

Assessment of Nurses Knowledge and Associated Factors Toward Prevention and Management of Cytotoxic Extravasation in Selected Public Hospitals Oncology Units, Addis Ababa, Ethiopia: A Cross Sectional Study

Girma Adugna*¹

Zelege Argaw²

Emebet Berhane²

¹Eka Kotabe General Hospital, Addis Ababa, Ethiopia

²Addis Ababa University Collage of Health Science, School of Nursing And Midwifery, Addis Ababa, Ethiopia

Abstract

Background: Cytotoxic extravasation is a major adverse effect than the combinations of sepsis, neutropenia, mucositis and gastrointestinal disorders. Pain, immobility, irreversible damage to nerves, tissues and tendons, skin grafting and loss of extremities are the significant morbidities secondary to extravasation.

Objective: The aim of this study was to assess nurse's knowledge and associated factors toward prevention and management of cytotoxic extravasation in selected public hospitals, Addis Ababa, Ethiopia, 2021.

Methods: A descriptive cross-sectional study design was conducted at Tikur Anbessa Specialized Hospital and Saint Paul Hospital Millennium Medical College that was purposely selected. A convenience sampling technique was employed for the selection of study participants. The data were collected by using a structured self-administered questionnaire. Data entry and cleaning were done by using Epi-Data version 4.6 and SPSS version 25. A logistic regression analysis technique was employed to evaluate the effect of independent variables on the dependent variable. Statistical significance was declared at $p \leq 0.05$. The data description is presented in the text, tables and graphic representation.

Result: A total of 124 nurses voluntarily participated in the study with a response rate of 93.2% and 58.1% were female nurses. The majority (45.2%) of study participants are from the age group of 20-29 years. The mean (\pm SD) age was 31.86 (\pm 5.987) years. A total of 34.7% of respondents had a good levels of knowledge to prevent and manage cytotoxic extravasation. Nurses who received training were 6.6 times more likely to have good knowledge of the prevention and management of cytotoxic extravasation; [AOR= 6.602 (2.705-16.109)].

Conclusion and recommendation: Generally 65.3% of study participants had poor knowledge of the prevention and management of cytotoxic extravasation. A high number (66.9%) of nurses' were not trained on cytotoxic extravasation. Supporting nurses working in cancer centers with continuous training programs to enhance their knowledge on extravasation should be a primary task.

Key words: Nurses, Cytotoxic extravasation, Knowledge, Prevention, Management.

Article Information

Article Type: Research Article

Article Number: IJCT-138

Received Date: 21 September, 2022

Accepted Date: 02 November, 2022

Published Date: 09 November, 2022

***Corresponding author:** Girma Adugna, Eka Kotabe General Hospital, PO Box: 1971, Addis Ababa, Ethiopia.

Citation: Adugna G, Argaw Z, Berhane E (2022) Assessment of Nurses Knowledge and Associated Factors Toward Prevention and Management of Cytotoxic Extravasation in Selected Public Hospitals Oncology Units, Addis Ababa, Ethiopia: A Cross Sectional Study. Int J Cancer Treat Vol: 5, Issu: 2 (09-15).

Copyright: © 2022 Adugna G et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Acronyms And Abbreviations

AAU: Addis Ababa University; BMI: Body Mass Index; BSc: Bachelor Of Science; CVAD: Central Venous Access Device; DM: Diabetes Mellitus; DMSO: Dimethyl Sulfoxide; ETB: Ethiopian Birr; IRB: Institutional Review Board; IV: Intravenous; MOH: Minster Of Health; MSc: Master Of Science; Na Cl: Sodium Chloride; PIV: Peripheral Intravenous; QOL: Quality Of Life; SP: State Of Sao Paulo; SPHMMC: Saint Paul Hospital Millennium Medical College; SPSS: Statistical Package For The Social Sciences; TASH: Tikur Anbessa Specialized Hospital; UK: United Kingdom; UN: United Nation; USA: United States Of America.

Introduction

When the physiology of healthy tissue and organs is interrupted by the invasion and spread of abnormal cells throughout the body cytotoxic agents are principal options for treatment [1]. Compounds that induce toxicity to the cells and inhibit cellular proliferation are termed cytotoxic. Exposure of both normal and abnormal cells to cytotoxic agents has different outcomes that range from minor adverse effects to cell death [2].

Cytotoxics are essential drugs used in health institutions for the management of a variety of cancer and noncancerous disorders. The word cytotoxic is used interchangeably with chemotherapy, antineoplastic and oncology drugs [3]. Cytotoxic is a major type of systemic cancer treatment that refers to one or more anti-cancer drugs/ chemotherapeutic agents [4]. Throughout the world more than one million intravenous infusions of cytotoxic is administered by nurses each day for the treatment of cancer disorders and administration of cytotoxic can result in various safety issues for nurses as well as for cancer patients [5]. As a result of the direct effect on cellular division cytotoxics cause many adverse effects on the tissue besides controlling cancer cells [4].

One of the adverse effects of cytotoxic administration is extravasation, defined as accidental or unintentional outflow of cytotoxic medication from blood vessels to the nearby tissues during intravenous administration. The extravasated cytotoxic medication had a toxic effect on nerves, tendons, and joints. If immediate management doesn't take place it has diverse consequences like local pain, skin grafting, surgical debridement, patients' distrust, increased the length of hospital stay & medical costs and surgical removal of extremities [6].

There are several factors for the occurrence of extravasation in addition to health care provider's issues such as lack of knowledge and training. The veins of patients who are treated with chemotherapy are fragile, mobile, and difficult to cannulate. Certain other factors like surgical removal of breast and lymph node dissection impair the flow of venous system that result for leakage and development of extravasation [6].

The symptoms of extravasation due to some cytotoxic drugs can take place immediately or lasts weeks to even months. Healing of impaired skin integrity secondary to cytotoxic extravasation is delayed in cancer patients as

a result of long time reaction and extensive deep ulcers formation. Extravasations of cytotoxic drugs through the central line is rare (0.24% of 815 patients). Preparation, administration, and post-treatment follow up of cytotoxic drugs is not only the duty of nurses because clinical symptoms are different, other professional disciplines should be participated in the prevention and management of extravasation [7,8].

Each day extravasation happens even with the availability of effective treatment options and different preventive mechanisms are in place. Physical intervention, pharmacological intervention and surgical intervention are among treatment modalities for extravasation depending on the amount of extravasated drug, health status of patient and time of treatment is started [9].

Inspecting blood backflow, aspirating remaining drug, marking the affected area, applying cold or hot compress, administering antidote and reporting incidence are major steps in the prevention and management of cytotoxic extravasation, However nurses knowledge about prevention and management of cytotoxic extravasation is little [10].

The primary objective of cytotoxic extravasation is prevention. Study findings in the city of Recife cancer hospital on 21 nurse's shows 85.7% of them had knowledge on how to prevent extravasation and 76.2% have correct information on signs and symptoms of extravasation. Depending on specific types of cytotoxic drugs 33.3 % of them use hot and cold compress when extravasation is occurred while 66.7% does not know when to apply cold or hot compresses after extravasation according to different class of cytotoxic drug and 90.5% had knowledge on topmost factors that predispose cancer patients to extravasation while 9.5 % are not knowledgeable. The finding indicates having knowledge on factors that contribute to extravasation is basic for quality improvement [11-21].

Cytotoxic Extravasation is a medical emergency that exposes cancer patients for serious disability, reduces quality of life (QOL) and puts nurses to the risk of unprofessional conduct claims. Nurses play a major role in providing care for cancer patients in addition to prevention and management of cytotoxic extravasation. Therefore it's essential to assess the care providers knowledge on how to prevent and manage the adverse effects associated with cytotoxic administration [4].

Methods and Materials

Study area and period

The study was conducted in two selected public hospitals in Addis Ababa, the capital city of Ethiopia. Addis Ababa is the largest city in Ethiopia, with an estimated population size of 4,793,699 on the estimated area of 527 square kilometers according to United Nations (UN) world urbanization prospects [22-31]. People from different regions of Ethiopia populate the city. There were 13 public hospitals among them Tikur Anbessa Specialized Hospital (TASH) and Saint Paul Hospital Millennium Medical College (SPHMMC) which provide multi-dimensional aspects of care to cancer patients

who need health care services for the entire country. Both hospitals provide teaching and clinical care services in oncology and other medical disciplines. The study was conducted from February 08/2021 - March 08/2021.

Study design

A quantitative descriptive cross-sectional study design was employed in this study.

Sample size determination

All nurses' (133) working in oncology departments were included in the study.

Sampling technique and procedure

From thirteen public hospitals; two public hospitals were selected using purposive sampling since they are health care service providers for cancer patients. Study participants from oncology units of both TASH and SPHMMC were selected by a convenience sampling technique.

Study variables

The dependent variables were knowledge of nurses about the prevention and management of cytotoxic extravasation. The independent variables were gender, age, professional level, total service year, training, health care facility-related factors and patient-related factors.

Operational definitions

Nurses in the study were asked 28 questions for the prevention and management of cytotoxic extravasation and were categorized as having good knowledge if they had a knowledge score above or equal to ≥ 23 points and poor knowledge if they scored below or equal to ≤ 22 points. Each respondent was awarded 1 point for the correct answer and 0 for the incorrect and I don't know answers [32].

Data collection tools and procedures

The questionnaire was adopted from related studies, and it was reliable with an acceptable Cronbach's alpha value of 0.83 [20]. The tool was revised by two experts (MSc in clinical oncology nurse). Data were collected by using a structured self-administered questionnaire.

Data processing and Analysis

The principal investigator assigned each questionnaire a unique code after data collection, and it was double-checked for completeness and consistency. Epi-data version 4.6 and SPSS version 25 were used to enter and clean the data. The strength and significance of an association between dependent and independent variables were calculated using odds ratios with a-95% confidence intervals. Logistic regression analysis was employed to evaluate the effect of independent variables on dependent variables. Those with a P value less than or equal to 0.05 were considered statistically significant.

Ethical considerations

Prior to data collection ethical clearance was obtained from the ethical committee of the department of nursing and midwifery, college of health sciences, school of nursing and midwifery of Addis Ababa University and institutional review board (IRB) of SPHMMC.

Results

Socio-demographic characteristics

A total of 124 study participants in selected public hospitals voluntarily participated in the study and the response rate was 93.2%. Among 124 nurses in the study, the majority of the respondents were female, 58.1% (n=72). Regarding age distribution this study showed that the majority [(45.2% (n=56)] of study participants were classified into the age group of 20-29 years. The minimum age of the respondents in the study was 24 years, and the maximum was 55 years, with a median age of 30 years. The mean (\pm SD) age was 31.86 (\pm 5.987) years. Regarding the professional level and specialty in oncology nursing, the majority of the respondents (86.3%) were BSc degree holders, and a lower percentage (12.9%) of respondents specialized in oncology nursing (Table 1).

Nurses' knowledge of cytotoxic extravasation prevention and management

According to this study, the percentage of correct answers was 26.6% regarding the statement that butterfly needles must not be used for cytotoxic infusion which increases the

Variables	Category	Frequency	Percent (%)
Gender	Female	72	58.1
	Male	52	41.9
Age in years	20-29	56	45.2
	30-39	53	42.7
	40-49	12	9.7
	≥ 50	3	2.4
Professional level	BSc	107	86.3
	MSc	17	13.7
Specialized in oncology nursing	Yes	16	12.9
	No	108	87.1
Years at work in oncology units	≤ 5 yrs	104	83.9
	6-10 yrs	17	13.7
	≥ 11 yrs	3	2.4
Training courses on cytotoxic Extravasation	Yes	41	33.1
	No	83	66.9

Table 1: Description of nurses' sociodemographic characteristics working in selected public hospitals oncology units, Addis Ababa, Ethiopia, 2021. (n= 124).

Variables	Correct	Incorrect
Phlebitis and infiltration around the puncture site is checked first.	113 (91.2%)	11 (8.8%)
Avoid cannulation over joints, inner wrist and the lower extremities.	104 (83.9%)	20 (16.1%)
Avoid cannulation where lymphedema is present.	96 (77.4%)	28 (22.6%)
Butterfly needles must not be used.	33 (26.6%)	91 (73.4%)
Flexible cannula is recommended.	101 (81.5%)	23 (18.5%)
CVAD should be used for long period infusion (12 -24 hrs)	68 (54.8%)	56 (45.2%)
Check for blood flow after cannulation and flush with 10 ml of normal saline.	115 (92.7%)	9 (7.3%)
Flushing with 10 - 20 ml of saline solution between different drug infusions is recommended.	103 (83%)	21(17%)
Flashback of blood should always be obtained before drugs are administered.	113 (91.1%)	11 (8.9%)
Frequent assessment of the insertion site for swelling, pain, redness and sluggish of infusion rate is recommended.	113 (91.1%)	11 (8.9%)
Double check by two nurses is needed for cannulation and drug dose calculation.	104 (83.9%)	9 (7.3%)

Table 2: Nurses' knowledge of cytotoxic extravasation prevention in selected public hospitals oncology units, Addis Ababa, Ethiopia, 2021. (N=124).

risk of extravasation. The majority (97.6%) of nurses in the study selected the correct answer for assessing the patient's condition prior to cytotoxic infusion (Table 2).

The majority (83.8%) of the study participants selected the correct answer toward the definition of cytotoxic extravasation. Regarding nurses' knowledge of the management of cytotoxic extravasation 68.6% of respondents correctly answered that the first step management of cytotoxic extravasation is to stop and disconnect the IV infusion tube immediately, but leave a secured cannula in place (Table 3).

The majority (65.3%) of respondents had a poor level of knowledge to prevent and manage cytotoxic extravasation. The minimum and maximum knowledge scores of the respondents are 7 and 28, respectively (Figure 1).

Factors associated with knowledge of nurses' toward prevention and management of cytotoxic extravasation

In this result training was a factor that was highly associated with nurses' knowledge of the prevention and management of cytotoxic extravasation; the results indicated that nurses who received training were 6.6 times more likely to have a good knowledge of the prevention and management of cytotoxic extravasation; [AOR= 6.602 (2.705-16.109)]. The results also indicated that nurses who specialized in oncology were 5.7 times more likely to have good knowledge of the prevention and management of cytotoxic extravasation; [AOR= 5.750 (1.770-18.681)] (Table 4).

Discussion

This study was undertaken to assess nurses' knowledge and associated factors for the prevention and management of cytotoxic extravasation in selected public hospitals in oncology units-in Addis Ababa, Ethiopia. Preventing the incidence of cytotoxic extravasation is cost effective than managing and this requires adequate knowledge. However, the findings of this study showed that nurses in the study had poor knowledge of the prevention and management of cytotoxic extravasation.

According to the findings of this study, the sociodemographic characteristics of the respondents were, male (41.9%). Similarly, the findings of a study conducted in

Baghdad city revealed that 42.2 % of the study participants were male [16]. However, it is quite different in the study of Brazil which states the dominance of females (90.4%) over males (9.6%) in the care of cancer patients. In another finding, 12.9% of the study participants in this study had a master's degree in oncology nursing which is higher than in the Brazilian study, which revealed that 9.5% of nurses had a master's degree in oncology nursing. This might be due to the difference in the sample size and study period between the countries [21].

In this study the overall percentage of nurses' knowledge of the prevention and management of cytotoxic extravasation was 34.7% and 65.3% of nurses had good and poor knowledge respectively, which is lower than the study conducted in Baghdad city Amal National Hospital, where 51.1% of nurses had a good level of knowledge and 48.9% had a poor level of knowledge. This might be due to the difference in the region and cancer treatment is also in the infant stage in Ethiopia [16].

Strength and Limitations

This study seeks to address a key, timely, and invisible health problem in the study setting. Since there are no similar studies in the study settings thus far, it provides information about the level of nurses' knowledge toward the prevention and management of cytotoxic extravasation. The research was conducted in a limited institution with a small sample size, which could restrict the study's generalizability. Nurses' knowledge was assessed only through the respondents' report.

Conclusion

In conclusion, the study summarizes the following:

This study showed that professional level, specialization in oncology nursing, service years, receiving cytotoxic extravasation training, patient related factors and health care facility-related factors are significantly associated with the knowledge of nurses toward the prevention and management of cytotoxic extravasation.

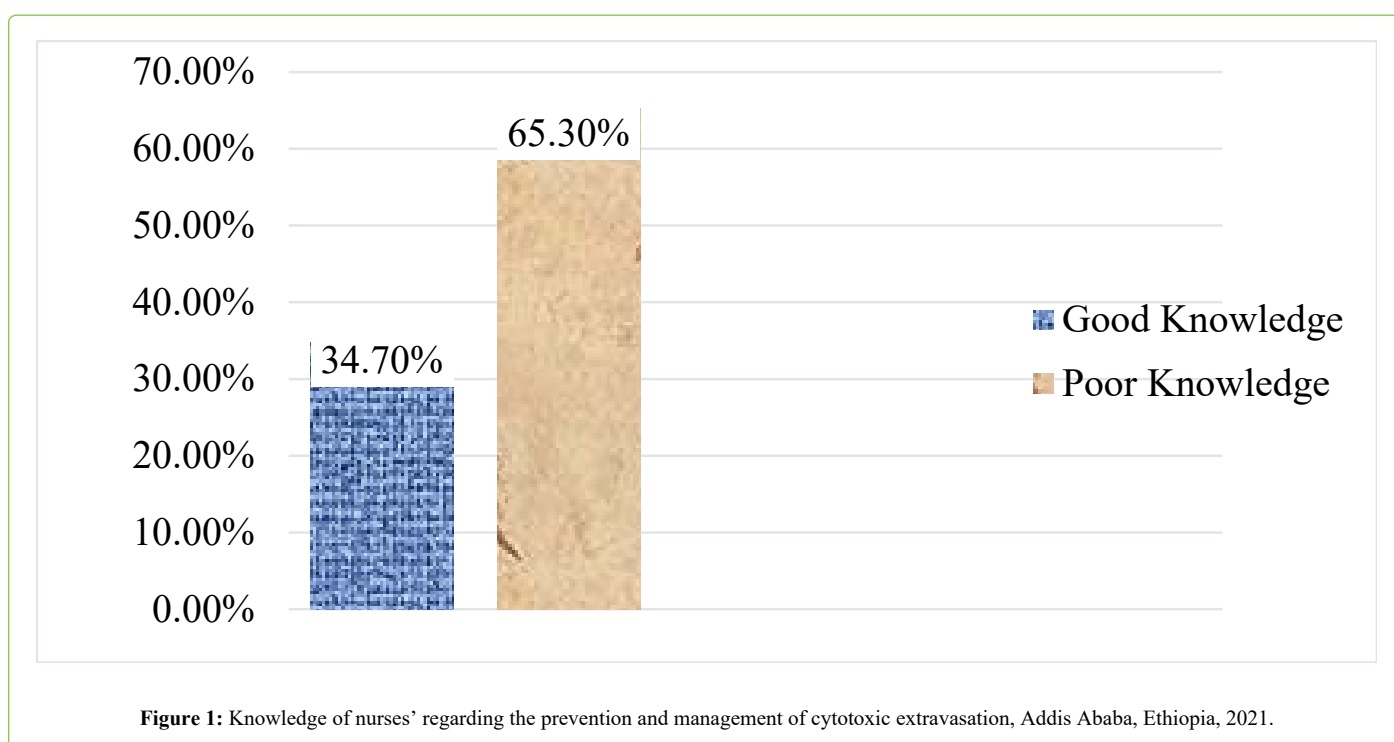
In general, knowledge about the prevention and management of cytotoxic extravasation is poor among study participants (83.1%), which exposes cancer patients to morbidities secondary to extravasation. The

Variables	Correct	Incorrect
Cytotoxic extravasation is infiltration of chemotherapy into sub dermal tissues surrounding the administration site.	104 (83.8%)	20 (16.2%)
Extravasation occurs when any liquid leaks into the surrounding tissue.	91 (73.3%)	33 (26.7%)
1 st step management is to stop and disconnect the infusion, but leave cannula in place.	85 (68.6%)	39 (31.4%)
Identify extravasated agents.	106 (85.4%)	18 (14.6%)
Aspirate extravasated solution with 10-20 ml syringe and record the volume.	76 (61.3%)	48 (38.7%)
Remove the cannula and mark the area.	109 (87.9%)	15 (12.1%)
Raise affected extremity over height of heart and administer analgesia as needed.	98 (79%)	26 (21%)
Avoid pressure application and alcohol compress at the affected area.	96 (77.5%)	28 (22.5%)
Pharmacologic treatments with or without hot or cold can be applied.	91 (73.4%)	33 (26.6%)
For daunorubicin, doxorubicin and epirubicin apply local cold for 1 hrs and repeat every 8 hours for three days.	61 (49.2%)	63 (50.8%)
For vinblastine, vincristine and vinorelbine apply dry heat for 30 minutes.	63 (50.8%)	61 (49.2%)
DMSO 50–99% is an antidote of extravasation.	43 (34.7%)	81 (65.3%)
Record the occurrence (date, site, drug & etc.).	117 (94.4%)	7 (5.6%)

Table 3: Nurses’ knowledge of the management of cytotoxic extravasation in selected public hospitals oncology units, Addis Ababa, Ethiopia, 2021. (n=124).

Variables	Category	Knowledge (prevention and management)		P Value	COR (95% CI)	AOR (95% CI)
		Good	Poor			
Profession	BSc	32 (29.9%)	75 (70.1%)	0.008	0.233 (0.079-.684)	0.208 (0.067-.643)*
	MSc	11 (64.7%)	6 (35.3%)			
Specialize in oncology nursing	Yes	11 (68.7%)	5 (31.3%)	0.004	5.225 (1.680-16.255)	5.750 (1.770-18.681)*
	No	32 (29.6%)	76 (70.4%)			
Service years	<=5	32 (30.7%)	72 (69.3%)	0.017	0.353 (0.150-.830)	4.280 (1.320-1.388)*
	>=6	11 (55%)	9 (45%)			
Training	Yes	27 (65.8%)	14 (34.2%)	0.001	8.076 (3.469-18.801)	6.602 (2.705-16.109)*
	No	16 (19.2%)	67 (80.8%)			
Patient related factors	Yes	12 (54.4%)	10 (45.4%)	0.001	0.101 (0.034-.300)	9.938 (3.335-29.620)*
	No	8 (7.8%)	94 (92.2%)			
Health care facilities related factors	Yes	73 (76%)	23 (24%)	0.015	0.244 (.078-.757)	4.105 (1.321-12.761)*
	No	13 (46.4%)	15 (53.6%)			

Table 4: Factors associated with knowledge of nurses toward prevention and management of cytotoxic extravasation, Addis Ababa, Ethiopia, 2021.



study also identified that a large number (66.9%) of nurses were not trained on extravasation. This result implies that improving a nurses level of knowledge concerning cytotoxic extravasation can eliminate the consequences of injury.

Recommendations

The following recommendations are forwarded based on the study findings to advance the nurse's knowledge on cytotoxic extravasation prevention and management:

For MOH and stakeholders

The Ministry of Health and stakeholders need to promote and enhance on-going educational opportunities for cancer care that have already begun to increase the knowledge of nurses. In addition, it should always be mandatory to develop and provide guidelines and access for extravasation kits at cancer treatment centers.

For researchers

Additional studies need to be conducted at multiple sites on large sample sizes in the future to assess nurses' knowledge of the prevention and management of cytotoxic extravasation.

For health care settings

Prevention of extravasation has always been the standard practice, and proper treatment and care after injury should be given as soon as possible before further complications occur. Healthcare facilities should facilitate ongoing training programs for nurses in the oncology unit on the prevention and early treatment of cytotoxic extravasation.

For health care workers (Nurses)

Nurses should empower patients through health education on early reporting and signs and symptoms of cytotoxic extravasation before administering cytotoxic drugs. Nurses working in the cancer centers should follow guidelines in reducing the consequences of extravasation injury and upgrading their knowledge on extravasation through different mechanisms is recommended.

Acknowledgment

The authors acknowledge the financial support of Addis-Ababa University, College of Health Sciences, School of Nursing and Midwifery, to Eka Kotabe General Hospital and Saint Paul Hospital Millennium Medical College for their educational opportunity and kind cooperation, respectively. Genet Merawi also deserves high praise and respect for her relentless support. Furthermore, this manuscript is part of Girma Adugna Master's thesis paper and we would like to thank Girma Adugna for his hard work. Finally, we want to thank all the participants in the TASH and SPHMMC who dedicated their time to providing valuable information.

Authors Information

BSc Nurse, Eka Kotabe General Hospital P. O. Box: 1971, Addis Ababa, Ethiopia.

BSc, MSc, Assistant Professor, Addis Ababa University Collage Of Health Science, School Of Nursing And Midwifery, P. O. Box: 4412, Addis Ababa, Ethiopia.

Lecturer, PhD Fellow, Addis Ababa University Collage Of Health Science, School Of Nursing And Midwifery P. O. Box: 4412, Addis Ababa, Ethiopia.

Authors Contribution

All authors were participated in the conception of research, coordinating data collection, data analysis and interpretation and manuscript preparation. The content of the final manuscript was evaluated and approved by all authors.

Funding

Addis-Ababa University funded the study for the partial fulfillment of Master of Science in clinical oncology nursing for the first author.

Availability of Data

Upon request all the data are available from the authors.

References

1. Federal Ministry of Health Ethiopia (2015) National Cancer Control Plan 2016-2020 of Ethiopia. This Prev Control Dir 2015: 83.
2. Istifli ES, Hüsünet MT, Ila HB (2019) Cell Division, Cytotoxicity, and the Assays Used in the Detection of Cytotoxicity. Cytotoxicity-Definition, Identification, and Cytotoxic Compounds: IntechOpen.
3. Boiano JM, Steege AL, Sweeney MH (2014) Adherence to safe handling guidelines by health care workers who administer antineoplastic drugs. *Journal of occupational and environmental hygiene* 11: 728-740.
4. de Oliveira Gozzo T, Costa Santos LA, Prado da Cruz LA (2017) Knowledge of The Nursing Team on The Prevention and Management of Extravasation of Chemotherapy Drugs. *Journal of Nursing UFPE/Revista de Enfermagem UFPE* 11.
5. Kreidieh FY, Moukadem HA, El Saghir NS (2016) Overview, prevention and management of chemotherapy extravasation. *World Journal of Clinical Oncology* 7: 87-97.
6. Al-Benna S, O'Boyle C, Holley J (2013) Extravasation injuries in adults. *ISRN dermatology* 2013: 856541.
7. Ferrari LA, Dinoi GL, Saibene G, Re B, Balzarini A, et al. (2016) Cytotoxic extravasation: an issue disappearing or a problem without solution? *Tumori Journal* 102: 290-293.
8. Rubach M (2018) Management of extravasation of antineoplastic agents. *Oncology in clinical practice* 14: 15-22.
9. Yan Y-M, Gong M, Chen J-L, Li D, Xu T-T, et al. (2017) Incidence, risk factors and treatment outcomes of drug extravasation in pediatric patients in China. *The Turkish Journal of Pediatrics* 59: 162-168.
10. Aziz A, Samoon Z, Shaheen Z, Feroz A, Khurshid M, et al. (2019) Audit on incidents and knowledge of nurses regarding chemotherapy extravasations at day care oncology of a tertiary care hospital in Karachi, Pakistan. *Journal of Oncology and Cancer Research*.
11. Melo JMA, Oliveira PPD, Souza RS, Fonseca DFd, Gontijo TF, et al. (2020) Prevention and conduct against the Extravasation of antineoplastic chemotherapy: a scoping review. *Revista Brasileira de Enfermagem* 73.
12. Reynolds PM, MacLaren R, Mueller SW, Fish DN, Kiser TH (2014) Management of extravasation injuries: a focused evaluation of noncytotoxic medications. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy* 34: 617-632.
13. Pluschnig U, Haslik W, Bartsch R, Mader RM (2016) Extravasation emergencies: state-of-the-art management and progress in clinical

- research. *memo-Magazine of European Medical Oncology* 9: 226-230.
14. Kim JT, Park JY, Lee HJ, Cheon YJ (2020) Guidelines for the management of extravasation. *Journal of educational evaluation for health professions* 17: 21.
 15. de Oliveira Gozzo T, Domingues de Almeida T, Prado da Cruz LA (2018) Notification of Extravasation of Chemotherapeutic Agents in a University Hospital. *Ciencia, Cuidado e Saude* 17.
 16. Hussin BK, Ahmed WAR (2020) Nurses knowledge about Management Extravasation Intravenous Cytotoxic Medication At Amal National Hospital in Baghdad City. *Indian Journal of Forensic Medicine & Toxicology* 14: 1159-1164.
 17. Pikó B, Laczó I, Szatmári K, Bassam AA, Szabó Z, et al. (2013) Overview of extravasation management and possibilities for risk reduction based on literature data. *Journal of Nursing Education and Practice* 3: 93.
 18. Melo JMA, Oliveira PPD, Rodrigues AB, Souza RS, Fonseca DFd, et al. (2020) Bundle construction and assessment before antineoplastic extravasation: a methodological study. *Acta Paulista de Enfermagem* 33: eAPE20190075.
 19. Chan KM, Chau JPC, Choi KC, Fung GPG, Lui WW, et al. (2020) Clinical practice guideline on the prevention and management of neonatal extravasation injury: a before-and-after study design. *BMC pediatrics* 20: 445.
 20. Sharour LA (2020) Oncology nurses' knowledge about exploring chemotherapy related-Extravasation care: A cross-sectional study. *Clinical Epidemiology and Global Health* 8: 780-784.
 21. Souza N, Bushatsky M, Figueiredo E, Melo J, Freire D, et al. (2017) Oncological emergency: the work of nurses in the extravasation of antineoplastic chemotherapeutic drugs. *Esc Anna Nery* 21: e20170009.
 22. Kapucu S, Özkaraman AÖ, Uysal N, Bağcivan G, Şeref FÇ, et al. (2017) Knowledge level on administration of chemotherapy through peripheral and central venous catheter among oncology nurses. *Asia-Pacific journal of oncology nursing* 4: 61.
 23. Abd El-Salaheen MH, Ahmed BO, Mahmoud AS (2018) Correlates to extravasation among patient receiving chemotherapy at a university hospital. *Egyptian Nursing Journal* 15: 71.
 24. Chung S-A, Choi E-H, Lee K-S, Chung K (2016) Nurses' Knowledge and Performance for Prevention of Extravasation at Peripheral Intravenous Therapy. *Journal of the Korea Academia-Industrial cooperation Society* 17: 183-191.
 25. Ong J, Van Gerpen R (2020) Recommendations for Management of Noncytotoxic Vesicant Extravasations. *Journal of Infusion Nursing* 43: 319-343.
 26. Chaudhary R, Karn BK (2012) Chemotherapy-knowledge and handling practice of nurses working in a medical university of Nepal. *Journal of Cancer Therapy* 3.
 27. Istiqamah I, Ramadhan R, Rahmayani D, Rahman S, Al Kahfi R, et al. (2017) Granting NaCl Compress to Extravasation Prevention. Chemotherapy Patients at Ulin Hospital Banjarmasin. *One Health to Address the Problem of Tropical Infectious Diseases in Indonesia*. Atlantis Press.
 28. Sartika M, Hutahaean S, Iriani R (2020) The Relationship Between Venous Location and Chemotherapy Extravasation Incidence in Cancer Patients. *International Conference of Health Development Covid-19 and the Role of Healthcare Workers in the Industrial Era (ICHHD 2020)*. Atlantis Press.
 29. Lee JM, Lee J, Jang YS, Kim YH (2018) Factors Related to Extravasation of Non-chemotherapy Vesicant Drugs in Peripheral Vein Catheters. *Journal of Korean Critical Care Nursing* 11: 11-20.
 30. Mohamed SAM, Abou Elmaati HMB, Mohamed EMH (2022) Eliminating Extravasation Events: Impact of Intervention Guidelines on Patients Receiving Chemotherapy.
 31. Desa U (2018) World urbanization prospects 2018. United Nations Department for Economic and Social Affairs.
 32. Rohani C, Kesbakhi MS, Mohtashami J (2018) Clinical empathy with cancer patients: a content analysis of oncology nurses' perception. *Patient preference and adherence* 12: 1089-1098.