Original Article

Investigation of the Frequency and Types of Errors During the Preparation and Injection of Chemotherapy Drugs

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Abstract

Background: Medical errors are common in the world, but in some wards and some conditions, they need a higher level of concern. Chemotherapy and its related wards are one of the concerning issues. There are limited studies about the occurrence of medical errors in patients who receive chemotherapy. In this study, we aimed to investigate the frequency and types of errors during the preparation and injection of chemotherapy drugs.

Materials and Methods: This cross-sectional study was conducted on patients who were referred to the outpatient chemotherapy department of Imam Hossein Hospital (Tehran, Iran) in 2024. Basic patient data, including age, gender, type of cancer, presence or absence of other underlying diseases, and type of chemotherapy regimen, were extracted. All medication orders during chemotherapy prescribed by the subspecialist physician were reviewed and recorded by the internal medicine specialist assistant under the supervision of the project's supervisory team (clinical specialist, subspecialist, and clinical pharmacy); errors related to the medication process and related to chemotherapy medication errors were identified according to the researcher-made checklist. A statistical significance level was considered less than 0.05.

Results: Three hundred patients were evaluated. Medical errors were observed in 247 (82.33%) patients. Medical errors were significantly higher in patients with metastatic cancers than in patients with non-metastatic cancers (P-value: 0.002). No hand washes the most common type of medical error (39.27%), and the most common cause was job burnout (33.60) was the most common cause of medical errors.

Conclusion: Medical error frequency during the preparation and injection of chemotherapy drugs in outpatient wards is 82.33%.

Keywords: Cancer, Medication error, Chemotherapy

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Introduction

A medication error is any avoidable incident that leads to inappropriate medication use or patient harm during drug therapy. These errors are common in healthcare and can cause complications, require additional interventions, extend hospital stays, or result in permanent disabilities or death[1-3].

The complexity of chemotherapy regimens can lead to medication errors at any stage, from prescribing to administration. Chemotherapy drugs are the second leading cause of fatal medication errors, with an estimated 44,000 to 98,000 patient deaths occurring each year in the United States due to these errors[4-7].

The frequency of medication errors among patients with malignancies varies across and within studies, influenced by factors such as setting (outpatient vs. inpatient) and route of administration (e.g., oral, intravenous, or intrathecal). However, it is unclear if these factors explain the differences in errors between studies. To date, there are limited data regarding chemotherapy medication errors during the prescribing, preparation, dispensing, and administration phases[8-10]. Therefore, in this study, we investigate the frequency and types of errors during the preparation and injection of chemotherapy drugs in an outpatient ward.

Methods

This was a cross-sectional study, which was conducted in 2024 in the outpatient chemotherapy department of Imam Hossein Hospital (Tehran, Iran) to collect all anti-neoplastic medication errors related to errors in prescribing, drug preparation, and drug distribution.

The inclusion criteria for this study included adult patients with any cancer who were referred to the chemotherapy department as an outpatient within six months of the start of the study in 2024.

Data collection was continued in a non-randomized manner until the specified sample size of 300 patients was reached. Clinical oncologists selected treatment regimens, and based on the information in this form, possible medication errors at each stage of the medication process, including prescribing, dispensing, preparation, and administering the drug to the patient, were evaluated and identified for severity and possible consequences.

Basic information about patients, such as gender, age, type of cancer, presence or absence of other underlying diseases, and type of chemotherapy regimen, was determined and extracted. After that, all medication orders during chemotherapy prescribed by the subspecialist physician were reviewed and recorded by the internal medicine specialist assistant under the supervision of the project's supervisory team (clinical specialist, subspecialist, and clinical pharmacy), and errors related to the medication process and related to chemotherapy medication errors were identified according to the researcher-made checklist.

Statistical analysis: Quantitative data were described using mean and standard deviation, while qualitative data were presented as frequency and percentage. To examine the difference in the mean age of patients between the two groups, the Mann-Whitney U test was used due to the non-normal distribution of this variable (based on results of the Q-Q plot). For analyzing differences in the distribution of categorized variables, the Chi-square test or Fisher's exact test was employed. All analyses were conducted at a significant level of less than 0.05 using Stata software version 17.

Ethical issue: This study was approved by the ethical committee of Shahid Beheshti Medical University (IR.SBMU.MSP.REC.1403.521).

Results

In this study, 300 patients with cancer received outpatient chemotherapy. We divided patients into two groups, including those with and without medication errors. Two hundred forty-seven patients had medication errors, and 53 patients had no errors. The mean age of all patients was 50.97±12.13 years. One hundred forty-three patients (47.67%) were under 50, and 160 patients (53.33%) were female gender. The most common type of cancer was colon (21.33%). In addition, 46.33 % had metastatic cancer. The basic data are seen in Table 1. Generally, at least one error was observed at the time of the preparation and injection of the drug in 247 people (82.33%). After examining the basic information of patients between the

Table 1. Description of patients' information.

Variables	Without medication errors (n = 53, 17.67%)	With medication errors (n = 247, 82.33%)	Total (n = 300)	P_value
Age (years)	53.49 ± 11.90	50.43 ± 12.14	50.97 ± 12.13	0.13
Age category				
≤ 50 years	20 (37.74)	123 (49.80)	143 (47.67)	0.11
>50 years	33 (62.26)	124 (50.20)	157 (52.33)	
Gender				
Female	25 (47.17)	135 (54.66)	160 (53.33)	0.32
Male	28 (52.83)	112 (45.34)	140 (46.67)	
Cancer type				
Colon	12 (22.64)	52 (21.05)	64 (21.33)	0.56
Anorectal	11 (20.75)	49 (19.84)	60 (20.00)	
Stomach	1 (1.89)	1 (0.40)	2 (0.67)	
Pancreas	13 (24.53)	43 (17.41)	56 (18.67)	
Breast	7 (13.21)	49 (19.84)	56 (18.67)	
Lung	9 (16.98)	51 (20.65)	60 (20.00)	
Larynx	0 (0.0)	2 (0.81)	2 (0.67)	
Presence of Metastasis				
Metastatic	35 (66.04)	104 (42.11)	139 (46.33)	**0.002***
Non-metastatic	18 (33.96)	143 (57.89)	161 (53.67)	

Data presented as mean ± standard deviation or frequency and percentage (%)
*Statistically significant, P-value<0.05

two groups, only metastatic cancer distribution between the two groups was significantly different (P=0.002) (Table 1).

In terms of the number of errors in Figure 1, in 98 patients (32.67 %), only one error, and in 149 patients (49.67 %) at the time of preparation and injection of chemotherapy drugs, more than two cases (Figure 1).

Table 2 shows the results of the type of error in 247 patients at the time of preparation and injection of chemotherapy. According to the results, the most common cause of error in these patients was 97 no hand wash (39.27%), 96 (38.87%) no use of gloves, and 56 incompleted drug administration (22.67 %).

Table 3 shows the results of the cause of the error in 247 patients at the time of preparation and injection of chemotherapy. The most common causes of the error were job burnout (33.60%), fatigue and inadequate sleep of personnel (33.60%), low nursing-to-patient ratio (31.98%), and insufficient knowledge of personnel (29.96 %).

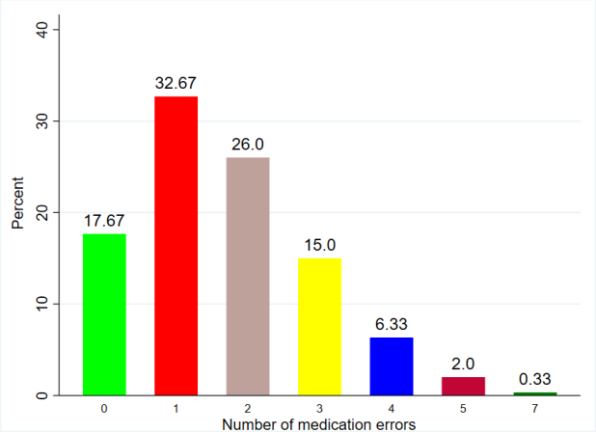

Figure 1. Axial ADC depicts the method of measurement of tumoral and pontine ADC using ROI.

Discussion

In the current study, we assessed the medical errors in patients who received outpatient chemotherapy in a tertiary center. It was found that among 300 patients evaluated, medical errors were observed in 247 (82.33%) patients. Medical errors were significantly higher in patients with metastatic cancers than in patients with non-metastatic cancers. No hand washing was the most common type of medical error, and the most common cause of job burnout was the lack of hand washing.

In a review by Kahangi et al., it was reported that out of 125 articles, eighteen were reviewed. The main types of chemotherapy medical errors are prescription, dispensing, preparation, and administration errors, with prescription and preparation errors being the most common. They did not report an incidence rate of medical errors in their review[11]. In the current study, we did not categorize

Table 2. Type of medication errors during drug preparation and injection in the outpatient chemotherapy department.

Type of medication errors	Frequency (%) (With medication error, n = 247)
Missing dose	26 (10.53)
Wrong dose	0 (0.0)
Wrong medication	27 (10.93)
Wrong medication indication	8 (3.24)
Inadequate knowledge about medication	0 (0.0)
Wrong time	22 (8.91)
Failure to dilute with the right volume of solution	30 (12.15)
Dilution using the wrong solution	5 (2.02)
No fluid therapy before medication administration	0 (0.0)
Wrong administration	3 (1.21)
Wrong documentation	25 (10.12)
No hand wash	97 (39.27)
Incomplete order	56 (22.67)
Use of trade PR abbreviated name instead of generic or full name of medication	24 (9.72)
No use of gloves	96 (38.87)
Intention to drug interaction	23 (9.31)
Wrong patient	0 (0.0)
Wrong infusion rate	0 (0.0)
Selection of wrong treatment regimen	0 (0.0)
Adding a wrong medication to the chemotherapy solution	0 (0.0)
Wrong date	1 (0.40)
Using an expired medication	1 (0.40)
Wrong dosage units	3 (1.21)
Incomplete prescription of pre-chemotherapy medication	10 (4.05)
Intention to medication sequencing in multi-medication regimens	22 (8.91)

Data presented as frequency and percentage (%)

medical errors into different types. We observed that no hand washing, lack of gloves, and incomplete prescriptions of drugs were the most common causes of medical error facing patients with malignancies.

Al Khawaldeh et al. assessed medical errors in cancerous patients who received intravenous chemotherapy administration errors in a tertiary hospital in Jordan. They evaluated 654 cases and identified 15,042 potential error opportunities, with 4,112 errors detected, representing 27.3% of cases. Of these errors, 19.9% were due to errors in the administration process, 48.3% were related to aseptic techniques, and 12.8% were due to other causes. We observed that the most common type of medical error occurred in the category of aseptic techniques (no hand washing and lack of glove use), with a rate of 39.27% and 38.87%, respectively. Then, drug administration errors were observed in 22.67% of our cases. Although the rates of medical errors are relatively similar in these studies, a slight difference in the results may be observed due to the difference in the sample size of the studies. Our study was done on 300 patients, but Al Khawaldeh et al.'s study assessed 654 patients, and this was one of the limitations of our study.

Ulas et al. determined medication errors during chemotherapy preparation and administration in Turkey. They reported that 83.4% of the 210 nurses experienced errors during chemotherapy preparation and administration. The most frequent errors were incorrect dosing by physicians (65.7%) and noncompliance with administration sequences (50.5%). The most common causes of medical errors were a heavy workload (49.7%) and a lack of adequate staff (36.5%). In the current study, we found that job burnout and personnel fatigue were the most common underlying causes of medical errors. Although the medical terms for presenting problems by nurses were different, it seems that the underlying causes are similar between the two studies. Lack of personnel in the related wards and overload of work may be the main reasons for medical errors in these wards. By fair division of work between more nurses and physicians, workload and burnout decrease, and the medical staff can be more careful and accurate.

Table 3. Medication errors during drug preparation and injection in the outpatient chemotherapy department.

Medication errors reasons	Frequency (%) (With medication error, n = 247)
Heavy workload	22 (8.91)
Low nurse-patient ratio	79 (31.98)
Job burnout	83 (33.60)
Delay in medication preparation and dispensing in the pharmacy	1 (0.40)
Employment of inexperienced staff	35 (14.17)
Lack of rechecking by another staff member	4 (1.62)
Errors in transcribing by another staff member	6 (2.43)
Limited supervision and non-continuous assessments	1 (0.40)
Inattention to changes in patients' conditions	6 (2.43)
Prescribing all medications for a patient altogether at the beginning of treatment	11 (4.45)
No use of medication labels	25 (10.12)
Staff fatigue and inadequate sleep	83 (33.60)
Systemic errors	70 (28.34)
Staff's limited knowledge	74 (29.96)
Medications with similar names or pronunciations	1 (0.40)
Errors in medication storage	1 (0.40)

Data presented as frequency and percentage (%)

In another study, Dorothy et al. reported medical errors of chemotherapy administration in a referral center. Of the 110 participants, 52 (47.3%) encountered 78 medication errors. These included 33 (42.3%) prescription errors, 29 (37.2%) administration errors, 9 (11.5%) transcription errors, and 7 (9.0%) dispensing errors. Urban residents and educated people had a significantly higher risk of medication errors, as did participants treated with alkylating agents compared to other chemotherapy classes [12]. We found that medical errors were observed in 82.33% of 300 cancerous patients. This difference in the incidence of the studies may be attributed to the variation in sample size between the studies. Generally, types of medical errors are comparable between the current study and the study of Dorothy et al. We did not identify the risk factors of medical errors; however, it seems that this issue warrants further investigation in studies, as the findings of Dorothy et al.'s study are noteworthy.

Conclusion

Medical errors during the preparation and injection of chemotherapy drugs in outpatient wards are not rare, and the frequency of this problem in our ward was 82.33%. No hand wash was the most common type of medical error, and job burnout was the most common cause. It seems that politicians and managers should increase the medical staff of wards to decrease workload and increase the accuracy of medical services.

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Conflict of interest

The authors further declare that they have no conflict of interest.

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