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Original Article

Medication errors in hematology-oncology ward by consultation: The role of the clinical pharmacologist

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Abstract

Background: The aim was to describe, evaluate and document the prevention of medication errors by clinical pharmacologist consultations in patients with cancer.

Methods: We assessed the effect of clinical pharmacologist consultation by the acceptance of interventions recommended due to dosage, frequency, duration of therapy errors and drug-drug interactions (DDIs). All medication errors detected by clinical pharmacologist were reported in the format of medical consultation. A documentation template was designed to collect the patient's data (sex, age, and diagnosis), prescriptions written, and drug-specific recommendations. For the descriptive analysis of medication errors, the unit of analysis was the number and percentage of errors.

Results: A total of 296 patients included in this study with a median age of 48.67±19.76 years of which 47.30% were females. 936 prescribing errors were detected and recommended for their correction. The specialist physicians accepted 897 of prescribed errors. DDIs that were detected in 66.22% of patients, were the most errors in this group of errors (47%). Improper dose (17.41%) wrong frequency (16.67%) and drug-food interaction (10.26%) were after that.

Conclusion: Pharmacological consultation in the hematology-oncology ward revealed many medication errors. The trust of physicians in the views of the clinical pharmacologist led to a large part of these errors being accepted and resolved.

Keywords: Clinical pharmacologist, Medication error, Patient safety

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Medication errors can occur every time and at any stage of the treatment process from prescribing to delivery of the drug to the patient. Moreover, the medication process involves the whole medical team, including physicians pharmacists and nurses (1). Medication errors with antineoplastic drugs can be very harmful and difficult, because this group of drugs are very toxic and have small therapeutic index (2). Antineoplastic agents are the second most common cause of fatal medication errors. (3). From the patient's safety perspective, the prevention of anticancer drug errors in hospitals has a significant priority and several recommendations have been published in various ways to reduce the likelihood of these errors (4). Currently, there are no positions for clinical pharmacologists specialized for onward activities in Iran. The number of hospital pharmacists are not enough, (on average, 0.86 hospital pharmacists are available per 100 hospital beds), in comparison with 1.42 in the United Kingdom and 14.1 in the USA. Also back-office activities (such as drug delivery to wards, medication logistics) take- up most of the hospital pharmacist's time. On the other hand, the majority of them are not specialized pharmacists (5). Few clinical pharmacologists are doing consultation as well.

For this reason, the implementation of interventions by clinical pharmacologists in other countries such as Denmark, Russia, etc. (6, 7) in our hospital setting was not possible in this study. To run such programs, we need to have a full-time clinical pharmacologist. But given the fact that the information of doctors, nurses and health providers about the drug safety problems is rising, constructive interventions of Iranian clinical pharmacologists seem to be desirable.

We therefore designed a pharmacologic consultation program for a clinical pharmacologist that was tailored to our specific setting, and conducted an intervention study to explore whether consultation could improve medication safety in an Iranian hospital ward (hematology and oncology) or not. Our main research questions were: *a*- Is the designed program associated with a reduction in prescribing errors and increasing patient safety? *b*- Can the study results be generalized to other wards of a hospital?

Methods

Design and setting: Following approval from the Ethics Committee of Urmia University of Medical Sciences, the study was performed in the hematology-oncology ward of an academic tertiary care 300-bed hospital in Urmia-Iran. The medical staff of the closed-format, 25-bed hematology-oncology ward consisted of board-certified intensivists attends, residents, interns and nurses.

The aim of the study was to describe, evaluate and document the prevention of medication errors by clinical pharmacologist interventions in patients with cancer. We assessed the effect of clinical pharmacologist consultation by the number and acceptance of interventions recommended by the clinical pharmacologist due to dosage, frequency, duration of therapy errors and DDIs based on the interventions identified by Leape et al.(8). The intervention was the assignment of an experienced senior clinical pharmacologist to evaluate drug chart of 296 patients admitted in the hematology-oncology ward between March to September 2017. All medication errors detected by clinical pharmacologist were reported in the format of medical consultation, reviewed and analyzed accordingly. A documentation template was designed to collect the following information: patient data (sex, age, and diagnosis), prescriptions written and drug-specific recommendations and outcome measures. The clinical pharmacologist tells his comments and recommendations to the residents, and attending staff to reform them. All possible paired combinations drug-drug were recorded and analyzed using the book Drug Interaction Facts 2015 by David S. Tatro- a book chosen because of its high accuracy when compared to other references(9). In this study, nutritional supplements, serums, electrolytes and vitamins have not been investigated. Patients readmitted during the study period and received the same drugs were excluded from the present study. Consecutive patients who fulfilled the inclusion criteria were recruited.

Statistical Analysis: Quantitative data were analyzed using SPSS for Windows Version 17.0. For the descriptive analysis of medication errors, the unit of analysis was the number and percentage of errors, with a prescribing medication order containing one or more drugs was considered to correspond to one or more medication errors. We used proportional-odds ordinal logistic-regression models to compare multiple outcome categories to assess the independent effect of age, gender and number of drugs on the frequency of the patient's errors

Results

A total of 296 patients included in this study with a median age of 48.67±19.76 of which 47.30% were females. The median number of drugs used per person was 5.65. Demographic characteristics are listed in table 1. During the 6-month study period, 1672 prescriptions (including chemotherapy and support) of 296 adult cancer patients were prospectively analyzed. The clinical pharmacologist identified 936 drug-related problems (55.98% of the prescriptions). One or more medication errors were identified for 262 (88.50%) of the 296 patients. The specialist physicians accepted 897 of prescribed errors (95.83%). DDIs that were detected in 66.22% of patients, were the most errors in this group of errors (47%). Improper dose error (17.41%), wrong frequency (16.67%) and food-drug interaction (10.26%) were after that. Wrong route of administration and wrong drug for indication included the minimum number of errors (5.13% and 3.53%, respectively). The most drugs involved in medication errors were cardiovascular system drugs followed by gastrointestinal related drugs, nervous system agents, anticancer and anti-infective drugs, respectively. Examples of the most significant DDIs (grade 1) that need attention by physicians were shown in table- 2. Examples of the most drugs that have been prescribed improperly from the point of dose have been shown in table-3.

Table 1. Demographic profile of 296 in-patients hospitalized during the period under study

Average number of drugs per encounter	Type of Cancer and Number of Patients								Sex		Age/Year Mean±SD
5.65	Others:38	Multiple Myeloma:47	Leukemia:126	Lymphoma :35	Genitourinary :19	Lung :5	Gastrointestinal :18	Breast :8	Female :140	Male :156	48.67±19.76

Table 2- The most prevalent potential drug interactions

The Five most prevalent potential drugs with Grade=1 Significance interactions	Examples
ASA	ASA+Heparin
Heparin	ASA+Warfarin
Antifungal Azoles	Azoles+Vincristine
Warfarin	Azoles+Opioid
Opioides	Warfarin+NSAID

Table 3- Examples of improper dose

Drug	Cause of improper dose
Vancomycin	No dose adjustment due to GFR reduction
Gentamicin	No dose adjustment due to GFR reduction
Pantoprazole	Due to a prescription abroad from the relevant Guideline
IVIG	Due to a prescription abroad from the relevant Guideline
Warfarin	Due to drug-drug interaction
Methotrexate	Due to drug-drug interaction

Table 4. Prescription Errors

	Type of errors(No.)	Type of recommendations(No.)	Outcome
Prescription Errors (936)	Improper dose(163)	Change in drug dosing	Consensus (158)
			No Consensus(5)
	Wrong frequency(156)	Change in dosing frequency	Consensus(151)
			No Consensus(5)
	Wrong route of administration(48)	Change in route of administration	Consensus(45)
			No Consensus(3)
	Wrong drug for indication(33)	Discontinue drug	Consensus(29)
			No Consensus(4)
	Drug-food interaction(96)	Change in delivery time	Consensus(92)
			No Consensus(4)
	Drug-drug interaction(440)	Discontinue drug(57)	Consensus(53)
			No Consensus(4)
		Change in drug dosing (126)	Consensus(117)
			No Consensus(9)
		Monitor the Lab values frequently(43)	Consensus(38)
			No Consensus(5)
		Monitor patients closely(214)	Consensus(214)
			No Consensus(0)

The accepted recommendations (897/936) involved different interventions like changing in prescribed drug doses (275/289) or dosing frequency (151/156), Change in delivery time (92/96), drug discontinuation (82/90), changing the route of administration (45/48), and laboratory values monitoring (38/43). Examples of interventions are shown in table 4.

After adjustment for confounder effect of drugs, gender and the frequency of errors in the proportional-odds model, female gender increases the odds of error 2.66 in wrong indication, 1.79 in wrong route while it decreases the odds of making errors in DDI with the odds ratio of 0.56. Number of drugs as an independent variable increases the odds of errors with odds ratio of 2.21 for wrong dose, 1.21 for wrong frequency and 1.42 for drug-food interactions while in DDI, it decreases the odds by 0.64. Age was an important factor only in DDI (table 5).

Table 5- Independent Predictors of the types of errors in patients.

		Odds Ratio	P>z
DDI	Drugs	0.64(0.56 – 0.74)	<.0001
	Female sex	0.56 (0.37 – 0.86)	0.007
	Age (per year)	0.98 (0.97 – 0.99)	0.026
Drug-food interaction	Drugs	1.42 (1.20 – 1.67)	<.0001
	Age (per year)	1.01(0.99 – 1.02)	0.086
	Female sex	0.90(0.53 – 1.52)	0.70
Wrong indication	Drugs	0.90(0.71 – 1.16)	0.43
	Age (per year)	0.99(0.97 -1.01)	0.90
	Female sex	2.66 (1.20 – 5.92)	0.018
Wrong route	Drugs	0.90(0.73 – 1.11)	0.35
	Age (per year)	0.99(0.98 – 1.01)	0.81
	Female sex	1.79 (0.93 – 3.43)	0.067
Wrong frequency	Age (per year)	1.00(0.99 – 1.02)	0.088
	Drugs	1.21(1.04 – 1.40)	0.009
	Female sex	0.90(0.57 – 1.42)	0.65
Wrong dose	Drugs	2.21(1.82 – 2.67)	<0.0001
	Age (per year)	1.00(0.99 – 1.02)	0.27
	Female sex	0.68(0.41- 1.14)	0.152

Discussion

The role of clinical pharmacologists in reducing medication errors have been proven in many studies (10-15). Our study has shown that the clinical pharmacologist intervention could reveal medical errors in patients hospitalized in hematology-oncology ward and given the physician's welcome to this intervention, is effective at reducing the prevalence per patient of error, preventing potentially DDIs and improving the efficiency of medication use. We found the incidence of error and its reduction nearly in line with other studies. Percentage of accepted recommendations in our study was 95.83%. This percentage in the case of Leape L. et al's study was 99% (8). The reason for not accepting some recommendations was that counseling was initiated after the start of the treatment, for example, fluconazole was administered in combination with vincristine without dose adjustment before the consultation. However, the rate of agreement of physicians in this study was higher than the Klopotowska's study, in which the pharmacist stayed in ward (ICU) (95.83 vs 71%) (5). The most errors in this study were the DDIs. In patients with cancer, DDIs are common. Patients treated systemically for cancer are particularly at risk for DDIs (16, 17). In total, 440 DDIs were identified in 188 patients (2.34DDI/patient). Of all DDIs, 15.45% were classified as major. In the point of clinical significance, 14.55% of DDIs were grade1. This interaction is associated with significant outcomes and drug discontinuation or close monitoring was recommended. These findings in the point of severity of interactions and significance rating scale were approximately similar with the results of other studies that investigated DDIs in patients with cancer (16, 18).

Although DDIs was the most error in our study (47%) but there are several studies that reported DDIs frequency more than the present study (19-22). Physicians agreed with clinical pharmacologist to verify orders associated with DDIs in the 95.9% of cases. Verification included: drug discontinuation, dose changing, monitoring of plasma levels or close observation of patients. The second most commonly reported medical error in this study was the improper dose (17.41%) that was less than the other studies (10, 14, 23, 24) but more than Ho's study (25). Given the fact that the number of patients in these studies was not equal, we think that this difference in results is probably related to the sample size and the pharmacological information of physicians.

Wrong frequency that means the incorrect interval between doses was the third error revealed by clinical pharmacologist in the present study (16.67%). Wrong frequency differs from omission dose that leads to a patient receiving the drug in wrong time. In other studies, wrong frequency was lower than our study (1, 11) often these errors were corrected before the start of the second dose and the patients were not harmed by this error. Our findings suggest that despite the part time attendance of clinical pharmacologist and of the fact that specialist physicians were not accustomed to pharmacologic consultations, the high number of recommendations acceptance by these physicians shows that pharmacologic recommendations were clinically appropriate. As a first step, one can hope that, given the results obtained, this method might be generalized to other wards of a hospital. Because of insufficient qualified staff, our work did not study adverse drug reactions (results from medication errors) and savings due to the correction of irrational prescriptions. Another limitation of our study was the lack of constant presence of the clinical pharmacologist in the ward, and some of the errors occurred before the intervention of clinical pharmacologist. To our knowledge, this is the first study that investigated the effect of pharmacologic consultation in an Iranian hospital for patients with cancer with the aim of reducing medication errors. Despite these limitations, our priority was to conduct a practical study to explore the potential effect of this approach to a patient safety.

In Conclusion, the results of our study showed that pharmacological consultation in the hematology-oncology ward revealed many medication errors, including DDIs. The trust of physicians in the views of the clinical pharmacologist led to a large part of these errors being accepted and resolved. Clinical pharmacologist full-time presence in wards seems to prevent more errors.

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References

1. Sheikh D, Mateti UV, Kabekkodu Sh, Sanal T. Assessment of medication errors and adherence to WHO prescription writing guidelines in a tertiary care hospital. Future J Pharm Sci 2017; 3: 60-4.
2. van Leeuwen RW, Jansman FGA, van den Bemt PM, et al. Drug–drug interactions in patients treated for cancer: a prospective study on clinical interventions, Ann Oncol 2015; 26: 992-7.
3. Zareifar S, Abdolkarimi B, Razmjooee Sh, Mehravar Z. Chemotherapy medication errors nursing education and review of literatures. J Neuroinform Neuroimaging 2016; 1: 5-7.
4. Ranchon F, Salles G, Späth H, et al. Chemotherapeutic errors in hospitalised cancer patients: attributable damage and extra costs. BMC Cancer 2011; 11: 478.
5. Klopotowska J, Kuiper R, van Kan HJ, et al. On-ward participation of a hospital pharmacist in a Dutch intensive care unit reduces prescribing errors and related patient harm: an intervention study. Crit Care 2010; 14: R174.
6. Zagorodnikova Goryachkina K, Burbello A, Sychev D, et al. Clinical pharmacology in Russia—historical development and current state. Eur J Clin Pharmacol 2015; 75: 159-63.
7. Brøsen K, Andersen S, Borregaard J, et al. Clinical pharmacology in Denmark in 2016 – 40 years with the Danish society of clinical pharmacology and 20 years as a medical speciality. Basic Clin Pharmacol Toxicol 2016; 119: 523 -32.

8. Leape LL, Cullen DJ, Clapp MD, et al. Pharmacist participation on physician rounds and advers drug events in the intensive care unit. JAMA 1999; 282: 267-70.
9. Tatro DS. Drug interaction facts: the authority on drug interactions. 1st ed. St. Louis, MO: Lippincott Williams & Wilkins 2015; pp: 6-18
10. Delpeuch A, Levveque D, Gourieux B, Herbrecht R. Impact of clinical pharmacy services in a hematology/oncology inpatient setting. Anticancer Res 2015; 35: 457-60.
11. Sipora K, Venkateswara R, Nadendla RR. The role of clinical pharmacist in reducing medication errors in outpatient counseling department in a secondary care hospital. Int J Pharma Res Health Sci 2016; 4: 1291-4.
12. Mshiemish BA. Role of the clinical pharmacist in reducing preventable adverse drug events. Iraqi J Pharm Sci 2011; 20: 85-90.
13. Theophanous-Kitiri S, Polykarpou G, Mourouzi A, et al. Clinical pharmacy interventions in oncology. PPME 2012; 6: 8-12.
14. Grimes TC, Deasy E, Allen A, et al. Collaborative pharmaceutical care in an Irish hospital: uncontrolled before-after study. BMJ Qual Saf 2014; 23: 574–83.
15. Williams D. Monitoring medicines use: the role of the clinical pharmacologist. Br J Clin Pharmacol 2012; 74: 685-90.
16. van Leeuwen RW, Brundel D, Neef C, et al. Prevalence of potential drug–drug interactions in cancer patients treated with oral anticancer drugs. Br J Cancer 2013; 108: 1071-8.
17. Riu-Viladoms G, Carcelero San Martín E, Martin-Conde MT, et al. Drug interactions with oral antineoplastic drugs: The role of the pharmacist. Eur J Cancer Care 2019; 28: e12944.
18. Chen L, Cheung W. Potential drug interactions in patients with a history of cancer. Curr Oncol 2014; 21: 212-20.
19. Faria CO, Reis CM, Santos AG, et al. Drug interactions in elderly cancer patients treated at a hematology-oncology outpatient clinic. Revista Brasileira de Cancerologia 2018; 64: 61-8.
20. Nightingale G, Pizzi LT, Barlowa A, et al. The prevalence of major drug-drug interactions in older adults with cancer and the role of clinical decision support software. J Geriatr Oncol. 2018; 9: 526-33.
21. Shetty V, Chowta MN, Chowta KN, et al. Evaluation of potential drug-drug interactions with medications prescribed to geriatric patients in a tertiary care hospital. J Aging Res 2018; 2018: 5728957.
22. Mouzon A, Kerger J, D'Hondt L, Spinewine A. Potential interactions with anticanceragents: a cross-sectional study. Chemotherapy 2013; 59: 85-92.
23. Manias E, Williams A, Liew D, et al. Effects of patient-, environment and medication-related factors on high-alert medication incidents. Qual Assur Health Care 2014; 26: 308-20.
24. Ulas A, Silay K, Akinci S, et al. Medication Errors in Chemotherapy Preparation and Administration: a Survey Conducted among Oncology Nurses in Turkey. Asian Pac J Cancer Prev 2015; 16: 1699-705.
25. Ho L, Akada K, Messner H, et al. Pharmacist's role in improving medication safety for patients in an allogeneic hematopoietic cell transplant ambulatory clinic. Can J Hosp Pham 2013; 66: 110-7.