart, M., Spruill, A.D., Cheek, S., et al. Safe handling: Implementing hazardous drug precautions. *Clin J Oncol Nurs*, 2012; 16(3), 251-254. doi:10.1188/12CJON.251-254
- [18]. Hassan MA.: Suggested guidelines: Assess Patient Caregivers Knowledge and Practice toward Safe Handling Chemotherapy research at Assuit university hospital, result. (2014) PP: 50-67.
- [19]. Mohsen, Magda M., and Manal E. Fareed. "Chemotherapy Safety Protocol for Oncology Nurses: It's Effect on Their Protective Measures Practices." *World Academy of Science, Engineering and Technology, International Journal of Medical, Health, Biomedical, Bioengineering and Pharmaceutical Engineering* 7.9 (2013): 529-537.
- [20]. Polovich M, Clark PC. Nurses' Use of Hazardous Drug Safe Handling Precautions. Unpublished study. Georgia State University. (2010)
- [21]. Fashafsheh Ahmed Ayed I, Eqtait Lubna Harazneh F. Knowledge and practice of nursing staff towards Infection Control Measures in the Palestinian Hospital. *J Edu prac*. 2015;6(4):79-91
- [22]. Abd Al-Magid, A., Alaa Aldeen, S., Mohammed, S., & Abd Elatef, Z. Nursing care standards for cancer patients undergoing chemotherapy. (2012) *J Am Sci*, 8(5), 108-120.
- [23]. Rizalar S., Tural E., Altay B., "Nurses' protective measures during chemotherapy preparation and administration in Turkey." *International journal of nursing practice* 18.1 (2012): 91-98.
- [24]. Al-Attar, Wafaa MA, and Abaul Hassain M. Al-Gannem. "Effectiveness of the nursing educational program upon nurse's knowledge and practices concerning chemotherapy precautions." *IOSR Journal of Nursing and Health Science (IOSR-JNHS)* Volume 4, Issue 6 Ver. III (Nov. - Dec. 2015), PP 07-13 www.iosrjournals.org.
- [25]. Bolbol SA, Hassan AA, El-Naggar SA and Zaitoun MF" Role of Occupational Health and Safety Program in Improving Knowledge and Practice Among Nurses Exposed to Chemotherapy at Zagazig University Hospitals." *Egyptian Journal of Occupational Medicine*. 40.2 (2016): 219-235.
- [26]. Keat, C. H., Soaid, N. S., Yun, C. Y., & Sriraman, M. " Improving Safety-Related Knowledge, Attitude and Practices of Nurses Handling Cytotoxic Anticancer Drug: Pharmacists' Experience in a General Hospital, Malaysia" *Asian Pacific Journal Cancer Prevention*, 14 .1(2013): 69-73
- [27]. Kosgeroglu, N., Ayranci, U., Ozerdogan, N., & Demirustu, C. "Turkish nurses' information about, and administration of, chemotherapeutic drugs." *Journal of clinical nursing* 15.9 (2006): 1179-1187.
- [28]. Abbasi, K., Hazrati, M., Mohammadbeigi, A., Ansari, J., Sajadi, M., Hosseinnazzhad, A., & Moshiri, E. (2016). Protection behaviors for cytotoxic drugs in oncology nurses of chemotherapy centers in Shiraz hospitals, South of Iran. *Indian journal of medical and pediatric oncology: official journal of Indian Society of Medical & Pediatric Oncology*, 37(4), 227.
- [29]. Polovich M, Martin S, editors. Nurses' use of hazardous drug-handling precautions and awareness of national safety guidelines. *Oncol Nurs Forum* 2011; 38(6): 718-26.