

## RESEARCH ARTICLE

Editorial Process: Submission:05/17/2023 Acceptance:10/12/2023

# Impact of In-Service Training Program on Nurses' Performance for Minimizing Chemotherapy Extravasation

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## Abstract

**Objective:** The objective of this study was to evaluate the impact of an in-service training program on nurses' performance in minimizing chemotherapy extravasation. **Method:** Quasi-experimental (Pre /Posttest) research design was utilized to conduct this study. The study was conducted at the internal medical oncology departments at South Egypt Cancer Institute. A convenience sample was used to select all available nurses working in medical oncology departments (40) nurses. Data was collected by using a pre/post questionnaire sheet for nurses' knowledge, Pre/post observation checklist for nurses' practice, and an in-service nursing training program on nurses' knowledge and practice for minimizing chemotherapy extravasation. **Results:** The majority of nurses have attained any training program related to chemotherapy extravasation in their last 10 years of educational and professional training, There was a Positive correlation between nurses' knowledge scores pre and post-implementation of in-service training program with  $\pm$ SD mean  $23.77 \pm .97$  and with P. value  $<0.001^{**}$  There were highly statistical significant differences between total score checklist nurses' practice pre/ post implementation of in-service training program on nurses to minimize chemotherapy extravasation through mean  $234.97 \pm .15$  and Value  $< 0.001^{**}$ . **Conclusion:** The In-service training program had statistically significant improvement on totally nurses' knowledge and practice on minimizing chemotherapy extravasation.

**Keywords:** Chemotherapy- extravasation- In-service training program

*Asian Pac J Cancer Prev*, **24** (10), 3537-3542

## Introduction

Chemotherapeutic drugs are the most widely used modality for treating cancer. Over a hundred distinct chemotherapeutic agents are currently available. It is also referred to as antineoplastic, cytotoxic, or anticancer drugs or agents because it kills rapidly dividing cancer cells by interrupting the cell cycle (Abd El-Salaheen et al., 2022). Extravasation is one of the inadvertent complications of chemotherapy. It refers to the leaking of medicine from the blood outside the venous lumen, resulting in tissue damage. Pain, tingling or burning sensations, and edema around the intravenous injection site are the primary symptoms. Tissue necrosis can result from extravasation if it is not treated appropriately. Moreover, severe hurts caused by extravasation of chemotherapy often need surgical intervention such as debridement, reconstruction, or even amputation, thus resulting in elongated hospital stays and prolonged morbidity, and high costs (Gong et al., 2021). Oncology nurses must continue their education and training to ensure the safe administration of chemotherapy and emphasis the importance of being proactive rather

than reactive to side effects like extravasation. In order to develop a structured educational program to increase nurses' knowledge about extravasation; evaluation of their knowledge is the first step "Based on the results" the educational program content will be developed (Sharour, 2020) .

Nurses' performance referred to the actual conduct of activities to fulfill responsibilities in accordance with standards. It is an indication of what is done and how well it is done, as well as a focus on the nurses' overall behavior and the application of specialized knowledge and skills learned through training and practice integration (Ahmed et al., 2018).

Knowledge and professional skills of nurses are brought up to date and the best practices for carrying out various responsibilities are improved through in-service training. Nurses who actively participate in in-service training have a better chance of learning and growing professionally (Khan et al., 2018). In-service training program include a set of measures taken to empower nurses and increase their competence so that they can carry out their responsibilities more effectively. This is done to

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assist the organization in achieving its goals. In-service training improves the staff's occupational knowledge and professional skills, as well as the best practices for carrying out various responsibilities (Chaghari et al., 2017). The aim of this study was to evaluate the impact of implementing an in-service training program on nurses' performance for minimizing chemotherapy extravasation.

## Materials and Methods

### Study design

Quasi-experimental research design (Pre & post) test was utilized to fulfill the aim of this study.

### Setting

The study was conducted in female and male internal medical oncology departments at South Egypt Cancer Institute.

### Sample size

All available nurses who are willing to participate in the study, convenience sample 40 nurses are working in medical oncology departments, male and female with age group (18-60) years.

### Tools of this study

In this study, outcomes were evaluated using a questionnaire which was applied using interviews or filled by the subjects. They stated that the questionnaire included two parts:

#### Tool (I) Questionnaire sheet for Nurses' knowledge

Part (1) Demographic data for nurses; include 4 items as age, qualification, years of experience, and attained program related to chemotherapy extravasation.

Part (2) Pre/post assessment of nurses' Knowledge regarding chemotherapy extravasation; it was developed and collected by the researcher based on current national and international literature to assess nurses' level of knowledge pre and post-implementation of the in-service training program, which includes 14 questions; These questions are developed according to the content of the in-service training program.

#### Scoring system

The questionnaire sheet for nurses' knowledge contained 14 questions and the total score them were 50 scores; Two definitions (4 scores) each one had two scores for a complete answer, one score for incomplete, and zero for didn't know, eight enumerate questions each one had some points given one score for each correct answer, the half score for an incomplete answer and zero for didn't know and four questions (yes/ no) question one score for correct answer and zero for didn't know.

- Score less than 50% referred to a poor level of knowledge.
- Score from 50: 75% referred to the fair average level of knowledge.
- Score of more than 75% referred to a good level of knowledge.

#### Tool (II) Observation checklist for nurses

pre/ post observation checklist was applicable by the researcher to evaluate the nurses' practice before and immediately after the implementation of in-service training program. It was folded into 4 main items. Adopted from (Olsen et al., 2019; Yoost and Crawford, 2019).

A. General care (Hand washing); Alcohol swab included 2 items and Soap and water included 6 items.

B. Properly peripheral catheter insertion included 30 items.

C. Safe administration of chemotherapy (vesicant, irritant, bolus) via intravenous cannula IVC. It included 20 items.

D. Extravasation management standards, according to grades of extravasation (1 & 2) included 3 items for each, and grades (3 & 4) included 9 items for each.

Scoring system for nurse's practice; during training and implementing the previous procedure according to in-service training program the correct practice of each step was given two degrees, incorrectly done equal one degree, not done/ not applicable equal zero. The adequate level was estimated to be 80% and more while in adequate level was calculated from less than 80%.

Tool (III) In-Service training program on nurses' Performance for minimizing chemotherapy extravasation:

It was written in the Arabic language based on the appraisal of relevant literature and theoretical knowledge of various aspects of the study using books, articles, internet, periodicals, and magazines. It includes two parts: Theoretical part: included knowledge about chemotherapy (definition and uses) and chemotherapy extravasation (definition, risk factor, causes, signs and symptoms, grades, complications, prevention and management). Practical part: included nurses' practice as training on hand washing as general care, training on proper peripheral catheter insertion (intravenous cannulation), and training on the safe administration of anti-cancer drugs via intravenous cannula and extravasation management standards of chemotherapy extravasation.

#### Procedures

- The researcher introduced herself to the available nurses in the oncology units, explained the purpose of the study, and obtained their verbal consent to participate in the in-service training program from the head of the selected department (medical oncology units).

- After conducting a comprehensive literature review (including nursing textbooks, journals, and online resources) on chemotherapy extravasation and evaluating the specific nurses' knowledge and practice in this regard, the researcher was designing and tested the in-service training program.

#### Validity and reliability

Approval to conduct this study; an official letter was issued to the director of medical oncology departments at South Egypt Cancer Institute. Protection of human rights; the studied nurses were informed that their participation is totally voluntary and confidentiality and anonymity were assured. A panel of five experts assessed the tools' content validity in relation to the program. Reliability was tested

by using Cronbach's alpha test (0.89).

Pilot study derived from actual study sample (10%); the motivation behind this study was for 2 reasons: first, to make sure that the designated study tools are easy to use. Second, before using the designed tools, test their usefulness and resolve any issues that need to be addressed. The questionnaire sheet and checklist were changed so that the best-fitting final form could be created.

In order to gather the necessary information, the researcher interviewed the nurses in small groups. The researcher gives the questionnaire sheets to all nurses to assess their knowledge and skills pre-implementation of the in-service training program. Use tool I: The questionnaire sheet for Nurses' knowledge and tool II: The observation checklist for nurses. Schedule the in-service training session for both theory and practice, was a total of seven sessions repeated once for each group, four days/week. From the start of October to the end of December in 2022. Implement in-service training program using tool III: In-Service training program on nurses' Performance for minimizing chemotherapy extravasation; the researcher prepared the training place, teaching aids, and media (modified Arabic handouts, pictures, and videotapes). Each session usually started with a summary of what had been taught during the previous session and the objectives of the new session. The duration of the first three theoretical sessions is about 20- 30 minutes for each one and the duration of these last four practical sessions is about 30- 45 minutes for each. Practical sessions were training on the main procedure of the in-service training program; each nurse in the study obtains a copy of the in-service training program booklet. The end of each session makes for discussion and feedback.

#### *Theoretical & Practical sessions of in-service training program*

- First session; included knowledge about chemotherapy definition, uses, definition of chemotherapy extravasation, common causes, and different risk factors for chemotherapy extravasation. Second session; contained information about signs and symptoms, grades and expected complications of chemotherapy extravasation depending on the different modalities of intravenous chemotherapy drugs induce extravasation. Third session; including prevention, and management standard of chemotherapy extravasation. Fourth session; contained training on hand washing. Fifth session; training on proper peripheral catheter insertion. The sixth session; included training on the safe administration of (chemotherapy agents) via intravenous cannula. The seventh session; included extravasation management standards.

In estimating the outcome of the in-service training program immediately after the implementation of the program, an interview questionnaire and checklist sheet were carried out for both nurses' knowledge and practice using tool I: Questionnaire sheet for Nurses' knowledge and tool II: Observation checklist for nurses.

#### *Ethical Considerations*

The Faculty of Nursing's Ethical Committee

approved the research proposal and official approval and administration permission were obtained from the head of the selected department (medical oncology department). During the application of the research, there was no risk for the subjects of the study. The study adhered to standard clinical research ethical guidelines. After outlining the nature and purpose of the study, verbal consent was obtained from the nurses who were willing to participate. The subject data's confidentiality was guaranteed. They explained that nurses had the right to discontinue the study at any time and that participation was entirely up to them. During the data collection, anonymity was taken into consideration.

#### *Statistical design*

Data analysis was conducted using Statistical Package for the Social Sciences (SPSS) software program version 25. Data expressed as "mean  $\pm$  standard deviation" "number, percentage". Using T-test is used to decide the significance of numeric variables. The chi-square test is used to determine the significance of the non-parametric variable. The P-value was considered statistically significant when  $p < 0.05$ .

## **Results**

#### *Demographic data for nurses*

The majority of studied nurses' ages were 20 to less than 40 years old (87.5 %), more than half of studied nurses had an institute of nursing as regard to the level of education (60.0%) and the majority (75.0%) of nurses have attained any training program related chemotherapy

Table 1. Percentage Distribution of Demographic Data for Studied Nurses (n=40).

Variables	Frequency	
	n=40	%
Age		
18 > 20	2	5
20 > 40	35	87.5
40 $\geq$ 65	3	7.5
Education		
diploma nursing	9	22.5
institute nursing	24	60
university nursing	7	17.5
Years of experience		
less than one years	3	7.5
1 > 5	6	15
5 > 10	15	37.5
more 10 years	16	40
Attained training		
No	30	75
Yes	10	25
Benefits outcome of previous attaining program		
No	30	75
Yes	10	25

Table 2. Comparison between Nurses' Knowledge Pre/ Post Implementation of an In-Service Training Program on Nurses to Minimize Patients' Complications of Chemotherapy Extravasation (n=40).

Question	Answer	Pre program		Post program		P - value
		n	%	n	%	
Q1: Define of chemotherapy	Correct	34	85	40	100	0.01*
	Incomplete	6	15	-	-	
Q2: Uses of chemotherapy	Correct	23	57.5	40	100	0.001**
	Incomplete	17	42.5	-	-	
Q3: There is effect of chemotherapy when extravasated outer the vein	Yes	33	82.5	40	100	0.001**
	No	7	17.5	-	-	
Q4: What's meant by extravasation	Correct	24	60	40	100	0.001**
	Incomplete	16	40	-	-	
Q5: Patients risk factors related extravasation	Correct	5	12.5	40	100	0.001**
	Incomplete	35	87.5	-	-	
Q6: Medication risk factor related extravasation	Correct	3	7.5	40	100	0.001**
	Incomplete	37	92.5	-	-	
Q7: extravasation risk factors related cannula devise	Correct	6	15	40	100	0.001**
	Incomplete	34	85	-	-	
Q8: extravasation risk factors related to health care team	Correct	20	50	40	100	0.001**
	Incomplete	20	50	-	-	
Q9: Sign & Symptoms of Extravasation	Correct	4	10	40	100	0.001**
	Incomplete	36	90	-	-	
Q10: Nursing management of extravasation	Correct	-	-	40	100	0.001**
	Incomplete	40	100	-	-	
Q11: Complications of chemotherapy	Correct	4	10	40	100	0.001**
	Incomplete	36	90	-	-	
Q12: Is there recover from extravasation	No	4	10	-	-	0.058*
	Yes	36	90	40	100	
Q13: do you know grades of extravasation	No	25	62.5	-	-	0.001**
	Yes	15	37.5	40	100	
Q14: do you know nursing management related each grades	No	20	50	-	-	0.001**
	Yes	20	50	40	100	

Chi-square test\*\* significant difference at p. value<0.001- Independent T-test\*\*significant difference at p. value<0.001

extravasation in their last 10 years educational and professional training, Table (1) details the socio-economic and educational background of the studied nurses.

*Pre/post assessment nurses' Knowledge regarding chemotherapy extravasation*

There was a Positive correlation between nurses' knowledge scores pre and post-implementation of the in-service training program with  $\pm$ SD mean 23.77 $\pm$ .97 and with P. value <0.001\*\*, Table (2) details the nurses' Knowledge regarding chemotherapy extravasation pre/

post-implementation of an in-service training program on nurses to minimize chemotherapy extravasation.

*Pre/ post observation checklist for nurses*

There were highly statistical significant differences between total score checklist nurses' practice pre/ post implementation of in-service training program on nurses to minimize chemotherapy extravasation through mean 234.97 $\pm$ .15 and P.value < 0.001\*\*, Table (3) details the nurses' observation practice checklist for nurses.

Table 3. Percentage Distribution of Total Score Checklist Nurses' Practice Pre/Post-In-Service Training Program on Nurses to Minimize Chemotherapy Extravasation (n=40).

	Pre		Post		P-Value
	n	%	n	%	
Total observation checklist					
Inadequate (less than 75%)	40	100	0	0	0.001**
Adequate (more than 75 %)	0	0	40	100	
Total observation checklist mean $\pm$ SD	102.15 $\pm$ 16.55		234.97 $\pm$ .15		0.001**

Chi-square test\*\* significant difference at p. value<0.001- Independent T-test\*\*significant difference at p. value<0.001

Table 4. Comparison between Numbers and Percentage of Patient's Extravasation Sign Pre/Post-In-Service Training Program (n=150)

Patient's extravasation sign	Pre		Post		p-value 1	p-value 2
	N	%	N	%		
No extravasation sign	120	80	138	92	0.001**	
Extravasation sign	30	20	12	8		0.0001***

Chi-square test\*\* significant difference at p. value<0.001- Independent T-test\*\*significant difference at p. value<0.001; P-value (1), refers to a comparison between numbers and the percentage of no Patient's extravasation sign pre/post-in-service training program; P-value (2), refers to a comparison between numbers and percentage of Patient's extravasation sign pre/post-in-service training program.

#### *Comparison between incidence of patient's extravasation sign pre/ post implementation of in-service training program*

Represent that there were highly significant differences between numbers and percent of cases complain from extravasation pre/ post implementation of in- service training program. This study indicates that in general, 150 patients underwent different cycle of chemotherapy pre and post in-service training program; 20 % (30 patients) complain extravasation of chemotherapy. While post program extravasation incidence decreased to 8 % (12 patients), Table (4) details the Comparison between incidence of patient's extravasation sign pre/ post implementation of in-service training program.

## Discussion

In the present study, the researcher provides oncology nurses with a wealth of knowledge and the teaching and training skills necessary to prepare them to provide safe adjustments regarding the proper insertion of intravenous cannulation, the proper administration of vesicant, irritant chemotherapy infusion, and nursing management standards of extravasation based on the severity of its grades. These results are highlighting the importance of continuing education and in-service training in improving nurses' knowledge and strengthening their competencies.

Concerning with studied nurses' demographic characteristics the current study findings illustrate that the majority of studied nurses' ages were 20 to less than 40 years old, more than half of studied nurses had an institute of nursing as regard to the level of education and they didn't attain any training program related chemotherapy extravasation although most of them had experienced more 10 years in the oncology field.

These results are congruent with (El-Fadl NMA, 2020) who demonstrate that more than two-fifths of the studied nurses were within the age group of 20 <30 years, all of them were females, and the majority of them were married, less than two-thirds of the studied nurse had the technical institute of nursing. This finding may be due to a shortage in the number of baccalaureate nurses working in oncology units and three-quarters of them did not attend any training courses about chemotherapy.

The opinion of the researcher this finding might be due to the lack of a hospital in-service training department, a lack of training motivation, and an increased daily workload.

In the light of present findings of this study on medical oncology nurses at South Egypt Cancer Institute

show statistically significant differences in nurses' knowledge in all items pre/ post implementation of an in-service training program on nurses' performance for minimizing chemotherapy extravasation. This matched with (Abd Elfatah et al., 2022) who revealed that the level of knowledge for more than half of nurses before the implementation of the protocol of care was poor. Also match with (Hassan and Hasary, 2022) who noted that the critical factor in achieving effective prevention of chemotherapy-induced extravasation is consistent training and knowledge of all members of the health team regarding chemotherapy administration, which is accomplished through the provision of current institutional policies and practical training procedures.

In the present study, we strongly mentioned that there were statistically significant differences between nurses' practice in all items pre and post-implementation of an in-service training program on nurses' performance for minimizing chemotherapy extravasation, as regarding Properly Peripheral Catheter Insertion( intravenous cannulation), Safe administration of anti-cancer drugs via (intravenous cannula IVC) and extravasation management standards for different extravasation grades.

The current study was in harmony with (Rudolph and Larson, 2018) who studied ' ' Etiology and treatment of chemotherapeutic agent extravasation injuries' ' and found that there was a great improvement in the practice score levels obtained by nurses after the application of the designed nursing protocol, concerning measures of nurses in the event of extravasation and a small number of the nurses used prevention and management of extravasation compared to post and follow up test.

The current study represents that there were highly significant differences between numbers and percent of cases complaints from extravasation pre/ post implementation of the in-service training program. This study indicates that in general, 150 patients underwent a different cycle of chemotherapy; twenty percent (30 patients) complain of extravasation of chemotherapy pre-implementation of the in-service training program, while the incidence decreased to eight percent post-implementation of the program.

The present study's findings agreed with (9) who mentioned that the educational program had improved nurses' knowledge and performance, particularly in minimizing chemotherapy extravasation in his study entitled "Nursing management for prevention of peripheral chemotherapeutic extravasation"

In conclusion, the In-service training program had statistically significant improvement on totally

nurses' knowledge and practice on minimizing chemotherapy extravasation. Hence, highly qualified nurses should assess nurses knowledge and skills of chemotherapy administration, prevention, and management of chemotherapy extravasation continuously. Recommendation: Renewed chemotherapy courses and training for all staff nurses' especially new staff working in medical oncology to be licensed and responsible. Periodically in-service training programs should be implemented among oncology staff.

## Author Contribution Statement

All authors contributed equally in this study.

## Acknowledgements

The authors would like to express their sincere thanks to the institutions that provided organizational and scientific support throughout this academic project. In fact, the authors warmly thank and express their gratitude to all who helped in fulfilling any responsibilities toward this work especially; the nursing staff and patients in the medical oncology department at South Egypt Cancer Institute for their cooperation and positive responses.

## Conflicts of Interest

The authors declare no conflicts of interest.

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