

Safety Standards Guidelines: Effect on Nurses' Performance Regarding Safe Handling of Chemotherapy Drugs for Pediatric Patients

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Abstract: Background: Nurses are likely be exposed to an increased number of antineoplastic drugs (ADs) at work because of the rising incidence of cancer among pediatric patients and the introduction of more complicated treatment regimens. These medications must be handled and used by pediatric nurses with great cautions due to their toxicity. **Purpose:** To evaluate the effect of safety standards guidelines on nurses' performance regarding safe handling of chemotherapy, drugs for pediatric patients. **Design:** A quasi-experimental design (pre, post and follow-up test) was used. **Setting:** The study was performed at the Oncology Department at Specialized Pediatric Hospital in Benha City. **Sample:** A convenience sample of 50 nurses who were working in the selected setting. **Instruments** Three instruments were used: (a) Structured Interviewing Questionnaire Sheet, (b) Observational checklist for nurses' practice regarding safe handling of antineoplastic drugs and (c) Nurses attitude regarding safe handling of antineoplastic drugs. **Results:** Nurses who had competent performance related to safe handling of antineoplastic drugs on pre, post and follow up were 14%, 99% and 91% respectively. **Conclusion:** safety standards guidelines significantly improved nurses' knowledge, practice, and attitudes regarding safe handling of antineoplastic drugs for pediatric patient. **Recommendation:** Periodic in-service training programs are required for oncology pediatric nurses to increase their knowledge and competency.

Keywords: *Nurses' performance, safe handling of chemotherapy drugs, safety standards guidelines*

Introduction

Childhood cancer is the main cause of disease-related fatalities in children and adolescents (ages 0–19) in the US and other developed nations.

According to, World Health Organization (WHO), over 400,000 children and adolescents (0–19 years old) are diagnosed with cancer, and

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children die from the disease every three minutes and chemotherapy agent is the most common treatment cancer for children and teenagers (World Health Organization, 2023).

According to Fathi et al. (2021), thirty percent of all cancer cases occur in children under the age of fifteen. Additionally, a child's survival rate at three years old is 85%, and at five years old, is 81%. Most children admitted to pediatric oncology units require chemotherapy agent to save their lives. Despite the benefits these drugs, it is associated with many adverse events, such as teratogenic, mutagenic, and carcinogenic to humans (Ferlay et al., 2022).

Chemotherapy agents are also known as cytotoxic drugs (CDs), anti-neoplastic drugs (ADs), and oncology medications. ADs are medications intended to inhibit the proliferation of cancerous cells. Alkylating compounds, antimetabolites, hormones, antibiotics, and mitotic inhibitors are among these medications. ADs are currently made and used to treat immunologic and rheumatologic conditions as well as cancer (Hosen et al. 2019).

These medications all have unique pharmacological characteristics that prevent cell division. Unfortunately, because of their nonselective mode of action, they affect both healthy and cancerous cells, which can have a negative impact on patients' health as well as the health of healthcare professionals who deal with them on a regular basis (Oncology Nursing Society, 2018).

The use of ADs for illnesses other than cancer, high-dose chemotherapy, and a combination of more complicated treatment plans, along with the increased incidence of cancer, would raise the danger of exposure to these medications for healthcare professionals (Hosen et al., 2019).

According to recent research, 17% of nurses who work in cancer wards may have inhaled or come into contact with these medications via their skin or eyes. Additionally, managing ADs during pregnancy may expose nurses to many reproductive consequences, such as, spontaneous abortion, miscarriage, or fetal loss, infertility, and premature births (Wiley, 2017).

Additionally, a Brazilian study found that (75.75%) of nursing officers exposed to chemotherapy chemicals experienced audiometric notch, (56.25%) complained of vertigo, and (100%) of them displayed altered caloric test results (Mishra, & hawana, 2021). According to a large-scale randomized controlled trial (RCT) involving approximately 56,000 registered nurses in Canada, their health was at risk due to an elevated risk of developing cancer in the breast and rectum following occupational exposure to cytostatic agents (Ratner et al., 2020 and Koulounti et al., 2019).

Many medical professionals handle these medications in violation of prescribed guidelines, even though doing so carries risk. Some nurses believe that they are not individually sensitive to the related health concerns, even when they are aware of ADs exposure and safe handling

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requirements. For example, "I have been doing this for years without wearing a gown and I am fine," or "I am past my childbearing years. A nurse may decide, for instance, to skip wearing a gown intended for chemotherapy rather than a lab coat. If a lab coat is worn instead of a disposable gown, there may be a risk of cross-contamination in locations where coworkers spend time. Ignoring safety precautions can injure individuals as well as anyone nearby (Friese, 2020).

As a result, international organizations such as the National Institute for Occupational Safety and Health (NIOSH), the American Society of Hospital Pharmacists (ASHP), and the Oncology Nursing Society (ONS) have recommended safety standards guidelines to prevent and minimize occupational accidents among healthcare workers. These guidelines help healthcare workers understand the basic practices and precautions needed to prevent patient harm, minimize exposure to personnel, and minimize contamination of the work and patient-care environments (Devi & Sharma, 2019).

Although these guidelines are available, Egyptian nurses are not adhering to safety standards as much as they should, which highlights the need to accept the guidelines and incorporate them into oncology unit training (Zayed, et al., 2019). This is why the purpose of this research was to assess how safety standards guidelines affected nurses' ability to safely handle chemotherapy medications for pediatric patients.

Significance of the study:

Chronic AD exposure can cause damage to the liver, kidneys, lungs, heart, and reproductive system. In addition, malignancy, mucosal ulcers, and bone marrow suppression could occur. Adverse health consequences from occupational exposure to ADs and following safe handling rules are not widely documented in developing countries (Rai et al., 2021). Additionally, a study was conducted in Alexandria, Egypt, found that nurses and clinical pharmacists exposed to ADs reported a greater rate of oral ulcers (36.36%) and impaired fertility (31%) than the non-exposed group (3.8 and 7.4%, respectively). Additionally, compared to the non-exposed group ($7307 \pm 2001.4/\mu\text{l}$ and 0.51 ± 0.12 mg/dl, respectively), the ADs-exposed group had a considerably lower mean white blood cell count ($6518 \pm 2064.79/\mu\text{l}$) and a significantly higher mean creatinine level (056 ± 0.13 mg/dl). Additionally, poor controls were also observed, with the main ones being a lack of medical surveillance (100%), a lack of training (69.1%), inadequate handling procedures, and a low utilization of personal protective equipment, especially among nurses (Elshaer, 2017).

Most hospital managers, clinical pharmacists, and nurses themselves have not taken the possibility of harmful health effects from occupational exposure to ADs seriously. This can be explained by a lack of crucial knowledge about the scope of the issue. Furthermore, there has been no assessment of the

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application of safety precautions and exposure control techniques. The purpose of the current study was to evaluate the potential adverse health effects associated with occupational exposure to ADs and assess adherence to exposure control methods.

Purpose of the study:

The purpose of the current study was to evaluate the effect of safety standards guidelines on improving nurses' performance regarding safe handling of chemotherapy drugs for pediatric patients.

Research Hypotheses:

- 1) Nurses who receive safety standards guidelines are expected to exhibit higher levels of knowledge regarding safe handling of chemotherapy drugs for pediatric patients. Posttest than on pretest.
- 2) Nurses who receive safety standards guidelines are expected to exhibit higher levels of practice regarding safe handling of chemotherapy drugs for pediatric patients. posttest than on pretest.
- 3) Nurses who receive safety standards guidelines are expected to exhibit more positive attitudes towards safe handling of posttest than on pretest.

Operational definitions:

- Safety Standards Guidelines: are principles of drug preparation, drug absorption methods, antineoplastic drug adverse reactions (ADRs), how to use personal protective equipment correctly and measures in case of work-related exposure to antineoplastic medications and

proper disposal of waste. It will be assessed using part 2 (Nurses' knowledge about safe handling of antineoplastic drugs based on safety standards guidelines) in instrument one.

- Nurses' performance regarding safe handling of chemotherapy drugs: They are nurses administration of cytotoxic substances, arrangement and transportation of equipment and medications, labeling chemotherapy, preparation of biosafe cabinet, safe administration of antineoplastic drugs, utilization of personal protective, use of a plastic backing absorbent pad, withdrawing cytotoxic medications and administration of cytotoxic drugs. It will be assessed using observational checklist for nurses' practice regarding safe handling of antineoplastic drugs based on safety standards guidelines (instrument two).

Methods

Research design:

The study was conducted using quasi-experimental design that included pre, post and follow-up tests.

Research settings:

The study was conducted at Oncology Department in Specialized Pediatric Hospital in Benha City, which is affiliated to Egyptian Ministry of Health and Population. It is located on the 4th floor and contained 8 beds.

Research Sample:

A convenience sample of all available nurses (50 nurses) who were providing direct care and handling of

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chemotherapy drugs for pediatric patients regardless of their characteristics at the previously mentioned setting.

Instruments:

Three instruments were utilized to collect the data, and achieve the purpose of the study:

Instrument one: A structured Interviewing Questionnaire Sheet.

It was developed by the researchers and included two parts:

- **Part 1:** characteristics of studied nurses. It involved nurse's age, gender, educational level, years of experience and attending training courses regarding safe handling of antineoplastic drugs.
- **Part 2:** Nurses' knowledge about safe handling of antineoplastic drugs based on safety standards guidelines. The researchers edliteratures (Alehashem and Baniasadi, 2018) to assess nurses' knowledge concerning antineoplastic drugs and their safe handling. It consisted of 37 closed ended questions including proper principles of drug preparation, drug absorption methods, antineoplastic drug adverse reactions (ADRs), how to use personal protective equipment correctly, measures in case of work-related exposure to antineoplastic medications and proper disposal of waste.

Scoring system

One point was provided for each correct answer and zero for incorrect. The total level of knowledge was good,

if the level of knowledge was $\geq 80\%$. and scores range from 29 - 37 points), If level of knowledge was $60 < 80$ and scores were between 28 to 22 points, level of knowledge was considered average If the level of knowledge was $< 60\%$ and scores ranged from 0 to 21 points nurses were considered to have poor knowledge.

Instruments two: Observational checklist for nurses' practice regarding safe handling of antineoplastic drugs based on safety standards guidelines.

It was adopted from Alehashem and Baniasadi, (2018). It included 42 items and was divided into four parts:

- **Part 1:** Nurses performance in relation to safe preparation of antineoplastic drugs. It included 18 items including routes of administration of cytotoxic substances, arrangement of medications, transportation of medications, and preparation of drugs in a biosafety cabinet.....etc.
- **Part 2:** Nurses performance regarding safe administration of antineoplastic drugs. It included 14 items including personal protective equipment (PPE), such as shoe covers, gowns, and gloves. Use a plastic backing absorbent pad for preparation. Withdrawal of cytotoxic medications using a positive or negative pressure technique, external surface of syringe is wiped with alcohol swab after cytotoxic drug

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withdrawal and administering the cytotoxic drug using the correct technique.... etc.

- **Part 3:** Nurses performance regarding safe leakage of antineoplastic drugs. It included 4 items as while preparing and administering medications, a spill-kit is readily available, documented the spillage check list...etc.
- **Part 4:** Nurses performance regarding safe transport and waste disposal of antineoplastic drugs. It included 6 items including washing hands both before and after the procedure, discarding gloves and gowns, breaking glass fragments or vials into the proper chemo waste receptacle, and disposing of cytotoxic waste material in a yellow bagetc.

Scoring system:

According to the actual nurses' practices, every step had two levels, done was given (1) and not done was given (0). Their total level of practice was divided as competent level ($\geq 85\%$) with score ranged from (35-42) points and incompetent level ($< 85\%$) with score ranged from (0- < 35) points.

Instrument three: Nurses' attitude regarding safe handling of antineoplastic drugs based on safety standards guidelines.

It was adopted from Zayed, et al., (2019). It contained 8 items such as handling antineoplastic drugs safely ensures that I am not in danger; using

personal protective equipment (PPE) when handling antineoplastic drugs is crucial; handling antineoplastic drugs while experiencing work overload is unacceptable, adverse health effects of antineoplastic drugs exposure are worrying.... etc. Every item is rated on a three-point scale ranging from 2 (agree), 1 (uncertain) and 0 (disagree). Total scores of items were (0 - 16) scores. It has been graded as; positive attitude: $\geq 75\%$ (above or equal 12 degrees) and negative attitude: $< 75\%$ (below 12 degrees).

Reliability

The reliability of tools was applied to establish the extent to which categories in the questionnaire were correlated to one another by Cronbach's co-efficiency alpha. The estimated reliability of instruments one, two, and three was 0.87, 0.89, 0.66, and 0.57 consequently. As a result, it is possible to conclude that the instrument is highly reliable.

Validity

To evaluate the face and content validity of the study instruments, the researchers submitted it to five experts (four pediatric nursing professors and one professor in pediatric medicine) to assure the validity of content. The scale content index average (S-CVI/AVE) was used to evaluate the content validity. The lower limit of acceptability for S-CVI/AVE was 0.80. The experts' opinions showed that the items on the scales correlated well with each other. Then data was gathered using the final form. This phase lasted

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for one month from the beginning to the end of June 2023.

Ethical considerations

Approval of the Ethical Research Committee in the Faculty of Nursing, Banha University was obtained (2023/7/9) prior data collection. A formal written consent was obtained from all studied nurses. The nature of the study and its expected findings were explained to studied nurses in clear and simple clarification. Nurses were guaranteed that all information gathered was anonymous and used only for research. Also, they were informed that every study participant had the ability to discontinue participation at any time.

Pilot study

In order to assess the research feasibility, objectivity, clarity, and applicability of the study instruments as well as to estimate the time required for data collection, a pilot study on 10% (5 nurses) of total sample size was conducted. The pilot study sample has been included into the present study sample because there were no significant modifications.

Procedure:

A letter was submitted from the Dean of the Faculty of Nursing, Benha University to the director of Benha specialized pediatric hospital and the head of the oncology department containing purpose of the study and methods of data collection.

The study was carried out over A period of six months started at the beginning of July 2023, and lasted

until the end of December 2023, covering a period of four months for safety standards guidelines intervention then two months for follow up. to achieve the purpose of the study.

Nurses were divided into 5 groups, each group contained 10 nurses. The researchers warmly welcomed nurses Purpose of the study and methods of data collection were explained for each nurse. Then, each nurse was interviewed for about 10 to 15 minutes to fill out the knowledge questionnaire sheet by rotation two days per week (Tuesday and Thursday) during the morning shift from 9 am to 1 pm. Also, each nurse was observed during handling of antineoplastic drugs using observation checklist (instrument 2), the time required for each observation was ranged 20 to 30 minutes. The safety standards guidelines for nurses were designed by the researchers according to the nurse's needs. It was constructed, revised and modified based on relevant literature to empower nurses' knowledge, practice and attitude regarding safe handling of chemotherapy drugs based on safety standers guidelines.

To explain safety standards guidelines, nurses were divided into 4 groups, each group contained 10 -11 nurses. Each nurse received 7 sessions, 4 sessions for the theoretical part and 3 sessions for the practical part. Theoretical session lasted for nearly 20 minutes and practical session lasted for 40 minutes, Sessions were conducted two days/week in the morning shift.

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Theoretical Sessions: Session one was about safety standards guidelines, second session was about handling and preparation of antineoplastic medications, substantial conditions for drug preparation, equipment for drug preparation. Session three storage and transfer of antineoplastic. Session four leaking of antineoplastic drugs, leakage kit, appropriate actions in case of leakage.

Practical sessions: It is concerned with safety standards guidelines practices regarding antineoplastic drugs for pediatric patients in terms of preparation, management wasting disposal, and storage.

Different teaching methods were used such as modified lecture, brainstorming, demonstration, re-demonstration, and group discussion. Appropriate teaching media were included such as handouts beside audio-visual aids, role play, and real equipment to help proper insight of the content by nurses to achieve the objectives and contents of the educational guidelines.

Posttest was conducted one week later using the same pretest instruments to evaluate the effect of training safety standards guidelines on nurses' performance regarding safe handling of chemotherapy drugs for pediatric patients immediately after implementation, this phase lasted for two weeks.

Follow-up test was conducted two months later using the same pretest instruments for the same purposes.

Statistical analysis

Using an electronic computer and the SPSS version 20 statistical tool, the gathered data were arranged, tabulated, and analyzed. Descriptive statistics were used such as frequency and distribution for qualitative data, mean and standard deviation for quantitative data. Moreover, the chi square test was used in analytical statistics to compare categorical data between groups (X² value). Pearson's correlation coefficient test was also applied. In all results, a P value of less than 0.05 was recognized as statistically significant (*), a P value of less than 0.01 was highly statistically significant, and a P value of greater than 0.001 was very highly statistically significant (**).

Results:

Table 1 illustrates that, more than one third of studied nurses (36.0%) were in age group 19 < 30 and the means of their age was 29.825±8.995 year. While, more than half of them (58.0%) are female. Regarding educational level, more than one third of nurses (40.0 %) had technical nursing institute. In relation to years of experience, more than one third of studied nurses (38.0%) had 5 < 10 years on oncology unit. Also, less than two thirds of studied nurses (64.0 %) not attended any training about safe handling of antineoplastic drugs.

Table 2 demonstrates that mean knowledge of the studied nurses about proper principles of drug preparation is (2.250± 4.632) pre intervention which increases to (5.945± 2.121) in post intervention and (4.945± 2.021) 2

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months follow up intervention. It also demonstrates that, average knowledge of the studied nurses about precautions to be taken in the event of workplace exposure to anti-cancer medications and proper disposal of waste is (2.887 ± 0.875) in pre intervention which increase to (6.125 ± 1.745) post intervention and (5.125 ± 1.345) 2 months follow up intervention. Moreover, there was a highly statistically significant difference ($p < 0.001$) in studied nurses pre, post and follow up intervention.

Figure 1 clarifies, more than half of the studied nurses (57.0%) had poor level of knowledge regarding safe handling of antineoplastic drugs pre intervention. Meanwhile, most of them (95.0%) had a good level of knowledge post implementation of safety standers guidelines. While the majority of them (90.0%) had a good level of knowledge 2 months follow up intervention. Therefore, there were highly statistical significance difference ($P < 0.000$) between nurses' total level of knowledge regarding safe handling of antineoplastic drugs pre intervention compared to post and follow up intervention.

Table 3 clarifies that, mean practice of the studied nurses about drug preparation (before administration), is (4.800 ± 2.819) pre intervention, while mean practice is (17.653 ± 4.77) in post intervention and (16.55 ± 4.57) 2 months follow up intervention.

It also shows that, mean practice about drug administration is (7.600 ± 3.751) in studied nurses pre intervention, while mean practice is (20.52 ± 2.82) in post intervention and (19.04 ± 2.62) 2

months follow up intervention. Moreover, there was a highly statistically significant difference ($p < 0.001$) in study group pre, post and follow up intervention.

Figure 2 shows that almost the majority of the nurses studied (86.0%) had an incompetent level of practice regarding safe handling of antineoplastic drugs in the pretest. Meanwhile, nearly whole of them (96.0%) had competent level of regarding safe handling of antineoplastic drugs in the posttest. While the majority of them (91.0%) had competent level of regarding safe handling of antineoplastic drugs 2 months follow up intervention. Therefore, there were highly statistical significance difference ($P < 0.000$) between nurses' total level of practice regarding safe handling of antineoplastic drugs on pre intervention compared to post and follow up intervention.

Figure 3 clarifies that, nearly the majority of the studied nurses (87.0%) had negative attitude regarding safe handling of antineoplastic drugs on pretest. While, nearly whole (93.0%) of them have positive attitude regarding safe handling of antineoplastic drugs posttest. And the majority of the studied nurses (89.0%) had positive attitude regarding safe handling of antineoplastic drugs 2 months follow up intervention. Therefore, there were highly statistical significance difference ($P < 0.000$) between nurses' total level of attitude regarding safe handling of antineoplastic drugs in pre intervention

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compared to post and follow up intervention.

Table 4 shows that there was a positive correlation between nurse's total scores of knowledge, practice and attitude following the implementation of the safety standers guidelines

compared to pre intervention. As a result, statistically significant variance existed in nurses' knowledge, attitudes, and practices at 1% level of statistical significance on pre, post and follow up tests.

Table (1): Percentage distribution of studied nurses according to their characteristics (n=50)

Items	Studied nurses. n=50	
	N	%
Age/years		
19 < 30	18	36.0
30 <40	17	34.0
40 ≤ 50	15	30.0
Mean± SD	29.825±8.995	
Gender		
Male	21	42.0
Female	29	58.0
Educational level		
Bachelor	17	34.0
Technical nursing institute	20	40.0
Diploma	13	26.0
Years of experience		
< 5	14	28.0
5 < 10	19	38.0
≥ 10	17	34.0
Mean± SD	6.450±3.4932	
Attended training courses related to antineoplastic drugs		
Yes	18	36.0
No	32	64.0

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Table (2): Mean scores of nurses' knowledge about antineoplastic drugs safe handling on pre, post and follow up intervention (n=50)

Knowledge	Pre-intervention	Post-intervention	Follow up Intervention	T-test Test of Sig. (P1)	T-test Test of Sig. (P2)	T-test Test of Sig. (P3)
	X ± SD	X ± SD	X ± SD			
Proper principles of drug preparation	2.250± 4.632	5.945± 2.121	4.945± 2.021	t =11.793 P=0.000**	t =10.793 P=0.000**	t=2.762 P=0.108 ^{NS}
Ways of drug absorption	2.175±3.872	4.761±1.500	3.761±1.100	t =9.854 P=0.000**	t =8.793 P=0.000**	t=2.365 P=0.218 ^{NS}
ADRs of antineoplastic drugs,	1.545±4.889	6.125±2.745	5.125±2.345	t =10.762 P=0.000**	t =9.845 P=0.000**	t =3.241 P=0.114 ^{NS}
Correct method of using personal protective equipment	1.275±4.882	5.984±2.400	4.984±2.100	t =12.254 P=0.000**	t =11.142 P=0.000**	t =1.662 P=0.123 ^{NS}
Measures in case of occupational exposure to antineoplastic drugs and waste disposal	2.887±0.875	6.125±1.745	5.125±1.345	t=13.734 P=0.000**	t =12.345 P=0.000**	t=4.562 P=0.233 ^{NS}

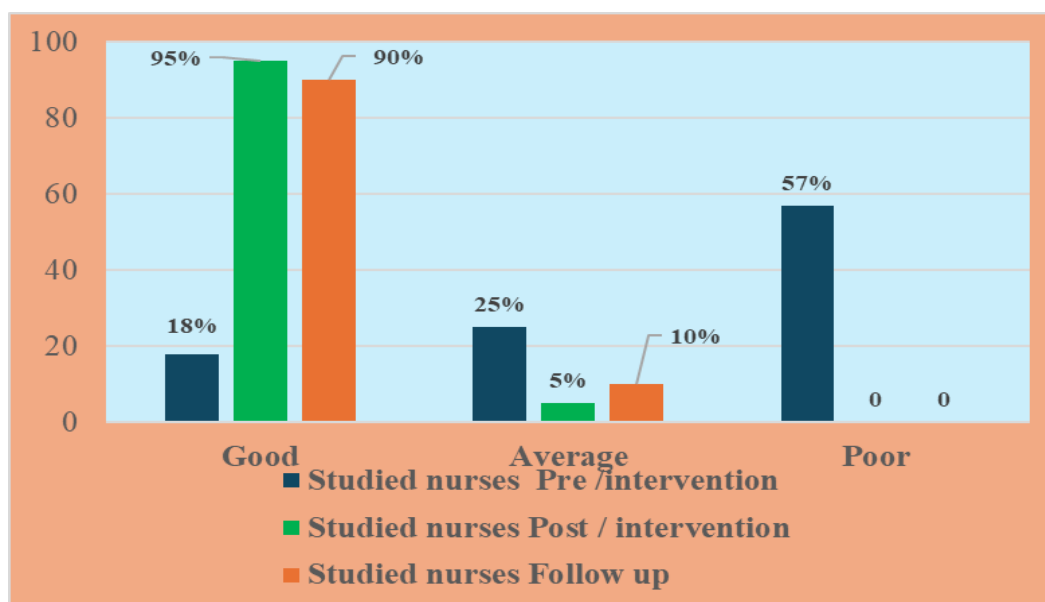
t= Pared test P= P-value NS= No significance at P>0.05 ** Very highly statistical significance difference (P<0.000)

P (1) P value for comparing between pre and post intervention

P (2) P value for comparing between pre and follow up intervention

P (3) P value for comparing between post and follow up intervention

Figure (1): Percentage distribution of the studied nurses according to their total level of knowledge regarding safe handling of antineoplastic drugs pre, post and follow up intervention (n=50)



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Table (3): Mean scores of nurses' safe handling practices of antineoplastic drugs on pre, post and follow up intervention (n=50)

Practice	Pre-intervention	Post-intervention	Follow up intervention	T-test Test of Sig. (P1)	T-test Test of Sig. (P2)	T-test Test of Sig. (P3)
	X ± SD	X ± SD	X ± SD			
Drug preparation (before injection)	4.800 ±2.819	17.653 ±4.77	16.55 ±4.57	t =13.793 P=0.000**	t =12.793 P=0.000**	t=2.752 P=0.115 ^{NS}
Drug administration	7.600 ±3.751	20.52 ±2.82	19.04±2.62	t =16.79 P=0.000**	t =14.01 P=0.000**	t=2.765 P=0.108 ^{NS}
Drug leakage	4.871±2.739	12.423±2.504	11.45±2.42	t =10.762 P=0.000**	t =9.845 P=0.000**	t =3.241 P=0.124 ^{NS}
Waste disposal performance	3.951±2.42	10.633±2.718	9.64±2.51	t =8.793 P=0.000**	t =7.793 P=0.000**	t=2.53 P=0.105 ^{NS}

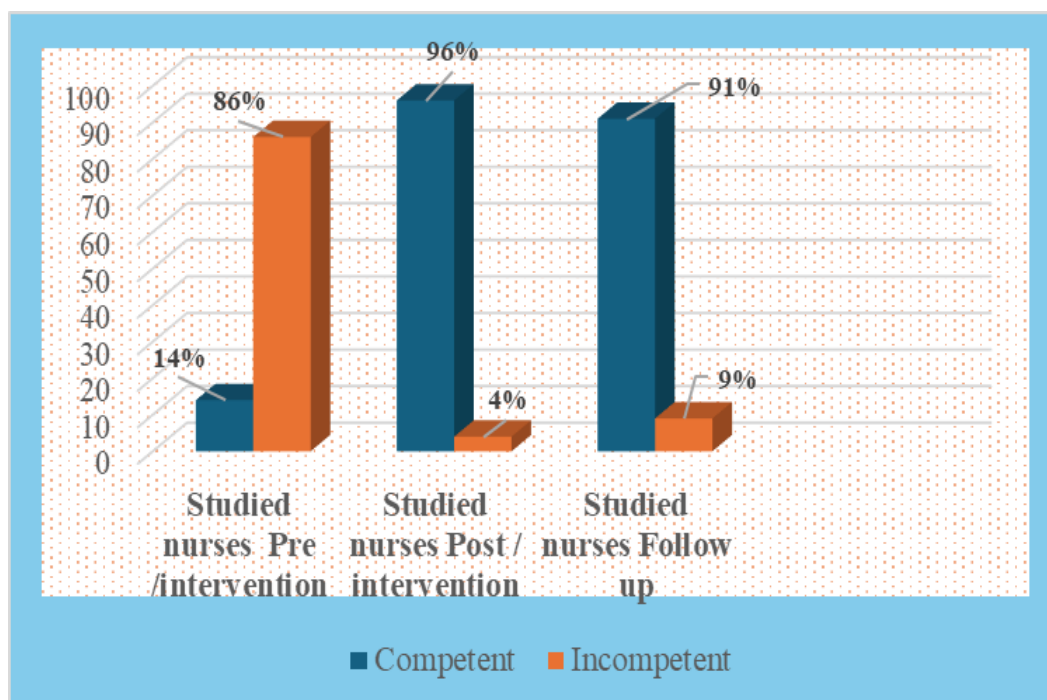
t= Paired test P= P-value NS= No significance at P>0.05 ** Very highly statistical significance difference (P<0.000)

P (1) P value for comparing between pre and post intervention

P (2) P value for comparing between pre and follow up intervention

P (3) P value for comparing between post and follow up intervention

Figure (2): Percentage distribution of the studied nurses according to their total level of practice regarding safe handling of antineoplastic drugs pre, post and follow up intervention (n=50)



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Figure (3): Percentage distribution of the studied nurses according to their total attitude regarding safe handling of ANPDs pre, post and follow up intervention (n=50)

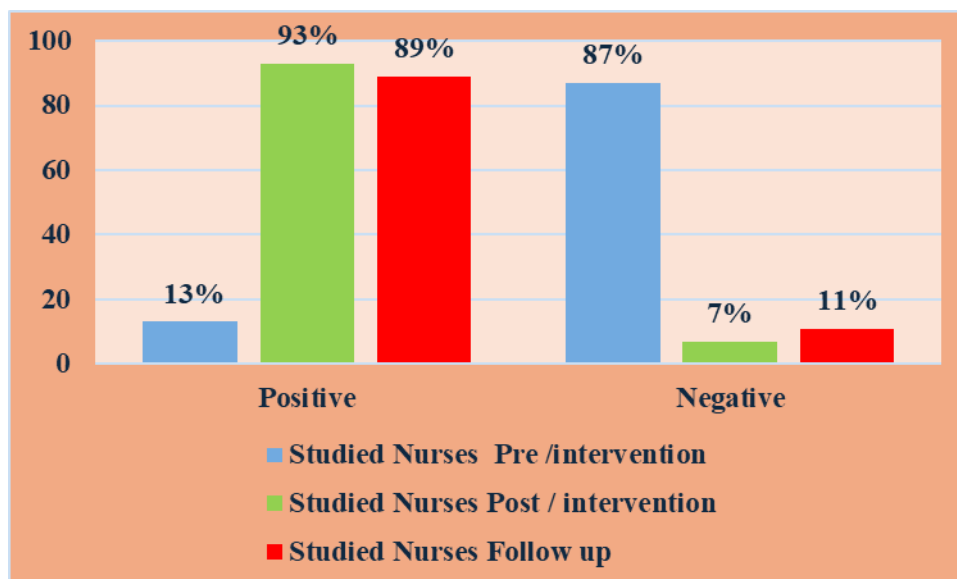


Table (4): - Correlation coefficient between total knowledge, total practice and total attitude of studied nurses (n=50)

Variables	Total knowledge score					
	Studied nurses					
	Pre /intervention		Post / intervention		Follow up intervention	
	R	P	R	P	R	P
Total practice score	0.511	0.000**	0.845	0.000**	0.732	0.000**
Total attitude score	0.453	0.000**	0.724	0.000**	0.624	0.000**

** Very highly statistical significance difference (P<0.000)

Discussion

Cytotoxic or chemotherapy drugs (CDs) impede the proliferation of healthy and sick cells and have hazardous side effects for the children who take them and the healthcare professionals who handle them at various stages, including preparation, administration, transportation, spill cleanup, and disposing of waste. To ensure their personal safety as well as

the protection of their patients, nurses require specialized knowledge, abilities, and attitudes because they are the healthcare professionals most subjected to the hazardous effects of these medications (Gazal et al., 2021). Therefore, the purpose of the current study was to evaluate the effect of safety standards guidelines on empowering nurses' in safely handling

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chemotherapy drugs for pediatric patients.

Regarding mean scores of nurses' knowledge about safe handling of antineoplastic medications before and after guidelines intervention, the result of the existing study illustrated that a highly statistically significant variation was observed in the mean scores of nurses' knowledge pre / post guidelines intervention ($p < 0.001$). The mean knowledge score increased significantly pre / post guidelines intervention ($p < 0.001$).

These findings were consistent with those of Hojati et al. (2023), who discovered a significant difference ($P < 0.001$) between the mean score changes in nurses' knowledge. (pre and posttest)

Based on the total level of knowledge about antineoplastic drugs in children pre/ post training safety standards guidelines intervention, the outcome of the current study indicated the knowledge of over half of the nurses in the study was poor regarding antineoplastic drugs pre-guidelines. However, in post guidelines most of them had a good level of knowledge.

From the perspective of the researchers This may be related to the fact that all nurses were eager to learn for the reason that the majority of them claimed that they did not receive training programs on the proper handling of cytotoxic medications despite using these medications for ten years or more. Also, the nurses said that there was no procedural book or instructions were accessible at the oncology facility to help them handle such medications.

This result aligns with Crickman and Finnell., (2019) who discovered the knowledge of all the nurses on the ward was boosted by a 30-minute online educational video about enhancing treatment approaches and lowering antineoplastic medication exposure.

The current study's findings demonstrated that there was a considerably significant difference in the total level of knowledge among nurses regarding antineoplastic drugs in the studied nurses pre compared to post guidelines. According to the researchers, the effectiveness of the safety standard guidelines is responsible for the increase in nurses' knowledge that followed the intervention and training sessions as a beneficial instrument for improving oncology nurses' understanding about cytotoxic medications.

The result was in accordance with Bolbol et al., (2016) who discovered that the nurses' level of understanding regarding cytotoxic medications was inadequate prior to intervention, owing to a lack of cytotoxic drug handling training courses. However, there was a highly significant enhancement in studied nurses' understanding of cytotoxic medications after intervention. Similarly, the current study concurred with Mahdy et al., (2017) They demonstrated that the mean score of all knowledge linked to the safe handling of cytotoxic medicines before and after safety guidelines intervention differed significantly (highly statistically).

The current study's findings made clear that, regarding the mean scores of

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nurses' safe handling practices of antineoplastic medications mean practice score increased significantly in post intervention compared to pre intervention ($p < 0.001$).

According to the researchers, this could be attributable to a lack of understanding about the dangers of cytotoxic medications and protective actions that be able to limit the danger of exposure to these treatments. Regrettably, a deficiency in awareness among nurses leads to unsafe activities, as well as incorrect procedures and handling during drug preparation.

The mentioned results are congruent with the findings of Elshamy et al., (2020) who claimed that releasing air from syringes containing CDs was a common dangerous nursing activity. Furthermore, Shrestha, (2022) stated that study nurses did not wear gloves, gowns, or other personal protective equipment when cleaning up spills or handling patient waste.

Accordingly, the total level of the nurses studied practice about antineoplastic drugs in children improved post training on safety standards guidelines, the current study's findings demonstrated that, nearly the majority of the nurses in the study had incompetent practice level regarding antineoplastic drugs in the study group pre-guidelines. While, nearly whole of them had competent practice level in the study group post guidelines.

According to the researchers, this might be because they started to be aware of the dangers connected to cytotoxic medications and their precautions. These results aligned with

Khan et al., (2020) Who stated that prior to the installation of teaching sessions, the majority of nurses performed poorly when it came to chemotherapy. However, when the teaching sessions were implemented, the nurse's knowledge and abilities improved.

Concerning the total practice level of the nurses under study, the present study's findings demonstrated a very statistically significant difference between the total practice level on pre and post intervention.

From the researchers' perspectives This might be as a result of the instruction which demonstrated the proper handling and safe disposal of cytotoxic medications. Moreover, oncology nurses' desire to repeat the procedures throughout the sessions can shield them from the negative effects of these medications and potentially save the patient's life. Providing nurses with guidelines, which included all the information required about cytotoxic medications, may also have contributed to the improvement in nurses' practices, as these guidelines were created and developed in accordance with the nurses' learning needs.

These findings agreed with Keat et al., (2019) who stated that the average score for all ward procedures rose from 7.6 to 15.3 out of 20.0, a twofold increase. Following the interventions, all of the characteristics that were examined showed a considerable improvement. Similarly with Al-Attar & Al-Gannem., (2019) who attested to the beneficial effects of training on nurses' performance. Additionally with

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Mishra & Bhawana., (2021) who showed how much the nurse's performance has improved with regard to the safe use of antineoplastic medications due to the use of PowerPoint and discussion approaches. As regards to nurses' total attitude regarding handling of antineoplastic drugs in children pre/ post intervention, the outcome of the current study clarified that, nearly the majority of the studied nurses had negative attitude about handling of antineoplastic drugs in the study group pre- intervention. While, nearly whole of them had positive attitude concerning handling of antineoplastic medications in post intervention. According to the researchers, this might be the case because the nurses wish to reduce or prevent any adverse effects or complaints they may already be experiencing as a result of using these medications.

This finding was consistent with Mahdy et al., (2017) who found that there was a highly statistically significant difference in the mean scores of nurses' attitudes toward the safe handling of cytotoxic medicines before and after the safety guidelines intervention. similarly with Taghizadeh Kermani et al., (2019) who illustrated that providing nurses with a 30-hour training program comprising lectures and practice sessions covering the fundamentals of oncology nursing can enhance their attitudes.

According to nurses' total attitude regarding handling of antineoplastic drugs in children pre/ post training safety standards guidelines intervention, the outcome of the

existing study Therefore, there were extremely significant statistical difference between the total attitude of nurses regarding handling of antineoplastic drugs in pre compared to post guidelines ($P < 0.000$).

This result was in accordance with Hojati et al., (2023) who discovered a significant difference ($P < 0.001$) between the mean score changes in the attitudes of nurses with time. The mean score of attitudes during the pre-intervention and post-intervention periods showed a substantial rise ($P < 0.001$). In similar lines, a study conducted in Malaysia by Keat et al. (2019) found that following a nine-month chemist-based intervention that included a series of technical, educational, and administrative support measures like administering antineoplastic drugs in a closed system, training workshops, training courses, and instruction updates, nurses' attitudes toward the safe use of antineoplastic drugs had significantly changed.

On the other hand, this result is conflicted with Chaudhary and Karn, (2022) who stated that none of the nurses were utilizing the four protective equipment required while handling cytotoxic drugs, and that no discernible variations were discovered in the frequency of dangerous behaviors in the working environment regarding cytotoxic drugs.

Regarding Correlation coefficient between total (knowledge, practice, and attitude) of nurses, the result of the study showed that, there is the total knowledge, total practice, and total attitude scores of nurses are positively

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correlated in pre / post guidelines ($P < 0.001$). This The results were consistent with Zayed et al., (2019) who found that there was a strong correlation between attitude and knowledge concerning careful handling of cytotoxic medications. Also, agreed with Alehashem and Baniasadi., (2018) They discovered a significant correlation between the knowledge, attitude, and practice scores in the various areas.

Conclusion:

On the basis of the existing study's results, it can be noticed that training safety standards guidelines significantly strengthened nurses' knowledge, practices and attitude regarding antineoplastic drugs in children.

Recommendations:

- Training sessions based on safety standards guidelines about chemotherapy must be conducted to nurses who work in oncology centers.
- To guide nurses in handling antineoplastic medications safely, the cancer center should include handbooks with instructions on nursing guidelines, protocols, and safe handling practices.
- Regular in-service training programs specialized in antineoplastic drugs administration are required to increase the knowledge and competency of nurses is required.

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