

Adherence to a Standardized Order Form for Gastric Cancer in a Referral Chemotherapy Teaching Hospital, Mashhad, Iran

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Abstract

Background: Standardized forms for prescription and medication administration are one solution to reduce medication errors in the chemotherapy process. Gastric cancer is the most common cancer in Iran. In this study, we have attempted to design and validate a standard printed chemotherapy form and evaluate adherence by oncologists and nurses to this form.

Methods: We performed this cross-sectional study in a Mashhad, Iran teaching hospital from August 2015 until January 2016. A clinical pharmacist designed the chemotherapy form that included various demographic and clinical parameters and approved chemotherapy regimens for gastric cancer. Clinical oncologists that worked in this center validated the form. We included all eligible patients. A pharmacy student identified adherence by the oncologists and nurses to this form and probable medication errors. Results are mean \pm standard deviation or number (percentages) for nominal variables. Data analysis was performed using the SPSS 16.0 statistical package.

Results: We evaluated 54 patients and a total of 249 chemotherapy courses. In 146 (58.63%) chemotherapy sessions, the administered regimens lacked compatibility with the standard form. Approximately 66% of recorded errors occurred in the prescription phase and the remainder during the administration phase. The most common errors included improper dose (61%) and wrong infusion time (34%). We observed that 37 dose calculation errors occurred in 32 chemotherapy sessions.

Conclusions: In general, adherence by oncologists and nurses with the developed form for chemotherapy treatment of gastric cancer was not acceptable. These findings indicated the necessity for a standardized order sheet to simplify the chemotherapy process for the clinicians, and reduce prescription and administration errors.

Keywords: Gastric cancer, Chemotherapy, Medication error, Standardized form

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Introduction

Medical errors are one of the most serious challenges in medical systems worldwide. Medication errors are the most prevalent medical errors.¹ The Institute of Medicine of the United States has classified medication errors to be among the top five medical errors, which can lead to serious injury and death.² Medication errors according to The National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) are “any preventable events that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer”. In a 2000 annual report, 44-98 thousands deaths due to adverse drug reactions and complications occurred in the United States.³ Medication errors have attributed to 7000 of these cases.⁴ Although no official statistics are available in Iran regarding the rate of medication errors, estimates are extremely high.⁵

Medication errors negatively affect patients, nurses, and health organizations leading to decreased quality of care. These errors are clinically significant and have adverse economic impacts such as increased length of hospitalizations. Thus, identifying the causes and taking to account measures for their reduction is considered a priority.⁶⁻⁹

Gastric cancer is the third leading cause of cancer death in men and fifth leading cause in women worldwide. This cancer is the most common gastrointestinal cancer in Iran.¹⁰

Antineoplastic drugs possess a narrow therapeutic index, which can lead to toxicity even at therapeutic doses. The complexity of chemotherapy regimens make them more prone to medical errors. In addition, the higher sensitivity of cancer patients to the adverse reactions of drugs and their several comorbidities increase the likelihood for medication errors.¹¹ Numerous attempts have been made to enhance safe administration of antineoplastic drugs. However, numerous studies reported problems with medication errors.^{12,13} According to statistics from 2010, 21% of medication errors in chemotherapy

were fatal and 23% caused permanent disability.¹⁴ To enhance safety in administration of chemotherapy regimens, all members involved in the chemotherapy process should play a role in standardization of the protocols.^{15,16}

Numerous studies have reported that standardized chemotherapy forms improve oncology patient care and reduce errors in the medication process.¹⁷⁻²¹ The standard form is a written order form that includes a standard of the ideal variables necessary to precisely complete chemotherapy orders. These variables include diagnosis, regimen, height, weight, body surface area (BSA), route, frequency, duration, chemotherapy dose, and calculation based upon BSA. Inclusion of these variables diminishes the chance for a medication error.²²

However, standard forms have not been sufficiently used in oncology ward of our hospital. Therefore, in this study we aimed to design and validate a standard form for treatment of gastric cancer in the oncology ward of a teaching hospital. We evaluated treatment team adherence to this form with a focus on the occurrence of medication errors.

Materials and Methods

We conducted this cross-sectional study from August 2015 until January 2016 in the oncology ward of a teaching medical center in Mashhad, Iran.

This study included patients diagnosed with gastric cancer that received chemotherapy regimens and were between 18 and 70 years of age. We excluded patients with baseline hepatic (serum transaminase levels >2-3 times higher than the upper limit of normal), renal (estimated glomerular filtration rate <50 ml/min) or heart (ejection fraction <50, if the echocardiography was available) failure.

A clinical pharmacist prepared a standardized form based on available international guidelines.^{22,23} All clinical oncologists that worked in this center reviewed and approved this form. The form included information about patients' demographic and clinical data - age, weight, and

height, BSA, past medical and drug histories, diagnosis and stage of disease. All approved chemotherapy protocols for gastric cancer mentioned in various guidelines and the patient's regimen (dosage of drugs, route of administration, and duration of the treatment course) and medication brands were included in the form. Acute adverse drug reactions that occurred during the administration were also recorded. The standard form is presented as a supplement with this paper.

A clinical oncologist completed this form at the time of each patient's visit, after which a pharmacy student in the Outpatient Chemotherapy Department collected the forms. All medication errors (i.e., selection of regimen, dose of medication, route of administration, duration of therapy, selection of suitable diluent, rate of infusion) and possible adverse effects were evaluated and recorded by the pharmacy student. After data collection, the BSA for each patient was re-calculated based on the patient's height and weight, and compared with the BSA calculated by the physician. The BSA calculation was based on the Du Bois formula according to its high reliability and accuracy among all available formulas for BSA calculation.²⁵ Prescribed doses more than 5% over or under the calculated dose were considered medication errors based on recommendations by previous studies.^{26,27}

Results are mean±standard deviation (SD) or number (percentages) for nominal variables. Data analysis was performed using the SPSS 16.0 statistical package.

Results

Population data

The study population consisted of 54 patients, 42 (77.8%) males and 12 (22.2%) females. The mean age of the population was 61.3±10.93 years. The average weight of the patients was 53.85±10.93 kg with a BSA of 1.56±0.17.

Most patients (37.3%) had stage III disease (Table 1). Oxaliplatin plus 5-fluorouracil (5-FU) was the most common prescribed chemotherapy regimen in 49.0% of patients (Table 2).

Table 1. Classification of patients' disease stage.

Stage	Frequency (%)
Unknown	24.5
II	19.3
III	37.3
IV	18.9

Adherence to standardized chemotherapy protocol: Medication errors

During these 6 months, we evaluated 249 sessions of chemotherapy and observed medication errors in 54 sessions. These errors occurred in the treatment process of 23 (42.6%) patients. Most (66.07%) errors happened in the prescription process by the physicians and nurses made 19 (33.93%) errors during the administration step.

In 103 sessions, the chemotherapy regimens were compatible with approved regimens available in the standard form. However, physicians modified the other 146 regimens due to various circumstances that included the patient's clinical state and hospital facilities.

We noted 37 dose calculation errors in 32 (12.85%) chemotherapy sessions. The highest dose calculation error belonged to folic acid (22.41%) and the mean percentage of error (15.2±2.85 %) as seen in Table 3. In most treatment courses patients received lower than the recommended doses (27.18%; Table 4). BSA calculation errors occurred in only 3 cases.

We observed that 19 errors during chemotherapy administration were related to the infusion time. In all cases, the oxaliplatin infusion

Table 2. Frequency of prescribed chemotherapy regimen.

Regimen*	Frequency	Percent
EOX ¹	28	11.2
FLO/FLP ²	12	4.8
Chemoradiotherapy	46	18.5
Oxaliplatin plus 5- fluorouracil	122	49.0
Cisplatin plus irinotecan	6	2.4
Oxaliplatin plus capecitabine	8	3.2
Modified ECF ³	18	7.2
Carboplatin plus paclitaxel	9	3.6

*The details of each regimen are available in the supplement.

¹Epirubicin+Oxaliplatin+Capecitabine

²Folic acid+5-Fluorouracil +Oxaliplatin/ Folic acid+5-Fluorouracil +Cisplatin

³Epirubicin+Cisplatin+5-Fluorouracil

Table 3. Dose calculation error for different chemotherapeutic agents.

Name of drug	Number of courses	Range of error (%)	Mean of error ¹ (%)	Std. deviation
Oxaliplatin	185	0-14.6	14.6	0.0
5-Fluorouracil	204	0-25.2	13.4	5.48
Folinic acid	58	0-16.7	15.2	2.85

¹The mean of the error was reported for errors greater than 5%.

time was less than the recommended time in various regimens.

There were no errors regarding selection of carrier solution (type and volume) and route of drug administration.

The classification of medication errors based on a psychological approach is usually the preferred method, as it explains events rather than describing them.²⁸ Table 5 summarizes this classification for medication errors in the current study.

Discussion

Gastric cancer has high incidence in Middle Eastern countries, including Iran.¹⁰ Because of the narrow therapeutic index of chemotherapy agents and their high toxicity, medication errors in chemotherapy are of particular importance. It is reported that millions of deaths due to preventable medication errors occur annually in cancer patients. Therefore, prevention of medication errors in patients who receive chemotherapy should be a priority.^{29,30}

Development and standardization of therapeutic guidelines and protocols as a standardized printed or electronic form is one of the main ways for medication error reduction, particularly in chemotherapy. These forms can improve physician prescribing patterns and prescription completeness.^{20,31} A number of studies performed in the oncology wards of hospitals have evaluated the occurrence of medication errors after implementation of a standardized printed/electronic prescription form. Dumasia and Drelichman performed a study from 1999 to 2003 in the oncology ward of a teaching hospital in the United States to evaluate quality performance improvement with implementation of standard chemotherapy order forms. They reported that the average order completeness

improved from 45% to 81% when they designed a standard written form that replaced the unstandardized blank order sheets. Implementation of the electronic chemotherapy form increased the completeness to 93%.³¹ Another study by Voeffray et al. in Switzerland assessed the effect of a computerized physician order entry (CPOE) system on the number of prescription errors. They reported that the CPOE system reduced errors in chemotherapy prescription from 15% to 5%.³²

To the best of our knowledge, the current study is the first study that has particularly assessed gastric cancer patients. In this study, the standard form contained approved regimens for treatment of various stages of gastric cancer with recommended doses, infusion time and suitable carrier for all medications, was prepared. Application of this form could reduce prescription writing time and medication errors. In our cross-sectional study, we assessed 249 total sessions. Overall, there were 56 medication errors recorded, from which 37 (66.07%) happened in the prescription step and nurse were responsible for 19 (33.93%) errors in the administration step.

A Turkish study of patients who received chemotherapy regimens in 18 chemotherapy departments in 2015 reported the most common errors involved prescribing the wrong dose of medications by physicians (65.7%) and receipt of improper drugs (50.5%).³⁰ Our findings supported those of other studies (Table 6).^{25,27,33,34} A significantly lower medication error rate existed in our study. Most errors occurred in the

Table 4. Distribution of dose calculation error in gastric cancer patients.

Dosing	Frequency (%)
Suitable	66.99
Overdose	5.83
Underdose	27.18

prescription step, in contrast to previous studies where administration step errors were usually more common. The high rate of prescription errors in this center might be due to limited access to medications and their high prices, which forced oncologists in most cases to round the doses to the available dosage form to reduce the cost. In practice, there are many limitations for prescribing the exact amount of medicines such as high price and limited dose packages. Often, the prescribing dose of a cytotoxic drug is not solely based on a protocol. Dose modification of dose is based on other medical factors - performance status, nutritional status, existence of comorbidities, bone marrow reserve, current blood counts, and previous adverse effects of the chemotherapy regimen. In numerous cases, the standard regimens were modified because of the lack of facilities to admit patients, which forced them to use outpatient chemotherapy and resulted in shorter infusion time or duration of treatment course. Prescribing a specific dose of a cytotoxic agent is mainly a medical judgment based on patient status and not solely on the protocol of a regimen.

On the other hand, nurses trained in chemotherapy administration effectively reduced administration phase errors.

The dose calculation errors occurred in 83.26% of patients; 68% received less than the required dose. Lower than the therapeutic dose can reduce treatment efficacy and higher doses than the required dose puts patients at risk of adverse

Table 5. Frequency of different types of medication errors based on the psychological approach.

Type of medication error		N (%)
Mistakes	Knowledge-based	-
	Rule-based	37 (66.07)
Skill-based	Action-based	19 (33.93)
	Memory-based	-

effects.³⁵ Another cause of dose calculation error is miscalculation of a patient's BSA due to inaccurate measurements of height and weight. Sometimes BSA is estimated instead of the precise calculation. However, this error was observed in only 3 cases.

Limitations of this study included the brief time of the study and small numbers of patients. Second, we initially planned to perform a multi-center study to validate the standard form with oncologists from three hospitals in Mashhad, Iran. However, because of difficulties, we evaluated this form in one center. We did not perform a pre-implementation phase study and could not compare pre- and post-implementation error rates. Due to the long duration of infusion for medications (up to 46 hours) in some regimens, we were unable to evaluate the infusion time due to the absence of the pharmacy student in the ward. In these cases, the student relied on nurses' reports.

Table 6. Epidemiology of medication errors in chemotherapy. A comparison with the published literature.

	Fyhr and Akselsson ³²	Rinke et al. ³³	Dhamij et al. ²⁶	Walsh et al. ²⁵	Present study
Year of study	1996-2008	1999-2004	2012	2008	2015-2016
Length of the study	12 years	5 years	8 months	9 months	6 months
Design	Retrospective	Retrospective	Retrospective	Retrospective	Cross-sectional
Patients age (y)	All ages	<18	<18	All ages	18-70
ME ¹ rate (%)	NS ²	1	11	8.1	9.90
Types of errors					
Errors in order (%)	42	10	13	36	66.07
Errors in administration (%)	16	48	43	56	33.93
Dosing error rate (%)	45	22.9	9	NS	60.71
Rate of error in duration of infusion	NS	NS	26	NS	33.93
Wrong route	NS	12.2	NS	NS	No
Wrong patients	0.08	NS	NS	NS	No
Wrong drug	30	NS	NS	NS	No

¹Medication error; ²Not specified

Conclusion

In this oncology center, physician adherence to the standardized protocol was not suitable in terms of the correct regimen selection for treatment of gastric cancer. Most medication errors occurred in dose calculation, which have mostly resulted in underdosing medications. Underdosing medications can lead to treatment failure. Avoidance of rounding the calculated medication doses and precise calculation of patients' BSA before determination of medication doses can improve quality of chemotherapy, patient outcome, and reduce the occurrence of an adverse drug reaction.

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Conflict of Interest

No conflict of interest is declared.

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