

Chemotherapy Health Hazards among Oncology Nurses and Its Possible Relation to Malpractice and Workplace Environment

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ABSTRACT

Context: Chemotherapeutic drugs are chemical substances used for cancer treatment and are known to be carcinogenic, teratogenic, and mutagenic to humans. Occupational exposure to chemotherapeutic drugs has led to higher health hazards among nurses who handle them.

Aim: Assess chemotherapy health hazards among oncology nurses and their possible relation to malpractice and the workplace environment.

Method: A descriptive and exploratory research design used in the present study. All available nurses from both sexes working in the chemotherapy department comprised 50 nurses with one year of experience. The study was conducted at Oncology Center in Minia City, Egypt, in the outpatient and inpatient chemotherapy department. Three tools were used to collect the study data. An interview structured questionnaire for nurses was designed to assess the studied nurses' socio-demographic characteristics and medical history. The second tool is nursing practice observation checklists to assess safe practice in chemotherapy handling. The third tool was environmental safety checklists to assess workplace environmental safety.

Results: The main results of this study clarified that about half of the study sample (48%) complained of health hazards presented as skin irritation/allergy, chest allergy, and inflammation of eyes (45.8%, 16.7%, 37.5%, respectively). Maternal hazards presented mainly as irregular menstrual bleeding (50%), menorrhagia, and abortion (33.3%). Decrease environmental safety presented mainly as absence of biological safety cabinet, specific personal protective equipment (PPE), safe handling chemotherapy guidelines. Along with certain nurses' malpractice as most of the study sample (74%) has poor practice score in handling chemotherapy.

Conclusion: This study indicated the presence of general and maternal health hazards among nurses handling chemotherapy in the form of general and maternal health hazards. The study also clarified nurses' malpractice among about three-fourths of nurses and provided evidence of an unsafe environment. The results strengthened the increased need to improve nurses' knowledge and practice regarding chemotherapy handling and the provision of needed equipment/supplies to underpin safe and effective practice in this area.

Keywords: Chemotherapy health hazards, oncology nurses, malpractice, workplace environment

1. Introduction

Chemotherapy is one of the most commonly prescribed cancer treatment modalities (Zayed, Saied, El-Sallamy, & Shehata, 2019; Mohamed, 2015). Cancer chemotherapy refers to the use of chemical agents to destroy cancerous cells (Hammond et al., 2010). The risk of exposure to chemotherapeutics in healthcare professionals begins with the arrival of dangerous agents to their institution and ends with proper disposal. Nurses are working in oncology departments exposed to hazardous chemotherapy drugs while receiving or transporting prepared medications to the clinical area. The staff nurses may be exposed to needle stick injury or injured by fragments (Kopp, Schierl, & Nowak, 2013).

Additionally, they are also liable to risk through polluted food, drink, or through mouth reach by

contaminated hands (Sessink, Connor, Jorgenson, Tyler, 2011; Siderov, Kirsa, & McLauchlan, 2010; Pham, Ye, & Pal 2015).

Exposure to antineoplastic drugs can harm workers' health due to their toxicity and may cause undesirable and irreversible side effects when exposed and manipulated without considering safety measures (Fernandes, Pelissari, Cogo, & Filha, 2016). Pregnant nurses, in particular, are at high risk from exposure to chemotherapy since; it is associated with a high incidence of spontaneous abortion among oncology nurses (Polovich & Martin, 2011). Besides, Broadfoot (2019); Momeni, Danaei, and Askarian (2013); Mohsen and Fareed (2013); Kyprianou, Kapsou, Raftopoulos, and Soteriades (2010) mentioned that workplace exposure to chemotherapy drugs is associated with an increased risk of miscarriage and genetic toxicity.

The nursing society recommends that to provide quality care and maintain safety standards, nurses must be competent in oncology nursing practices and aware of risks

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in their workplace. A significant facet of this competency is that nurses must be remaining educated and regularly engaged in standard practical safety guidelines (Crannell, 2012).

The nurse must adhere to chemotherapy protection protocol either during the preparation or administration of chemotherapy. This protocol includes preventive measures, which comprise hand washing, using specific personal protection equipment (PPE) during chemotherapy handling, prohibiting food or drink, or smoking in the chemotherapy preparation room. Furthermore, all used waste components must be disposed of in the right containers according to the hospital's infection control policy (Roussel & Connor, 2013).

The National Institute of Occupational Safety and Health (NIOSH) states that health professionals exposed to chemotherapeutic agents as part of their professional practice should owe its precautions to eliminate and reduce exposure whenever possible. This precaution includes the use of (PPE) such as gloves, gowns, and masks (Casanova, Rutala, Weber, & Sobsey, 2012).

The safe handling chemotherapy guidelines recommend applying the hierarchy of control technologies to mitigate workplace hazards and limit nurses' exposure to hazardous drugs (HDs). A bundle of actions must be taken, such as wearing PPE and the use of closed-system drug transfer devices. Moreover, ventilation control as a biological safety cabinet is also of concern (Broadfoot, 2019).

Furthermore, the potential occupational risks for health care professionals may vary due to differences in the frequency and duration of use and individual vulnerability. All hospital staff nurses working with chemotherapy drugs should consider revenue protective measures to protect themselves from possible hazards, which is significantly increase during the administration of these drugs. Therefore, an authoritarian safety protocol is required at all times (Mohsen & Fareed, 2013).

2. Significance of the Study

Approximately 8 million health care workers are exposed to antineoplastic drugs, which can contribute to adverse health effects for these workers (Graeve et al., 2017). Occupational exposures to chemotherapy health hazards are often unrecognized due to a lack of systematic environmental monitoring and biomonitoring screening programs. While high levels of oncology nurses' exposures are thought to in cancer patients' drug administration, occupational health hazards exposure associated with one chemotherapy agent or a specific combination of therapy, which occur more frequently and over a more extended period, are not adequately documented. The widespread use of chemotherapeutic drugs in cancer treatment has led to higher health hazards among employees who handle and administer such drugs.

Several studies addressed the effect of chemotherapy on cancer patients, but little is concerned with its health hazards on nurses, so this study aimed to fill this gap. This

research attempts to describe and explore health hazards among oncology nurses concerning specific malpractice during manipulation and handling streak considering environmental safety.

3. Aim of the Study

Assess chemotherapy health hazards among oncology nurses and their possible relation to malpractice and workplace environment.

3.1. Research Questions

- What are the health hazards among nurses handling chemotherapy?
- What are the possible malpractices done by nurses during chemotherapy handling?
- Is the work environment safe for proper chemotherapy handling?

4. Subjects & Methods

4.1. Research Design

The descriptive cross-sectional study design was used in this study. Descriptive is used to describe the characteristics of a population or phenomenon being studied. It does not answer questions about how/when/why the characteristics occurred instead, it addresses the "what" question (what are the characteristics of the population or situation being studied?) (Polit & Beck, 2010).

4.2. Research Setting

The current study was carried out in the Oncology Center at Minia City, Egypt, in the outpatient and inpatient chemotherapy department. The inpatient chemotherapy department is located on the third floor. It consists of two rooms, one for adult males and one for adult females; each contains 4-5 beds. The outpatient chemotherapy department is located on the fourth floor. It consists of two rooms, one for adult males and one for adult females; each contains four beds. It is affiliated with the General Secretariat of Specialized Medical Centers, Ministry of health.

4.3. Subjects

All available nurses (50) from both sexes worked in the outpatient and inpatient chemotherapy department who are willing to participate in the study, with one year experience at least and currently assigned to provide direct care in oncology departments.

4.4. Tools of the Study

Data was collected using three tools developed by the researchers based on a literature review (Broadfoot, 2019; Polovich & Martin, 2011; Lynn, 2011). It includes the following:

4.4.1. A structured Interview Questionnaire

It includes two parts:

1st part assessed socio-demographic data of nurses, including gender, age, education, marital status, smoking habits, years of experience as an oncology nurse, and

previous training about safe handling of chemotherapy, presence of pregnancy, and lactation among female participants.

2nd part assessed the medical history of nurses. It compromised past and present medical health history, maternal health history, presented complaints among participants that solidified the exposure to chemotherapeutic agents. It includes general health hazards (skin allergy, chest allergy, eye inflammation, and cancer). It also included maternal health hazards such as (presence of menstrual disturbance, types of menstrual disturbance, the occurrence of abortion, frequency of occurrence, the occurrence of preterm labor, its number, intrauterine fetal death, congenital anomalies, or infertility).

4.4.2. Nursing Practice Observation Checklists

This tool developed by researchers after extensive review literature to assess safe practice in chemotherapy handling; it covered the following:

A. Nurse's practices during, after chemotherapy administration, in chemotherapy storage, and disposal. It included such procedures as prohibiting eating, drinking, and smoking in the medication handling areas, handwashing before and at the removal of chemotherapy, following waste disposal protocol, put on PPE, proper needle recapping, and documentation of extravasation. It assessed as done correctly (2 scores), incompletely or incorrectly done (1 score), and not done (scored zero). It measured for each nurse two times, once in the morning and second in the afternoon shift.

B. Nurse's practices in dealing with chemotherapy spillage and splashes; included immediate removal of chemotherapy contaminated gloves, and gowns, wash contaminated clothes separately, the immediate flush of eyes, wash of spillage, report spillage, and the proper discarding of all chemotherapy used the equipment. It assessed as done correctly (2 scores), incompletely or incorrectly done (1 score), and not done (scored zero). It measured when it occurred during researchers' visits.

Scoring system

A total score is summed and classified as good performance (if the score was more than 60%) and poor performance if the score was less than 60%.

4.4.3. Environmental Safety Checklists

The researcher developed it to assess workplace environmental safety. It included assessing the availability of needed equipment/supplies for the safest chemotherapy handling and needed equipment/supplies for managing the splashes. It was assessed as available (A), partially available (PA), or not available or usually/ rarely used (NA).

4.5. Procedures

Before collecting data from the oncology center affiliated to the Egypt Ministry of Health, permission from the oncology center directors and Research Center at Minia city was granted. The researchers explained the purpose of

the study for every agreed participant nurse involved in the study. Then, the researcher asked them to fill the 1st and 2nd parts of the first tool. After that, an observational checklist was used to assess nurses' practice (during and after chemotherapy administration), nurse's practices in dealing with chemotherapy spillage and splashes, and other observational checklists to assess the safety of the working environment. Each nurse observed two times, during the morning/afternoon shift twice weekly. Data collections finished over four months from October 2016 to January 2017.

The developed tool's content was examined by a jury of three experts in medical-surgical and community health nursing affiliated to Assuit University and two experts in medical-surgical nursing, affiliated to Minia University, Egypt, for testing the tool content validity. The jury agreed upon current study tools that are valid and fit the study aim. Inter-rater reliability assessed the second and third tools, and it was highly reliable.

A pilot study was conducted on five nurses (10%) of the total sample to assess the clarity, comprehensiveness, and relevance of the study tool and the feasibility of the research process. Results of the pilot study illustrated that no refinements and modifications were needed so that the pilot sample was included in the primary sample.

The subject's participation in this study was voluntary. The participant is informed about the purpose, procedure, benefits, nature of the study, and he/she has the right to withdraw from the study at any time without any rationale. Confidentiality and anonymity of each subject were ensured through coding of all data and protecting the obtained data.

4.6. Data analysis

A statistical package of (SPSS), version 20 used to analyze the study data. Descriptive statistics used to describe participants' characteristics. Number and percentage plus mean and standard deviation were used to assess health hazards concerning nurse's malpractice related to chemotherapy.

5. Results

Table 1 shows that most nurses were females (84%) aged between 20 to 30 years old (64%) and married (74%). About half of them had graduated from secondary nursing school (54%) and had more than ten years of experience in oncology (48%).

Table 2 reflects that nearly half of nurses (48%) in the current study had some general health hazards, including skin irritation 45.8%, inflammation of the eye 37.5%, and chest allergy 16.7%.

Table 3 clarifies that the maternal health hazards among female nurses in the study sample 28.6% had menstrual disorders mainly presented as irregular menstrual bleeding 50%, and about 33.3% of nurses had menorrhagia and complain of abortion with frequency ranging from once to thirteen times. Furthermore, 11.9% of nurses had preterm labor, 4.8% had intrauterine fetal death, 4.8% were born

babies with congenital anomalies, and no one complained of infertility.

Table 4 shows many health hazards in nursing practice, such as 100% of nurses eating, drinking, and smoking in the drug handling area, do not wash hands before administration or remove IV chemotherapy. Besides, all of them did not wear latex gloves when dealing with extravasation; do not wear a gown, mask in handling chemotherapy, and do not immediately remove gloves and any contaminated clothes in waste containers. Also, they did not wash the contaminated clothes separately with plenty of water, do not wash the spill areas with a detergent solution and clean water, do not report chemotherapy spillage, and do not discard used equipment in labeled containers. While all of them flush their eyes immediately if spillage occurs. 64%, 60%, put on protective gloves before and after removing IV chemotherapy.

Figure 1 shows the percentage distribution of total nurses' practices during chemotherapy handling, and it is precisely that most of the study sample, 74% has poor total practice scores.

Table 5 shows a qualitative analysis for the availability of safety measures in the oncology department. The table

shows the availability of PPE for the handling of chemotherapy are latex gloves, disposable gowns, and N95 masks. It also shows that there are no specific gloves, gowns, masks for chemotherapy handling. Appropriate chemotherapy drug transportation containers are partially available. Concerning the availability of needed equipment and supplies for managing splashes, the table reveals the unavailability of chemotherapeutic spillage kits, specific room for dealing with chemotherapy splashes, eyewash station, there is only accesses to running water for eyewash is available — no feasibility of washing the contaminated clothes/linens separately. Nursing guidelines for safe chemotherapy handling are not available.

Regarding the drug preparation areas, there is no biological safety cabinet for the preparation of chemotherapy. This finding is usually done in the pharmacy room (usually used) and sometimes in the nurses' station or treatment room (that are rarely used).

Table 6 shows no statistically significant correlation between the nurse's practice, age, and years of experience.

Table (1): Frequency and percentage distribution of demographic data among study sample (n = 50).

Personal data	No.	%
Gender		
Male	8	16.0
Female	42	84.0
Age / Years		
20 – 30	32	64.0
31- 40	18	36.0
Mean ± SD		23.6±10.1
Education		
Secondary Nursing School diploma	27	54.0
Technical institute diploma	8	16.0
Bachelor's degree in nursing	12	24.0
Postgraduate Diploma in nursing	3	6.0
Marital status		
Single	13	26.0
Married	37	74.0
Smoking Habits		
Yes	1	2.0
No	49	98.0
Years of experience in oncology		
1 – Less than five years.	18	36.0
5-10 Yrs.	8	16.0
>10 Yrs.	24	48.0
Mean ± SD		5.96±4.6
Previous Attendance of Course about Safe Handling of Chemotherapy	4	9.5
Presence of Pregnancy (for female n=42)	2	4.8
Presence of Lactation (for female n=42)	4	9.5

Table (2): Frequency and percentage distribution regarding the occurrence of general health hazards among the study sample (n=50).

General health hazards	(n= 50)	%
Presence of general health hazards (n=50)		
Yes	24	48%
No	26	52%
Type of general health hazards (complaints)		
Skin allergy or skin irritation (male and female nurses) (n=50)	11	45.8
Chest allergy (male and female nurses) (n=50)	4	16.7
Inflammation of the eye (male and female nurses) (n=50)	9	37.5
Cancer (male and female nurses) (n=50)	0	0

Table (3): Frequency and percentage distribution of maternal health hazards among female nurses in the study sample (n=42).

Maternal Health Hazards	No.	%
Menstrual disturbance		
Yes	12	28.6
Type of menstrual disturbance (n= 12)		
Irregular menstrual bleeding	6	50.0
Light or infrequent menstruation (oligomenorrhea)	2	16.7
Heavy menstrual bleeding & prolonged bleeding (menorrhagia)	4	33.3
Abortion		
Yes	14	33.3
If yes, frequency of abortion (n=14)		
Once	6	42.9
Twice	6	42.9
Four times	1	7.1
Thirteen times	1	7.1
Exposure to preterm labor		
Yes	5	11.9
If yes, number of preterm labor (n=5)		
Once	3	60.0
Twice	1	20.0
Three times	1	20.0
Fetal loss (intrauterine fetal death)	2	4.8
Delivery of babies with congenital anomalies	2	4.8
Infertility	0	0

Table (4): Nurses' practices in the handling of chemotherapeutic drugs (N= 50).

Nurses' Practice	Done %	Not Done %
Avoiding drinking, eating, and smoking in areas where handling chemotherapeutic agents.	0	100
Washing hands before IV chemotherapy administration	0	100
Washing hands when removing of IV chemotherapy	0	100
Washing hands following waste disposal	70	30
Wearing latex gloves before administration of IV chemotherapy	64	36
Wearing latex gloves When removing IV chemotherapy	60	40
Wearing latex gloves When dealing with extravasation	0	100
Wearing a gown, mask in the handling of chemotherapy	0	100
Proper needle recapping or disposal of the empty syringe	10	90
Document extravasation (date, time, location, drug name, dose)	0	100
Immediately remove gloves and any contaminated clothing with chemotherapy spillage and dispose of them into the waste container	0	100
Wash the contaminated clothing (with Chemotherapy Spillage) separately from other clothing with plenty of tap water	0	100
Immediately flush the eyes and the surrounding areas with a large volume of cold tap water if spillage occurs	100	0
Wash the spill areas using a detergent solution followed by clean water.	0	100
Report chemotherapy spillage to the head nurse	0	100
Discard all equipment into a chemotherapeutic agent labeled the waste container.	0	100

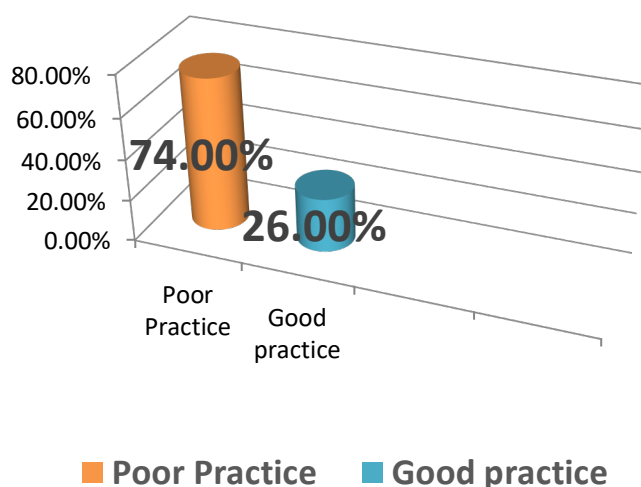


Figure (1): Percentage distribution of total nurses' practices during chemotherapy handling (n = 50).

Table (5): The availability of environmental safety measures in oncology departments: (qualitative analysis of the department resources).

Needed PPE in Handling Chemotherapy	Availability
Gloves	
Specific for chemo. handling	NA
Latex gloves	A
Gowns	
Specific for chemo. handling	NA
Disposable	A
Masks	
Specific for chemotherapy handling	NA
N95 Mask if indicated	A
Containers	
Appropriate Chemotherapy Drugs Transportation Containers are labeled, sturdy, leak-proof transport bags or boxes that are securely capped.	PA
Availability of needed equipment/supplies for chemotherapy splashes	
Presence of Chemotherapeutic Spillage Kit	NA
Specific room for dealing with chemotherapy splashes	NA
Eyewash station	NA
Access to running water.	A
Feasibility of washing the clothes/linen contaminated with Chemotherapy Spillage separately.	NA
Presence of Nursing Guidelines about Safe Handling Chemotherapy	NA
Drug Preparation Area:	
Biological safety cabinet	NA
Treatment room	Rarely used
Nurse's station	Rarely used
Pharmacy room	Usually used

A: Available

PA: Partially available

NA: Not Available

Table (6): Correlation between nurse's practice, age, and years of experience (n = 50).

Variables	Age		Years of experience	
	r	P-value	r	P-value
During chemotherapy administration	0.124	0.393	0.030	0.834
When dealing with chemotherapy spillage, splashes & disposal.	0.094	0.515	0.043	0.768
Total practice	0.026	0.859	0.049	0.737

6. Discussion

The handling of antineoplastic drugs is considered a significant occupational exposure to chemical agents in hospitals. It involves high-risk occupational health hazards at the workplace, affecting mostly pharmacists, nurses, and nurse technicians who are constantly involved in preparing and administering these drugs (Fernandes et al., 2016). The occupational risk of environmental contamination during the storage, reconstitution, administration of antineoplastic drugs, and elimination of residues are well documented (Moretti et al., 2011).

Furthermore, nurses' practice and workplace safety environment seem to have a valuable role in decreasing/avoiding these potential hazards. The present study was carried out to assess chemotherapy health hazards among oncology nurses and their possible relation to malpractice and the workplace environment.

The present study results reveal that most nurses were females, about two-thirds aged between 20 to 30 years old, and about three-fourths were married, reflecting that the young married female nurse is the cornerstone of the care of patients treated with chemotherapy. This finding maximizes the health hazards nurses can expose to during their work in oncology units. This result is consistent with Callahan et al. (2016), who mentioned that most of the nursing workforce is female (90%) and within childbearing years (median age of 31) in their study done in four oncology units and one intensive care unit. Also, Momeni et al. (2013) reported that approximately (94%) of participants were females with a mean age of participants of (31.6) years, and (59%) were married. Mohsen & Fareed (2013); Polovich (2010) supported study findings and mentioned that most nurses were females. This finding reaffirms the notion that nursing is still a predominantly female-dominated profession (Mohamed, 2015).

More than fifty percent of the nurses in this study have a secondary nursing school diploma concerning the level of education. This finding agreed with other studies done by Abd Al-Magid, Alaa Aldeen, Mohammed, & Abd Elatef (2012); Hassan (2014), where most nurses are a secondary nursing school diploma holders. A study done on one hundred oncology nurses found that (61%) were secondary nursing school diploma qualified nurses (Nwagbo, Ilesanmi, Ohaeri, & Oluwatosin, 2017).

Regarding years of experience, it was found that about fifty percent of nurses have more than ten years of experience in the oncology center, which poses a higher risk from prolonged exposure to chemotherapy. Hanafi et al. (2015) supported these findings in a study entitled "safe handling of cytotoxic drugs and risks of occupational exposure to nursing staffs." The study reported that the mean working experience for nurses was more than six years, also Nwagbo et al. (2017) in a study entitled "knowledge of chemotherapy and occupational safety measures among nurses in oncology units." The study mentioned that precisely 50% of the respondents had to work for over three years.

The present study results reveal that most nurses do not

previously attend training about proper handling of chemotherapy in the absence of safe handling chemotherapy guidelines. This result is in line with Bolbol, Hassan, El-Naggar, and Zaitoun (2016); Al-Attar and Al-Gannem (2015); Mohsen and Fareed (2013), who mentioned that approximately no nurse attend workshops about contact with cytotoxic drugs, and tiny percent (12%) reported that a standard guideline was present for dealing with cytotoxic drugs. Also, Momeni et al. (2013) mentioned that lack of adequate training in participants is noticeable in an enticeable study and concluded that long-term plans should be developed on a continuous training program for healthcare protect from chemotherapy adverse effects.

The current study found that about half of the study sample complained of different health problems, including skin irritation, inflammation of the eye, and chest allergy, which may contact chemotherapy agents. These findings were following Al-Attar and Al-Gannem (2015), Friese et al. (2015), Orujlu, Habibzadeh, Sakhvidi, and Hajaghazadeh (2016), who stated that there were a significant unintentional skin and eye exposure to chemotherapy drugs. Bolbol et al. (2016) reported that health hazards among nurses include eye affection (34.0%), skin and mucous membrane affection (24.0%). Momeni et al. (2013), in a study entitled "how do nurses manage their occupational exposure to cytotoxic drugs? A descriptive survey in chemotherapy settings, Shiraz, Iran," mentioned that headache and skin reactions were the most common adverse effects reported by participants.

Regarding health hazards among female nurses, the study finding demonstrated that more than a quarter of them had menstrual disorders, half of them presented with irregular menstrual bleeding, and about one-third of them had menorrhagia and experienced abortion, which occurs once, twice, four times and in (7.1%) occur thirteen times. Ratner et al. (2010) corroborated this finding, and Connor, Lawson, Polovich, and MacDiamid (2014) reported that; exposure to antineoplastic agents is associated with a range of reproductive health effects (such as menstrual changes and abortions). Elshamy, El-Hadidi, El-Roby, and Foud (2010) also reported that abortion incidence increased among nurses dealing with chemotherapy than other nurses (22.6%, 10.3%) was followed by infertility.

The present study showed that about one-tenth of participants' females complain from preterm labor while none complain from infertility. Moreover, the study also revealed that most participants did not have babies with congenital anomalies or fetal loss. These findings were incongruent with Boiano, Steege, and Sweeney (2014), who mentioned that exposure to chemotherapy drugs is associated with many adverse outcomes for occupationally exposed individuals, including but not limited to contact dermatitis; deoxyribonucleic acid (DNA) damage; chromosomal abnormalities; fetal loss; infertility; preterm births; and an overall increase in one's personal risk for cancer.

In our study, although they did not examine the nurses' perception of their vulnerability directly to exposure to hazard, our findings suggest a low perception of their vulnerability. This finding is because the assessment of nurses' practice in handling chemotherapy revealed little concern of handwashing before administration and when removing chemotherapy (none), while about three-fourths followed chemotherapy waste disposal protocol. Besides, no nurse used an available gown, mask and only use latex gloves in chemotherapy handling; besides, no one of the nurses documents extravasation.

Nwagbo et al. (2017) added that these findings might be partly due to inadequate provision of PPE by some employers and non-enforcement of use. This result is inconsistent with *Mohsen and Fareed (2013)*, who reported that the nurses' awareness of handling and administering chemotherapeutic drugs is of concern because it is crucial in raising safety standards.

Several studies are incongruent with our findings *Polovich and Martin (2011)*; *Al-Attar and Al-Gannem (2015)*; *Chaudhary and Karn, (2012)*; *Shrestha, (2012)*, who found that nurses did not adhere to wearing personal protective equipment when disposing of the waste of patients and dealing with spillage of chemotherapy. *Connor and Eisenberg (2010)* explained that inadequate use of protective measures among nurses reflects perceptions of their low probability of immediate injury when handling these agents. This finding is not in line with *Momeni et al. (2013)*; *Mohsen and Fareed (2013)* mentioned that approximately 5% of participants did not use any protective equipment.

This work showed that there is risky behavior among studied nurses working in oncology departments, including eating food in drug handling areas, unsafe handling of contaminated material, and unsafe cleaning of spills. In this regard, *Polovich and Clark (2012)* reported environmental contamination with chemotherapeutic drugs, partly due to poor nursing compliance to guidelines. Nurses are not sure if chemotherapy splashes should be washed very well with soap and water. Forty percent were unsure how to handle stained clothes or sheets with body fluids (*Nwagbo et al., (2017)*).

On the other hand, *Connor and Eisenberg (2010)* have observed that most policies and protocols in practice are directed toward patient safety and not health care personnel. *Jacobson et al. (2009)* added that a typical example is the American Society of Clinical Oncology and the Oncology Nursing Society standards for chemotherapy administration. These protocols focus on patients' safety and not nursing exposure. It can, therefore, be inferred from different studies that inadequate education and experience may contribute to unnecessary exposure, especially among nurses.

The result shows that circumstances in the workplace environment interfere with the nurses' use of precaution during chemotherapy handling. As the current study demonstrated, the unavailability of specific supplies/equipment needed for safe handling of chemotherapy in the oncology unit. These include chemo

PPE, biological safety cabinet for chemotherapy preparation, chemotherapeutic spillage kit, in addition to the clearly labeled cytotoxic container, eyewash station, and nursing guidelines about safe handling chemotherapy, which may increase the risk of occupational health hazards among study participants.

Hassan (2014) agreed with current study findings and reported that some PPE equipment is not available, including long-sleeved gowns, safety spectacles, or goggles. *Bolbol et al. (2016)* agreed with the current study. They mentioned that the working place environment was not safe; only 15.0% of the related wastes have been appropriately disposed of. However, the use of proper preparation cabins has increased dramatically since 1997; this is not the case in hospitals of developing countries like Egypt. *Abd Al-Magid et al. (2012)* explained that a lack of these facilities might affect the completion of the procedure. However, some studies suggested that workplace exposure levels decrease due to increased awareness and use of safety procedures. Environmental monitoring provides information on potential exposures by testing chemotherapy drugs on workplace surfaces and air (*Broadfoot, 2019*).

This result contrasts with other similar studies in which nurses reported the availability of spill kits in their workplace. While *Mohsen and Fareed (2013)*; *Kyprianou et al. (2010)* mentioned that the setting had a personnel protective barrier adequately. This finding may be related to decrease financial resources in our hospitals. Mohamed also mentions this (*2015*).

Finally, the present study results revealed no correlation between nurses' practice and their age or years of experience; this is because the majority of them not receive any training courses related to cytotoxic drugs. *Bolbol et al. (2016)* reported that the socio-demographic characteristics have no role in improving neither knowledge nor practice in their study.

7. Conclusion

This study indicated the presence of general and maternal health hazards among nurses handling chemotherapy in the form of general and maternal health hazards. The study also clarified nurses' malpractice among about three-fourths of nurses and provided evidence of an unsafe environment.

8. Recommendations

The risk of exposure to cytotoxic drugs can be dropped considerably by forming a committee in Egypt to regularly update guidelines on safely handling chemotherapy array with our resources with specific considerations to pregnant/lactating females. Periodic and consistent update of nurses' knowledge and practice, enforces nurses to follow the approved guideline, offers a safe work environment, conducts periodic screening programs for monitoring on potential exposures, and delivers needed equipment/supplies for safe handling of chemotherapy.

Further studies on a larger probability sample and in different research settings.

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