Acta Biomed 2023; Vol. 94, N. 3: e2023732 DOI: 10.23750/abm.v94i3.13457

Online Versus Traditional Educational Program on Oncology Nurses' knowledge and Practice

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Abstract. Introduction: Direct exposure to cytotoxic agents and safe handling of chemotherapy drugs (CDs) have raised a high concern among oncology nurses due to their potential health risks that can occur during preparation, administration, and waste management of these drugs. Objectives: The main aim of the study was to evaluate the effectiveness of online educational program versus traditional educational program on oncology nurses' chemotherapy safe handling. Method: Quiz experimental study was carried out at oncology Center and medical oncology departments that affiliated to Ain Shams University Hospital, Cairo, Egypt, from June 1, 2021 – January 30, 2022. The program and instruments were developed by the researcher for the purpose of the study. A convenient sample comprised of (80) oncology nurses was divided into two groups, online group consisted of (40) nurses and traditional group consisted of (40) nurses. The measurement of effectiveness of nursing educational program through the nurses' knowledge questionnaire included (48) multiple choice questions and observational checklist included (107) items of oncology nurse's practices which included 3 main domains; preparation& handling, administration of chemotherapy and disposal of chemotherapy drugs waste. Results: The study findings indicated that there were highly significant differences between the two studied groups in overall main domains related to nurse s' knowledge and practice pre-post implementation of traditional and online educational methods ($p < 0.001$), and the online educational program method had more effective on improving the oncology nurses' knowledge and practice than traditional program method ($p < 0.001$). Conclusion: The study concluded that the effectiveness of online educational program regarding nurses' knowledge and practices concerning chemotherapy safe handling is more successful than traditional education program.

Keywords:
Oncology nurses, traditional educational program, online educational program, knowledge, practice.

Introduction

Chemotherapeutic drugs (CDs) are the most widespread worldwide modality used in cancer treatment, and other autoimmune diseases (Yarbro et al., 2018). These drugs are administered systemically and work by disrupting the cell cycle and killing rapidly dividing cells. Therefore, CD cannot distinguish between cancerous and non-cancer cells and tends to cause gross damage, increasing treatment complications (Nettina, 2019).

The prevalence of these agents has increased exposure to CD among oncology nurses working in oncology departments. Exposure to chemotherapy drugs can cause acute and chronic health effects, including skin rashes, adverse reproductive effects (including infertility, miscarriage, and birth defects), and the potential for different cancers. (Olsen et al., 2019). Exposure to chemotherapy drugs can occur through inhalation, skin contact, ingestion, or injection. Improper hygiene behaviors such as eating, drinking, smoking at preparation or in preparation area administration, and disposal of chemotherapeutic drugs are inappropriate behaviors that increase the risk of exposure (El shamy, 2015).

The oncology nurse is a key person in the care of cancer patients, and the oncology nurses with specialized knowledge and skills play a major role in ensuring safe various stages during handling (i.e., transport, unpacking, storage, handling, administration, and disposal) and care of patients receiving chemotherapeutic drugs (Goodin, 2018). Little negligence or mistake may lead to adverse unpleasant effects for patients, staff and environment, there is a need to provide specialized knowledge and training to oncology nurses who providing care to patients receiving chemotherapy regarding safe handling of chemotherapeutic drugs in order to ensure safety for both patients' life and for their own safety of the workplace (Mohmed, 2015).

Nurses play an important role in improving health standards. Therefore, you should always keep your theoretical and practical knowledge up to date in this area. In fact, on-the-job training helps staff update their knowledge and skills and improve best practices for

performing various tasks and responsibilities (Chaghari, et al., 2017). Because of these requirements, implementation of comprehensive educational programs and regular monitoring of nursing competencies by each facility is critical (Al-Attar, 2015).

Educating oncology nurses requires innovative approaches as the difficulties in both providing and accessing face-to-face training become increasingly apparent, the power and scope of the internet now offer real possibilities to address some of the challenges faced by educators, oncology is indeed a challenging subject matter not only for any oncology nurse's trainee, but also for the educator, the online education programs may overcome some of the difficulties seen with traditional learning programs by allowing flexibility in time, place, and pace, for the clinically working trainee and educator (Degerfält et al., 2017).

The nursing is embracing online learning as a viable alternative to traditional learning environments. Several factors, such as shift work fatigue, low motivation, lack of backup staff, and interruptions due to continuing education programs during work time, make online learning a cost-effective and effective solution. The e-learning program is well suited to solve the problem of oncology nurses being unable to attend traditional courses due to shift schedules. (Bahrambeygi, et al., 2018).

Therefore, measuring the level of practice and utilization of knowledge source for implementation of education program among oncology nurses is critical to improving the quality of care across the region. Furthermore, online and face-to-face health training programs clearly facilitate the integration of appropriate knowledge into the practice of all health professionals, including nurses. Because a high-performance approach not only means better patient care, but it means big changes in health care on an economic and professional level (Tolera & Hui, 2017).

Aim

The current study aimed to evaluate the effect of online educational program versus traditional educational program on oncology nurses' knowledge and practice.

Research hypothesis

The implementation of online educational program will improve knowledge and practice of oncology nurses' more than traditional educational program.

Research Design

This study used quasi-experimental research with pre-test post-test design.

Setting

The study was carried out at oncology center and medical oncology departments that affiliated to Ain Shams University Hospital, Cairo, Egypt. Collected from June 1, 2021 – January 30, 2022.

Subjects

The study included a convenient sample of all available during the data collection period (80 oncology nurses), and had a minimum of one year of experience working at the previously mentioned setting at Ain Shams University Hospital, and providing direct care to oncology patient divided into two groups (traditional program group and online group who should have access to the internet, enough internet literacy as receive e-mail messages). Data collection tools researchers utilized two tools to conduct the present study.

Tool I: Assessment Questionnaire sheet (pre and post-test) The researcher designed this tool to assess oncology nurses' knowledge in caring that provide for oncology patients with chemotherapy drugs, and it was used a pre- and post-implementation of the education program based on recent literatures review Lynn, (2017); Berman, Snyder, & Frandsen, (2016); Alehashem, & Baniasadi, (2018); Hinkle, (2017). It was developed in simple English and included the following components:

Part 1: Demographic data sheet: This part concerned with personal information include, the oncology nurses (gender, age, marital status, educational level, years of experience in oncology units, Chemotherapy courses attendance, Type of chemotherapy course attended, Computer skills classification).

Part 2: Nurse's knowledge: The measurement of effectiveness of nursing educational program through the oncology nurse s' knowledge questionnaire included (48) multiple choice questions concerning chemotherapy precautions. The questionnaire which included different options questions have been formed to take the list is based on the system of right and wrong those answers were converted statistically to take code (1) for the correct answer and code (0) for the wrong answer. Nurses' total knowledge scores were calculated and classified as either satisfactory (85% or more) or unsatisfactory (less than 85%).

The online group were given pre & posttest of nurses' knowledge at the same time that be given to the traditional group.

Tool II: Oncology Nurses' Observational Checklist.

It used to assess oncology nurses' practice level regarding caring of oncology patients undergoing chemotherapy drugs, and it was developed by: Canadian Association of Nurses in Oncology/Association Canadienne des infirmières en oncology (CANO/ACIO), (2011). Observational checklist of oncology nurse's practices includes 108 steps which were divided into 5 parts as following:

Part 1 was used to assess oncology nurses' practices regarding safe handling practices during preparation of Cancer Chemotherapy / Cytotoxic Drugs; 14 step).

Part 2 was used to assess oncology nurses' practices regarding safe handling practices & Disposal of Hazardous;51 steps.

Part 3 was used to assess oncology nurses' practices regarding safe handling practices during Intravenous IV Administration of Cancer Chemotherapy / Cytotoxic Drugs via Intermittent Piggyback Infusion in a Peripheral Vein; 14 steps.

Part 4 was used to assess oncology nurses' practices regarding safe handling practices during infusion via central Venus accesses devices (CVAD) ;16 steps.

Part 5 was used to assess oncology nurses' practices regarding safe handling practices during IV Direct Administration of Cancer Chemotherapy/Cytotoxic Drugs via Peripheral Vein Checklist;13 steps.

The responses for the 108 practice steps were either by done correctly or done incorrectly. One grade was given for each correct step and zero for each incorrect or not done step. The total scores for the observation checklist were (108 grades). The total scores for every subgroup were calculated, and then the total score of the entire checklist was calculated for every oncology nurse. Then the mean of the total score for all nurses was calculated. The total score for oncology nurses' skills was then calculated. Scores below 85% were considered unsatisfactory, while scores of 85% or higher were considered satisfactory.

Method

Administrative process:

The research included three stages: preparation, implementation, and evaluation.

The preparation stage included:

- The researcher developed tools I and II the English language.
- The researcher designed an education program for oncology nurses.

Ethical considerations:

The research approval was obtained from the faculty of nursing research ethics committee before initiating the study. The researcher clarified the purpose and aim of the study to oncology nurses included in the study. Oral consent was obtained from oncology nurses to ensure willingness to engage in the study. The researcher-maintained anonymity and confidentiality of subjects' data. Oncology nurses were informed that they are allowed to withdraw from the study at any time without penalty.

The validity:

These questionnaires were reviewed by a panel of 7 experts; (5) medical surgical nursing experts at faculty of nursing, Ain Shams University and (2) medical consultants of the Oncology Departments at Ain Shams University Hospitals in order to evaluate its face and content validity. The experts reviewed the tools for its content, clarity, simplicity, relevance, comprehensiveness, and appropriateness. Following their assessment, the final versions of the tools and program were released.

A pilot study was carried out on 10% of oncology nurses to test the applicability of the study and to test clarity of the designed questionnaires, as well as to estimate the time needed for each tool. The modifications were done for the used tools then the final form was developed. Oncology nurses of the pilot study were excluded in the study's subjects. The reliability of the purposed data collecting tools was done by alpha Cronbach test which was 0.85 for the knowledge and 0.83 for the practice tool.

Assessment (pre-education program)

Meeting and discussion were held by the researcher and oncology' nurses to let them be aware of the aims, the nature of education program, as well as to get better cooperation during implementation phase of the program. Assessment of nurse's knowledge, practical and skills were made for this assessment to shed light and give more insight about the current nurse's knowledge and practice, as it is based on the results obtained from questionnaire and the observational checklist, as well as, literature review.

The education program was developed by the researcher; detected needs, requirement, deficiencies were translated to aim and objectives of the program. Moreover, teaching materials were prepared (e.g. lectures, discussion, demonstration and redemonstration, real object, PowerPoint presentation, booklet that helped in covering theoretical practical information).

Implementation stage:

Data collection and application of the education program lasted over a period of eight months, started from beginning of June 2021 to end of January 2022. Data was collected for both traditional and online group five days/week in the morning and afternoon shifts. Meeting and discussion were held by the researcher and oncology nurses to let them be aware of the aims, the nature of education program, as well as to get better cooperation during this phase of the program.

For online group; all participants had access to the internet, enough internet literacy as receive e-mail messages. For traditional group; the total number of groups was 8 groups. The educational program for traditional group of oncology nurses were in a free time of working shifts, started from 9 am to 2 pm, which was modified sometimes according to nurses' time free. The educational program hours were 5 hours per day per week. The total numbers of sessions were (10) sessions with same content for both traditional and online group divided as follow: 4 sessions for theoretical part and 6 sessions for practical part.

Evaluation stage:

The evaluation phase was done to determine the effect of this education program by comparing the results of pre & post implementation of program by using the same data collection tools which were done to online and tradition group of oncology nurses.

Statistical analysis

Computerized and statistical analysis of data were done by using the Statistical Package for the Social Sciences (SPSS) version 25.0. Descriptive statistics (frequency, percentage, mean and standard deviation) were used for the data presentation. Paired t-test was used to determine the difference. Reliability of the study tools was done using Cronbach's Alpha test.

Results:

The following tables are included in this study:

Table 1. Demographic characteristics of the studied nurses (N=80).

Variables	**Traditional group** (n=40)		**Online group** (n=40)	
	Mean ± SD		Mean ± SD	
Age:	25±0.22		25±0.26	
	N	%	N	%
Sex:				
Male	8	20%	10	25%
Female	32	80%	30	75%
Educational level:				
Diploma degree	6	15%	4	10%
Bachelor degree	33	82.5%	34	85%
Master degree	1	2.5%	2	5%
Marital status				
Single	22	55%	24	60%
Married	18	45%	16	40%
Years of experience:				
< 5	22	55%	24	60%
5< 11	10	25%	12	30%
11< 15	6	15%	4	10%
≥ 15	2	5%	0	0%
Chemotherapy courses attendance:				
Yes	6	15%	5	12.5%
No	34	85%	35	87.5%
Type of chemotherapy course attended:				

Online	0	0%	0	0%
Offline	6	15%	5	12.5%
Computer skills classification:				
Basic skills	24	60%	26	65%
Good skills	10	25%	11	27.5%
Advance skills	3	7.5%	1	2.5%
No skills	3	7.5%	2	5%

N: number; SD: Standard Deviation.

Table 1: shows that, the demographic characteristics of the two studied groups; It reveals that the mean age of the traditional group and online group were 25±0.22 and 25±0.26 respectively, the majority of two groups were females and were bachelor degree. 55% of traditional group were singles and their experience were less than 5 years, and 60% of online group were singles and their experience were less than 5 years. Also, 85% of the traditional group and 87.5% of the online group had not attended any chemotherapy courses before. As well, no one of the traditional and online groups attended to any chemotherapy online course. Concerning computer skills classification, 60% of study traditional group and 65% of online group have basic skills. Finally, there were no statistically significant differences between two groups regarding their demographic characteristics.

Table (2): comparison between the traditional and online groups regarding their level of knowledge about chemotherapy safe handling pre/post and follow-up implementation of educational program.

Pre			Post			Follow up				
Online group Mean ± SD	**T-test**	**P-value**	**Traditional group Mean ± SD**	**Online group Mean ± SD**	**T-test**	**P-value**	**Traditional group Mean ± SD**	**Online group Mean ± SD**	**T-test**	**P-value**
3.8± 1.1	0.7	>0.05 NS	6.6± 0.71	8.4± 0.53	11.8	< 0.001** HS	6.0± 0.59	7.6± 0.53	5.97	< 0.001** HS
5.6± 2.1	0.8	>0.05 NS	9.7± 1.6	13.2 ±0.99	5.94	< 0.001** HS	8.3± 0.47	11.5 ±0.50	6.49	< 0.001** HS
2.2± 0.8	0.7	>0.05 NS	4.6± 0.9	5.7± 0.65	4.80	< 0.001** HS	3.8± 0.48	4.8± 0.67	7.98	< 0.001** HS
4.2± 0.79	1.0	>0.05 NS	8.5± 1.3	11.2 ±0.87	16.2	< 0.001** HS	8.00 ±1.73	9.6± 1.20	4.77	< 0.001** HS
2.9± 0.75	1.1	>0.05 NS	4.9± 0.78	6.7± 0.69	12.8	< 0.001** HS	4.3± 0.46	5.2± 0.67	14.75	< 0.001** HS
18.3 ±5.54	1.7	>0.05 NS	34.3 ±5.39	45.2 ±3.75	14.8	< 0.001** HS	30.4 ±3.73	38.7 ±3.57	15.93	< 0.001** HS
P> 0.05 not significant										**P < 0.001 highly statistically significant

		Traditional group	**Mean ± SD**
	Oncology nurses' knowledge		
	Principles of CDS safe handling		3.9± 1.2
	Instructions of chemotherapy PPE		5.4± 2.3
	Chemotherapy preparation		2.3± 0.7
	Chemotherapy administration		4.3± 0.86
	Chemotherapy waste management		2.8± 0.87
	Total		18.7 ±5.93

Table 2. displays that, there were highly statistically significant differences between two studied groups (tradition and online) regarding their level of knowledge about chemotherapy safe handling post implementation and follow up of traditional and online educational methods in relation to the all items at (P< 0.001). Where the mean of total pre, post and follow up scores of traditional / online program were (18.7±5.93 / 18.3±5.54), (34.3±5.39 / 45.2±3.75), (30.4±3.73 / 38.7±3.57), respectively.

Table (3): comparison significant between the traditional and online groups regarding their level of practice about chemotherapy safe handling pre/ post and follow-up implementation of the two teaching methods.

Pre		Post				Follow up			
T-test	**P-value**	**Traditional group**	**Online group**	**T-test**	**P-value**	**Traditional group**	**Online group**	**T-test**	**P-value**
		Mean ± SD	**Mean ± SD**			**Mean ± SD**	**Mean ± SD**		
1.3	>0.05 NS	11.7 ±1.6	13.2 ±1.1	10.3	< 0.001** HS	9.3± 1.3	12.5 ±1.8	11.3	< 0.001** HS
1.7	>0.05 NS	10.9 ±0.9	12.9 ±1.1	12.4	< 0.001** HS	10.1 ±0.78	11.1 ±1.1	10.4	< 0.001** HS
0.9	>0.05 NS	12.8 ±1.7	14.3 ±0.88	13.6	< 0.001** HS	10.2 ±1.78	12.4 ±0.88	13.6	< 0.001** HS
1.0	>0.05 NS	10.9 ±0.86	12.5 ±1.71	9.9	< 0.001** HS	8.9± 0.86	11.0 0±0.69	10.9	< 0.001** HS
1.9	>0.05 NS	46.3 ±5.06	52.9 ±4.79	17.9	< 0.001** HS	38.5 ±4.72	47± 4.47	12.8	< 0.001** HS
P> 0.05 not significant				**P < 0.001 highly statistically significant					

			Traditional group	Online group	
	Oncology nurses' practice		Mean ± SD	Mean ± SD	
		CDs Preparation	6.2± 0.73	6.3± 0.94	
		Intermittent Infusion of CDs Administration via Peripheral Vein	6.9± 0.59	7.1± 0.83	
		CDs Administration via central Venus accesses	7.8± 1.3	7.8± 1.2	
		Direct Infusion of CDs Administration via Peripheral Vein	6.3± 0.86	6.4± 0.79	
		Total	27.2 ±3.48	27.6 ±3.76	

Table 3. Shows that, there were highly statistically significant differences between the two studied groups (tradition and online) regarding their level of practice about chemotherapy safe handling post implementation and follow up of traditional and online educational methods in relation to the all items at (P< 0.001). Where the mean of total pre, post and follow up scores of traditional education program were 27.2±3.48, 46.3±5.06, 38.5±4.72, respectively. But the mean of total pre, post and follow up scores of online education program increased to 27.6±3.76, 52.9±4.79, 47±4.47, respectively in compared to tradition program.

Table (4): Oncology nurses' level of skills regarding the practice about safe handling & Disposal of chemotherapy between the traditional and online groups' pre /post and follow-up implementation of the two teaching methods.

Post				Follow up			
Traditional group Mean ± SD	Online group Mean ± SD	T-test	P-value	Traditional group Mean ± SD	Online group Mean ± SD	T-test	P-value
5.9± 0.85	6.5± 0.94	4.6	< 0.001** HS	5.0± 0.66	6.01 ±0.75	5.2	< 0.001** HS
16.6 ±0.78	19.0 ±1.1	34.2	< 0.001** HS	13.1 ±0.70	16.2 ±0.81	22.2	< 0.001** HS
9.1± 1.78	10.8 ±0.63	19.13	< 0.001** HS	7.8± 1.78	8.9± 0.63	16.1	< 0.001** HS
8.8± 0.66	11.5 ±0.51	5.19	< 0.001** HS	8.7± 0.61	9.8± 0.73	4.15	< 0.001** HS
40.4 ±4.07	47.8 ±3.18	8.7	< 0.001** HS	33.6 ±3.75	40.9 1±2.92	11.4	< 0.001** HS
P> 0.05 not significant			**P < 0.001 highly statistically significant				

	Pre	**P-value**		>0.05 NS	>0.05 NS	>0.05 NS	>0.05 NS	>0.05 NS	
		T-test		1.80	2.4	1.7	2.6	3.3	
		Online group	**Mean ± SD**	4.4± 0.82	10.4 ±1.1	6.5± 0.88	7.3± 0.69	28.6 ±3.49	
		Traditional group	**Mean ± SD**	4.2± 0.85	10.3 ±0.78	6.4± 1.78	7.3± 0.86	28.2 ±4.27	
	Oncology nurses' practice			**Preparation of equipment**	**principles of safe handling during drug administration:**	**principles of safe handling during disposal of CDs equipment**	**principles of safe handling during disposal of CDs body fluids**	**Total**	

Table 4. displays that, there were highly statistically significant differences between the two studied groups regarding their level of practice about chemotherapy safe handling and Disposal of chemotherapy post implementation and follow up of traditional and online educational methods in relation to the all items at (P< 0.001). Where the mean of total pre, post and follow up scores of traditional education program were 28.2±4.27, 40.4±4.07, 33.6±3.75, respectively. But the mean of total pre, post and follow up scores of online education program increased to 28.6±3.49, 47.8±3.18, 40.91±2.92, respectively in compared to tradition program.

Discussion

Chemotherapy drugs (CDs) result in interfere of the growth of both normal and abnormal cells, and lead to toxic side effects for patient who receiving these agents and health care provider who participated in different steps of handling chemotherapy such as preparation, administration, cleaning of spills and wastes management. Oncology nurses are the health care providers who most exposed to the toxic effects of these agents. Therefore, special knowledge and skills are required to ensure the safety of yourself and your patients. (Zayed HA et al.,2019). This study was carried out in order to determine the effect of online educational program versus traditional educational program on oncology nurses' knowledge and practice.

The present study revealed that, the mean age for traditional face-to-face education program group was 25±0.22, while the main age of online education program group was 25±0.26, with no statistically difference between them, also the majority sex of oncology nurses from two groups were female (80%,75%), respectively. As regard educational level, the majority of two groups had Bachelor degree (82.5%, 85%), respectively. This result in agreement with Asefa et al, 2021, who mentioned that the age of oncology nurses had between (22 to 26) about two thirds of total studied oncology nurses. Also, two thirds of them were female and the majority of them had Bachelor degree.

Related to the marital status, more than half of traditional and online education program group were single (55%, 60%), respectively. This finding is on the same line with what was reported by Devi Sarita et al., 2019, that about two third of the nursing personnel were single.

In related to Years of experience, more than half of traditional and online education program group had experience less than 5 years (55%,60%), respectively; also, the majority of two studied groups didn't attend any course related to Chemotherapy safe handling (85%,87.5%), respectively. These results go in agreement with Hosen MS et al., 2019, who found about half of studied oncology nurses had experience less than 5 years,

the majority of them did not obtain any course regarding chemotherapy agents handling.

Regarding type of chemotherapy course attendance, the present study showed that, all studied oncology nurses from two groups didn't attend any online chemotherapy course. This finding was correspondent with Mun and Hwang. 2020, who found that, the majority of nurses in experimental group and control group didn't have online chemotherapy learning experience.

As regards to computer skills classification of oncology nurses, the current study revealed that, more than half of traditional and online education program group had basic computer skills (60%,65%), respectively. This finding was consistent with Ahmad et al., 2018, in a review article who stated that, one of the barriers for Internet and online education was lack of advanced Information and communication technology (ICT) skills made the most nurses practice basic computer information-seeking skills.

Based on the findings of the present study, it was found that highly statistically significant difference between traditional and online methods at post-test related to nurse's knowledge (P< 0.001), where it was found that the mean knowledge score 34.3±5.39, 45.2±3.75, respectively. While the pretest responses for oncology nurse's knowledge were no significant differences 18.7±5.93, 18.3±5.54. This finding shows that the effectiveness of the education program on enhancing their knowledge regarding chemotherapy safe handling. Also, the study revealed that the online educational program method was more effective than traditional face to face method on improving the oncology nurses' knowledge is due to the online method of education is flexible mode that allow learning anytime and anywhere.

These findings are in agreement with Mahdy et al., 2017, who showed that there was highly statistically significant difference between mean score of the total knowledge related chemotherapy safe handling pre and post intervention. The results are also supported by Bahrambeygi, et al., 2018, who stated that the e-learning program is more effective for nurses to resolve the problems resulting from traditional courses.

Regarding oncology nurses' level of skills regarding chemotherapy safe handling practice, pre implementation of educational program, the present study findings showed that there was no statistically significant difference between two studied groups regarding their practice about chemotherapy safe handling in relation to chemotherapy preparation, administration and waste management of chemotherapy.

The deficiency in practice skills before program implementation might be related to lack of knowledge, education and training program about the topic, lack of in-service training provided from the healthcare organization and no guidelines or procedure book available to guide them in all stages of chemotherapy preparation, administration, and waste disposal.

The results are consistent by a research of Asefa et al., 2021, who stated that nearly 69% of oncology nurses reported the lack of training program on the handling of CDs during preparation, administration of chemotherapy and disposal of wastes of CDs at their workplaces and the use of Personal Protective Equipment (PPE) remains suboptimal as none used all of PPE.

Regarding oncology nurses' practice about chemotherapy safe handling, post implementation of educational program, the present study revealed that, there was highly statistically significant difference between the two studied groups (pre-post) implementation program in relation to safe handling chemotherapy during preparation, administration and waste management of Chemotherapy (P< 0.001). Also, our study revealed that the online educational program method was more effective than traditional face to face method on improving the oncology nurses' practice, and there was highly statistically significant difference between the two studied methods at post-test related to oncology nurse's practice (P< 0.001) (table3-4).

This improvement in total practices after implementation of program is due to effectiveness of training that done during the practical sessions which showed actually the correct way of dealing with and safe handling technique of chemotherapy. Additionally, reinforcement of the education knowledge about chemotherapy safe handling which designed and developed based on their learning needs and distributed to oncology nurses which contained all information needed about chemotherapy. Moreover, the desire of oncology nurses to practice the steps during these sessions to be able to protect themselves of having side effects from these drugs and to save their patient's life.

The results are consistent by a research study of Nouri et al., 2021, that there was a significant improvement of practice performance among the oncology nurses on antineoplastic drug handling after effective training course in all stages of drug preparation, drug administration, and waste disposal. This clearly demonstrated the positive effect of the intervention on the safe handling of antineoplastic drugs among oncology nurses, the results also reflected the nurses' tendency to improve practice on chemotherapy drugs for protecting themselves and their patients from the adverse reactions of these drugs.

In this respect, von Grünigen et al., 2021, reported the e-learning method was an effective means to address the lack of training and practice opportunities on the safe handling of chemotherapies for healthcare workers to

reducing occupational exposure and increasing patient safety in cancer care centers, and evaluation of (a pre-test and post-test study) for training module on the safe handling of chemotherapy drugs was effective by using e-learning lessons and showed significant improvements ($p<0.01$) for most lessons and a high degree of participant satisfaction.

Conclusion

Based on our findings, it can be concluded that the online educational program is more effective than traditional education program regarding nurses' knowledge and practices concerning chemotherapy safe handling. It is recommended that further experimental studies need to be conducted to establish the effectiveness of online education program on oncology nurses' performance.

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