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PREDICTION OF CHEMOTHERAPY PRESCRIBING ERRORS FOR ONCOLOGY PATIENTS

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ABSTRACT: The chemotherapy prescribing errors (PEs) can lead to tragic consequences for the oncology patients. This cross-sectional observational study aims to predict the incidence of prescribing errors involving chemotherapeutic agents, and review their severity, through examining a random sample of 500 cancer patients at the out-patient chemotherapy unit of Ain Shams University Hospital, Cairo, Egypt; from March 2014 till August 2014. British Columbia Cancer Agency (BCCA) data base was used as a reference to identify the PEs. Prescription errors were classified according to their incidence and severity; in addition the relation between the risk factors and the observed PEs was studied. The study revealed that all the cases contained at least one error, the most common error incidence was the unspecified tumor staging in the protocol template (n=341, 68%), followed by dose error incidence (n=317, 66%). The risk factors predicting the prescribing medication errors were identified as: the protocol type, the tumor type, the toxicity type of the antineoplastic regimen, and others. Therefore identification of risk factors leading to prescribing errors should be targeted for the prevention of these errors, as well as, improvement of treatment (TTT) plan of the oncology patients.

INTRODUCTION: A medication error (ME) is any preventable event 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 [1]. In a study of Medication errors in the Middle East countries it was found that 46% of the MEs occurred during the prescribing stage [2]. Prescription errors occurred during chemotherapeutic agent treatment can lead to tragic toxicities because of higher vulnerability of patients, complex treatment regimens, intensive combinations, and narrow therapeutic index of drugs.

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When considering Medication errors, antineoplastic drugs are the second most common cause of death [3], therefore numerous recommendations have been published in order to decrease the risk of errors [4-6].

Prescription errors can vary in severity from minor to major faults such as inappropriate medication prescriptions, dose errors of the antineoplastic (Overdose related Incidents [7-10] could result in permanent damage or patient fatality [11-14], while under doses could compromise the success of therapy), and drug-drug interactions, those errors could occur due to wrong judgment or lack of expertized prescriber [15, 16].

Expanding clinical pharmacist professional roles can lead to the early identification of errors and their rectification before reaching the patients, to increase the success probability of the treatment plan. Therefore developing effective ways to

reduce errors requires the identification of their causes, in addition to the factors associated with the error incidence [17]. Several studies have addressed prescribing errors in the oncology service. On the contrary few studies have evaluated the effect of studying factors leading to chemotherapy- related prescribing errors.

In a cross- sectional study at an Adult Oncology Clinic in a main hospital in Alexandria, Egypt; showed that the proportion of errors in chemotherapy medication orders and hence the intervention rate was 66.6% [18], another study conducted in a tertiary care teaching hospital in South India found that a total of 4253 prescribing errors occurred in 1500 prescriptions (283.5%), of which 47.1% were due to omissions like name, age and diagnosis, in which the potentially harmful errors that were likely to result in serious consequences to the patient were estimated to be 11.7% [19]. Another 2 year observational study aimed to identify the predictors of medication prescribing errors involving anticancer treatments, risk factors identified as predictors of oncology related errors were patients with body surface area >2 m2, protocols involving more than three antineoplastic drugs , and inpatient care [17].

Our study aimed to identify the incidence and severity of PEs, as well as identifying predictors of prescribing errors in the oncology department involving tumor-related, and anticancer related factors.

MATERIALS AND METHODS:

Study Design:

It is a cross-sectional observational study examining a random sample of out-patients, with proven malignant disease receiving chemotherapy, over a period of 6 months on a biweekly selection basis from March 2014 till August 2014 who visit the chemotherapy unit, Oncology department, Ain Shams University Teaching Hospitals. In which a number of 500 patients were observed during the whole study.

The patients were diagnosed in the oncology department specialized clinics, and then the patients were referred to the central chemotherapy unit to receive their decided chemotherapy regimen according to pre-printed custom-made protocol templates of different chemotherapy regimens. All study patients received their chemotherapy dose in the central chemotherapy clinic(CCC).

1- Identification and assessment of prescribing errors incidence, and severity:

Prescription errors have been defined as MEs initiated during the prescribing process. These prescribing errors were defined, as described in the **Table 1**.

TABLE 1: CLASSIFICATION AND DEFINITION OF MEDICATION PRESCRIBING ERRORS.

Prescribing error	Definition
Unidentified protocol	The protocol wasn't identified on BCCA database.
Inappropriate medications	Medication ordered was not appropriate for patient based on indication, patient-specific variables, or clinical status.
Medication omission	Patient having an indication for which no treatment or inadequate treatment was prescribed.
BSA calculation error	BSA calculated by DuBois & DuBois equation differs from that calculated by physicians by more than +/- 5%.
Dose error	Under or overdose of more than 5% of antineoplastic drugs [17.]
Dose omission	Unspecified dosage for the medications.
Wrong dose time	The dose wasn't taken on the right day either it was delayed, or taken on time when it should be delayed.
Potential drug-drug interactions	Pharmacokinetic and pharmacodynamics interactions.
Lab test omission	Lab test specified for the protocol wasn't done before receiving the antineoplastic cycle.
Duplicate prescribing	Two or more drugs from the same class are prescribed to treat the same condition, or different conditions [23].
Omitted or improper route of administration of the chemotherapy	Unspecified route, wrong route, or improper route to the patient clinical status, and the protocol of choice.
Wrong infusion volume and rate of the diluent	Wrong infusion rate or volume of the diluent for medications administrated via intravenous route.

Improper follow up plan	Improper or omitted physical examinations and other medical tests after a specified number of cycles to audit the enhancement of the case after receiving certain protocol so that we can take decisions by continuing, stopping , or shifting the protocol.
Illegible hand writing	A crucial data in the prescription wasn't clear enough to be read.
Protocol not signed	The physician signature wasn't written on the protocol.
Stage not specified	Stage wasn't written by the physician.
Missed patient number	The serial ID number of the patient wasn't written.
The intention of treatment was not complying with the protocol of choice	The protocol of choice isn't tailored to the intention of treatment for a specific patient.

In addition to relying on the professional clinical pharmacy knowledge, the following resources including online database were used to identify potential prescribing errors incidence: in which the prescriptions were analyzed using globalrph.com data base. [20], to detect errors in BSA calculations, in addition to BC cancer agency (BCCA) cancer drug manual [21] , to identify errors including unidentified protocols, inappropriate medications, dose errors, improper diluent type and volume, as well as improper infusion rate, wrong follow up plan ,and non-compliance of intention of TTT to the protocol of choice. Drugs.com data base [22] was used to detect drug-drug interactions. The references used weren't the only right source, but they were chosen for their availability as open sources. The prescribing errors were classified according to their severity into 3 levels major, moderate, and minor [23]. In which, major means an adverse effect can cause permanent damage or life risk, moderate means an adverse effect can make harm and treatment is required, minor means small or no clinical effect, with no treatment required.

2-Identification and assessment of risk factors:

A risk factor is any attribute, characteristic or exposure of an individual that increases the likelihood of developing a disease or injury [24]. So we studied the impact of risk factors on prescribing errors because they can play central part in the prediction and prevention of prescribing errors [25]. Two types of potential risk factors were identified in this study:

a) Tumor related factors:

Tumor type (breast, lung, GIT, genitourinary, lymphoma, gynecology and others including head and neck cancer, melanoma, sarcoma, they were gathered in one category because of very few cases in each), as well as staging of tumor (early, locally advanced, metastatic), the definition of each stage according to the National Cancer Institute, cancer staging fact sheet is as follows;

- **Early** means: cancer is limited to the organ in which it began, without evidence of spread.
- **Locally advanced** means: Cancer has spread beyond the primary site to nearby lymph nodes or organs and tissues.
- **Metastatic** means: Cancer has spread from the primary site to distant organs or distant lymph nodes.

b) Chemotherapy related factors:

Intention of treatment (adjuvant, metastatic, palliative, neoadjuvant) protocol type(CHOP, Docetaxel protocols, FEC-100, FOLFOX, Gemcitabine protocols, Paclitaxel protocols, Trastuzumab, Zoledronic acid, and others), route of administration of chemotherapy(IV, PO), dose frequency(q21 d,q28 d), toxicity type of the chemotherapy cycle (Hematological, non-hematological, both, none or missed), number of cycles required (continuous variable data), course number in the cycle (continuous variable data) , and total number of drugs received by the patient including antineoplastic agents, pre and post medications (continuous variable data).

3-The statistical analysis:

Summary statistics of the data was performed to determine the incidence of prescribing errors in the oncology department of Ain shams university hospitals, as well as their severity. The prediction of PEs was performed in two steps. Firstly, univariate analysis was performed to assess the relationship between potential risk factors and

observed medication errors; the level of significance was ($p \leq 0.05$). Second, all borderline significant in univariate analysis were integrated into stepwise logistic regression model. The odds ratio (OR) and 95% confidence interval (CI) were computed.

RESULTS:

Data collection:

Between March 2014 and August 2014, a number of 500 chemotherapy receiving patients who suffered solid tumors were studied. Including the risk factors under study, the missed data was excluded from the study. **Fig.1** shows the demographics of the patients under study.

Whereas the number of cycles required for the protocol of choice, course number in the cycle, and the number of medications in the treatment regimen (including antineoplastic drugs, pre- and post-medications) were studied as continuous variables and not categorized.

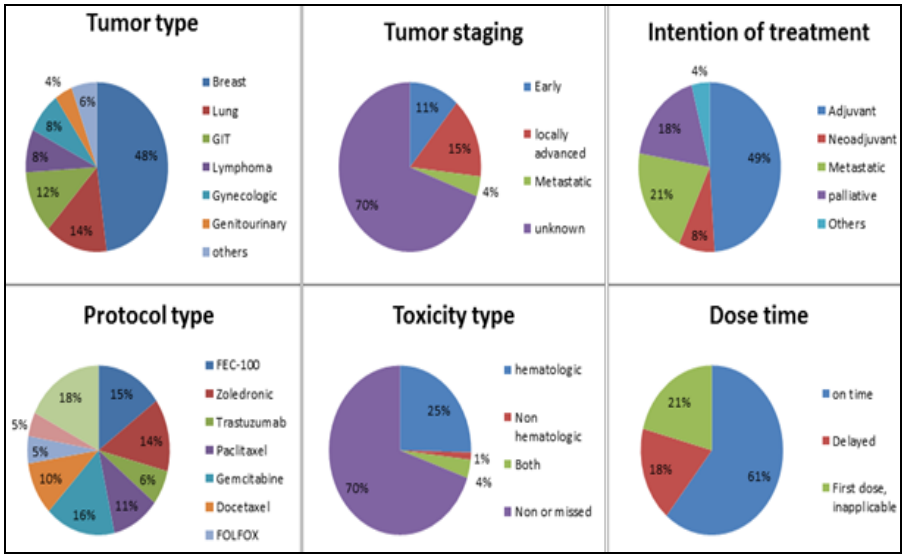

FIG.1: SHOWS THE DEMOGRAPHICS OF THE PATIENTS AND THEIR PERCENTAGE

Prescriptions of antineoplastic:

Among the 500 antineoplastic prescriptions 500 contained at least one prescription error (100%).

Fig.2 shows the percentage of each error incidence, and severity.

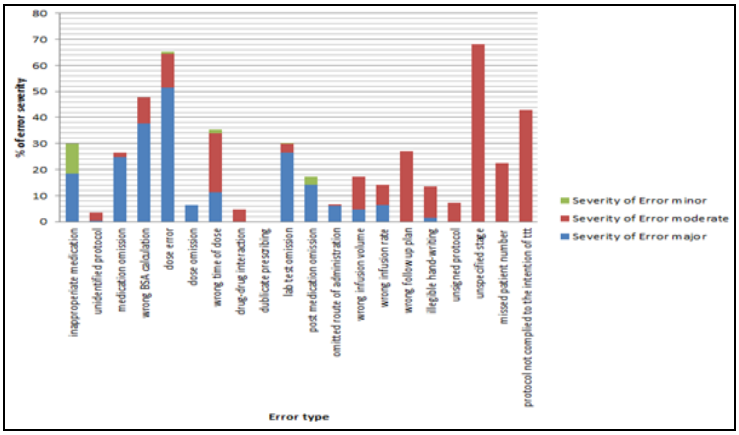

FIG.2: THE PERCENTAGE OF PRESCRIPTION ERROR INCIDENCE, AND SEVERITY

Univariate analysis:

Logistic regression model was applied for the categorical data; the data containing continuous values was analyzed using Mann-Whitney test as the distribution of data wasn't normally distributed.

The significant risk factors for the errors on the univariate level are summarized in the following tables.

TABLE 2: UNIVARIATE ANALYSIS OF THE SIGNIFICANT RISK FACTORS FOR INAPPROPRIATE MEDICATION ERROR.

Risk factor		Inappropriate medication error				
		Non		Yes		
		N	%	N	%	P-value
Tumor type	Breast	157	65.7%	82	34.3%	0.035
	Genitourinary	18	90.0%	2	10.0%	
	GIT	38	63.3%	22	36.7%	
	Gynecological	33	82.5%	7	17.5%	
	Lung	49	69.0%	22	31.0%	
	Lymphoma	34	82.9%	7	17.1%	
	Others	21	72.4%	8	27.6%	
Protocol type	CHOP	22	95.7%	1	4.3%	<0.001
	Docetaxel protocols	35	68.6%	16	31.4%	
	FEC-100	36	48.0%	39	52.0%	
	FOLFOX	17	65.4%	9	34.6%	
	Gemcitabine protocols	60	75.9%	19	24.1%	
	Other	61	69.3%	27	30.7%	
	Paclitaxel protocols	32	59.3%	22	40.7%	
	Trastuzumab	20	60.6%	13	39.4%	
	Zoledronic acid	65	94.2%	4	5.8%	

TABLE 3: UNIVARIATE ANALYSIS OF THE SIGNIFICANT RISK FACTORS FOR UNSPECIFIED STAGE ERROR

Risk factor		Unspecified stage error				
		Non		Yes		
		N	%	N	%	P-value
Protocol type	CHOP	6	26.1%	17	73.9%	<0.001
	Docetaxel protocols	18	35.3%	33	64.7%	
	FEC-100	45	60.0%	30	40.0%	
	FOLFOX	13	50.0%	13	50.0%	
	Gemcitabine Protocols	9	11.4%	70	88.6%	
	Other	30	34.1%	58	65.9%	
	Paclitaxel protocols	15	27.8%	39	72.2%	
	Trastuzumab	15	45.5%	18	54.5%	
	Zoledronic acid	8	11.6%	61	88.4%	

TABLE 4: UNIVARIATE ANALYSIS OF THE SIGNIFICANT RISK FACTORS FOR WRONG INFUSION VOLUME ERROR

Risk factor		Wrong infusion volume error				
		Non		Yes		
		N	%	N	%	P-value
Tumor type	Breast	194	91.1%	19	8.9%	<0.001
	GIT	90	89.1%	11	10.9%	
	Lymphoma	11	47.8%	12	52.2%	
	Other	118	84.3%	22	15.7%	

TABLE 5: UNIVARIATE ANALYSIS OF THE SIGNIFICANT RISK FACTORS FOR IMPROPER MEDICATION INFUSION RATE ERROR.

Risk factor		Improper medication infusion rate error				
		Non		Yes		
		N	%	N	%	P-value
Tumor type	Breast	200	95.7%	9	4.3%	<0.001
	GIT	96	96.0%	4	4.0%	
	Lymphoma	13	56.5%	10	43.5%	
	Other	121	89.0%	15	11.0%	

TABLE 6: UNIVARIATE ANALYSIS OF THE SIGNIFICANT RISK FACTORS FOR OMITTED OR UNADJUSTED POST TOXICITY MEDICATION ERROR

Risk factor		Omitted or unadjusted post toxicity medication error				
		Non		Yes		
		N	%	N	%	P-value
Protocol type	Docetaxelprotocols	43	84.3%	8	15.7%	<0.001
	FEC-100	54	72.0%	21	28.0%	
	Gemcitabine protocols	62	78.5%	17	21.5%	
	Other	149	87.6%	21	12.4%	
	Paclitaxel protocols	44	81.5%	10	18.5%	
	Zoledronic acid	61	88.4%	8	11.6%	
Toxicity	Hematological	80	64.5%	44	35.5%	<0.001
	non-hematological	4	57.1%	3	42.9%	
	both types	10	58.8%	7	41.2%	
	non or missed	312	91.8%	28	8.2%	

TABLE 7: UNIVARIATE ANALYSIS OF THE SIGNIFICANT RISK FACTORS FOR WRONG DOSE TIME ERROR.

Risk factor	Wrong dose time error												
	Non						Yes						
	N	Mean	Std. Deviation	Median	Minimum	Maximum	N	Mean	Std. Deviation	Median	Minimum	Maximum	P-value
Total number of drugs	320	7.53	2.70	8.00	0.00	13.00	166	7.91	3.00	9.00	0.00	13.00	0.033

TABLE 8: UNIVARIATE ANALYSIS OF THE SIGNIFICANT RISK FACTORS FOR DRUG- DRUG INTERACTION ERROR.

Risk factor	Drug- drug interaction error												
Total number of drugs	463	7.6	2.8	8.0	0.0	13.0	23	9.0	1.7	9.0	5.0	12.0	0.014

TABLE 9: UNIVARIATE ANALYSIS OF THE SIGNIFICANT RISK FACTORS FOR LAB TEST OMISSION ERROR.

Risk factor	Lab test omission error												
Number of cycles required	278	4.58	3.69	3.00	1	17	128	3.88	3.4	3.0	1	17.0	0.016

Multivariate analysis:

Borderline significant factors on the univariate level were further analyzed on the multivariate logistic regression model, In case there was only one significant factor on the univariate level so no further multivariate analyses could be done. The multivariate analysis was done on the following 2 errors only (inappropriate medication and unadjusted/ omitted post-toxicity medication). The protocol type was identified as predictor for the inappropriate medication error, while the toxicity type was the predictor factor for the error omitted or unadjusted post toxicity medication. As shown in **Table 10** and **Table 11.**

TABLE 10: MULTIVARIATE ANALYSIS OF THE SIGNIFICANT RISK FACTORS FOR IN APPROPRIATE MEDICATION ERROR

Risk factor for inappropriate medication error	95% CI for OR			
	OR	Lower	Upper	P-value
Protocol type				<0.001
CHOP vs Docetaxel protocols	10.1	1.2	81.3	0.030
CHOP vs FEC-100	23.8	3.1	186.0	0.002
CHOP vs FOLFOX	11.6	1.3	101.1	0.026
CHOP vs Gemcitabine protocols	7.0	0.9	55.2	0.066
CHOP vs other	9.7	1.2	76.0	0.030
CHOP vsPaclitaxel protocols	15.1	1.9	120.6	0.010

CHOP vs Trastuzumab	14.3	1.7	119.4	0.014
CHOP vs Zoledronic acid	1.4	0.1	12.8	0.791

TABLE 11: MULTIVARIATE ANALYSIS OF THE SIGNIFICANT RISK FACTORS FOR OMITTED/UNADJUSTED POST TOXICITY MEDICATION ERROR.

Risk factor for omitted/unadjusted post toxicity medication error	95% CI for OR			
	OR	**Lower**	**Upper**	**P-value**
Toxicity				<0.001
Toxicity (hematologic vs non-hematologic)	1.36	0.29	6.37	0.693
Toxicity (hematologic vs both types of toxicity)	1.27	0.45	3.58	0.647
Toxicity (hematologic vs non or missed toxicity)	0.16	0.09	0.27	<0.001

Table 12 summarizes the relation between the risk factors and prescribing errors; in which_: Means statistical analysis was not done on this relation X: Means statistical analysis was done and showed no significance on univariate, and multivariate logistic regression model +: Means statistical analysis was done and showed significance on univariate regression only and not multivariate logistic regression model. ++: Means statistical analysis was done and showed significance on both univariate, and multivariate logistic regression model. Not done: Means the number of positive cases containing the error was too small for the univariate analysis to be done.

TABLE 12: THE RELATION BETWEEN THE RISK FACTORS AND PRESCRIBING ERRORS

Risk factor / **Prescribing Error**	**Tumor type**	**Tumor stage**	**Intention of TTT**	**Protocol type**	**Number of cycles**	**Course number in cycle**	**Dose frequency**	**Total number of drugs**	**Toxicity**
Inappropriate medication	+	X	X	++	-	-	-	-	X
Unidentified protocol	-	-	-	-	-	-	-	-	-
Medication omission	-	-	-	X	X	X	-	-	X
Omitted/ unadjusted post toxicity medication	X	-	-	+	-	-	-	-	++
Wrong BSA	X	-	-	X	-	X	-	-	-
Dose error	X	-	-	X	-	X	-	X	X
Dose omission	-	-	-	-	X	X	X	-	X
Wrong dose time	-	-	-	-	X	X	X	+	X
Lab test omission	X	-	X	X	+	X	X	-	-
Potential drug-drug interaction	-	-	-	-	-	-	-	+	-
Duplicate prescription	-	-	-	-	-	-	-	-	-
Omitted or improper route of administration	-	-	-	X	X	X	-	-	-
Wrong infusion volume	+	-	-	Not done	-	-	-	-	-
Improper infusion rate	+	-	-	Not done	-	-	-	-	-
Wrong follow up	-	-	-	Not done	Not done	Not done	Not done	-	Not done
Illegible hand-writing	Not done	-	-	-	-	-	-	-	-
Protocol not signed	Not done	-	-	-	-	-	-	-	-
Unspecified stage	X	-	-	+	X	X	-	-	-
Missed patient number	X	-	-	-	X	X	-	-	-
Intention of TTT was not comply with the protocol of choice	-	Not done	Not done	Not done	Not done	-	-	-	-

DISCUSSION: The rate of antineoplastic medication errors reported in the literature range from 0.4% to 31.9% [26 – 29]. In our study, antineoplastic medication errors occurred at a huge rate of 100% of the cases ranging from minor to major severity faults. In this study there were two types of errors under study; errors of omission, and errors of commission.

The dose omission incidence was (6.4%), this percentage was higher than that of the outpatient chemotherapy infusion units at the Dana-Farber Cancer Institute, Boston which represented (0.58%) of the cases studied, and (23%) of the total number of adverse drug events reported [30].While the dose errors which was (66.2%), including the BSA erroneously calculated, or those involving inaccurate dose adjustment. This percentage was very high compared to that reported by Weingart et al in 2010, in which wrong dose involving oral chemotherapy was the most frequent type of error reported by (38.8%) [31].

The omitted stage of tumor in the protocol templates represented the highest percentage error (68.2%) in this study, although the strategy of patient treatment largely depend on the tumor staging, for the protocol of choice to be best tailored to the patient. It was a big problem especially in those protocols required staging to decide their appropriateness for the case, such as Paclitaxel/ carboplatin for treatment of gynecological cancer. The results were comparable to the Regional Cancer Centre of a tertiary care hospital in South India which reported omitted diagnosis in (61%)of the total number of prescriptions studied [19].

The inappropriateness of the protocol type represented (30%), which isn't a low percentage; it was largely dependent on the unspecified stage of tumor, and the lack of interest of studying the inclusion and exclusion criteria of each protocol, and the differentiation between the patients requiring dose modification, and those requiring shifting protocols.

There was no clear long and short term treatment strategy for each case. Such as the physicians prescribing FEC-100 protocol for patients requiring FEC-100/Docetaxel/ Trastuzumab protocol. The chemotherapy medications Methotrexate, Etoposide, Doxorubicin, Cyclophosphamide, and Vincristine were among the top 10 drugs in the United States Pharmacopeia MEDMARX database; a national, voluntary, Internet accessible error reporting system, for all error reports from 1999 through 2004 that involved chemotherapy TTT [32].

The medication omission data occurred at the percentage of (26.6%), this percentage was comparable as In Diaz-Carrasco et al retrospective study in which incorrect dose was (38.5%), and drug omission was (21.5%) [33].

The drug- drug interaction occurred at a level of (4.6%), this percentage was very low compared to that reported by Riechelmann et al., in 2007, in which the percentage of drug-drug interaction was (27%) [23]. The low percentage of this error in our study might be a reflection of the omitted medications.

Outcomes in these studies largely depended on the study design and the definition of medication error. Nine risk factors were identified as predictors of oncology medication errors based on a number of 500 patients, but only five of them were proved to be predictors through our study.

In our study, it was an aim to find predictors for the prescribing errors in the oncology department; therefore each risk factor was studied on a number of errors, which was thought there would be a relation between them.

The risk factor (protocol type), was a predictor of the errors inappropriateness of medication, unspecified stage, and omitted/unadjusted post toxicity medication. FEC-100 protocol prescriptions were the highest increasing inappropriateness, and decreasing unspecified staging. A possible explanation because it was mainly prescribed for breast cancer patients, which the physicians of the CCC were more expertized about this type of cancer diagnosis and staging, while this protocol was prescribed regardless its' exclusion criteria such as the patient age $\leq$ 60 years, and having lymph node metastases. Ranchon

et al., in 2012 proved that the Carboplatin prescriptions were associated with increasing the dose calculation errors [17].

Whereas the risk factor (the number of cycles required for each protocol) was a predictor of the error lab test omission, as the physicians were not keen of doing the lab test before each cycles, especially in those patients requiring protocols for more than three cycles.

The risk factor (toxicity type) was a predictor of the error unadjusted or omitted post toxicity medication, in which the odds of omitting added post toxicity medications is 6.25 times more if toxicity is hematological than if no toxicity was experienced by the patient .The physicians ignored the hematological toxicity experienced by the patients, especially those suffering anemia, as its treatment could increase nausea ,and vomiting of the patients ,while in case of neutropenia toxicity, physicians were confused about either to add filgrastim, or to delay the dose, or to reduce the dose, as well as the percentage of dose reduction.

The risk factor (total number of drugs in the protocol including pre-medications, post-medications and antineoplastic medication) was a predictor of wrong time of dose, and potential drug-drug interaction, that was because by increasing the number of drugs received by the patient that gave more chance for drug interaction between them, therefore toxicity of the protocol increased, and both the physician, and the patient became confused about receiving the next time of antineoplastic cycle. Although the finding that increasing number of medications was a risk factor for potential drug-drug interactions is consistent with previous studies [19]. It's surprisingly that it increased the wrong dose time in this study.

The risk factor (tumor type) was a predictor of inappropriate medication, in which, GIT department was the highest suffering that error, as FOLFOX-4 protocol [Oxaliplatin 85mg/m^2 day(d)(1,15), Leucovorin 200 mg/m^2/day (d1,2,15,16), 5-Fluorouracil 400 mg/m^2/day (d1,2,15,16) and5-Fluorouracil 600 mg/m^2/22 hour] wasn't found on the BCCA data base. On the other hand lymphoma tumor was highest tumor type leading to wrong infusion volume, and wrong infusion rate of about (52.2%), and (43.5%) respectively, that was because CHOP protocol templates of Ain Shams University central clinic (which was prescribed to about 50% of the lymphoma cases) showed a discrepancy with BCCA protocol template.

The present study suffered several limitations including:

- The study was done on a single university hospital.
- The missed data, it was the biggest challenge in our study.
- The protocol templates were compared to BCCA data base only.

CONCLUSION: Our study declares that prediction of prescribing errors is feasible throughout observing the effect of risk factors on the error incidence to improve the quality and efficacy of treatment. It is clearly obvious that the treatment of oncology patient should be computerized to avoid as possible errors for example BSA calculation and therefore dose errors [34]. Also the role of clinical pharmacist should be expanded ,and the physician ,pharmacist , nurse should work in health care team, in order to decrease the errors involving medications choice, doses, drug interactions, and administration of medications [35].

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REFERENCES:

1. The National Coordinating Council for Medication Error Reporting and Prevention 2014. Available at: http://www.nccmerp.org/med Error Cat Index. html (Accessed on 23rd May 2014.
2. Alsulami Z, Conroy S, Choonara I: Medication errors in the Middle East countries, A systematic review of the

literature. European Journal of Clinical Pharmacology 2013; 69(4):995-1008.
3. Phillips J, Beam S, Brinker A, et al: Retrospective analysis of mortalities associated with medication errors. Am J Health Syst Pharm 2001 Nov 15; 58(22):21-30.
4. Ma CSJ: Role of pharmacists in optimizing the use of anticancer drugs in the clinical setting. Integrated Pharmacy Research and Practice 2014; 3:11-24.
5. Goldspiel B, Hoffman JM, Griffith NL, Goodin S, et al: ASHP Guidelines on Preventing Medication Errors with Chemotherapy and Biotherapy. Am J Health Syst Pharm 2015 Apr 15; 72(8):e6-e35.
6. Bruce K, Hall L, Castelo S, Evans M, Frangoul H: Direct provider feedback to decrease chemotherapy ordering errors: the "gray envelope" initiative. Pediatr Blood Cancer 2012 Dec 15; 59(7):1330-1.
7. Klys M, Konopka T, Scislowski M, Kowalski P: Fatality involving vinblastine overdose as a result of a complex medical error. Cancer Chemother Pharmacol 2007; 59(1):89–95.
8. Jurek T, Rorat M, Dys P, Swiatek B: Fatal cisplatin overdose in the treatment of mediastinal lymphoma with the ESHAP regimen - analysis of the causes of the adverse drug event. Onkologie 2013; 36(1-2):49-52.
9. Aversa SM, Zanon S, Marino D, Canova F, Chiarion-Sileni V, Jirillo A : Overdose of Vinblastine in place of Vinorelbine during IGEV chemotherapy. Immunopharmacol Immunotoxicol 2012 Oct; 34(5):879-8050.
10. Chu G, Mantin R, Shen YM, Baskett G, Sussman H: Massive cisplatin overdose by accidental substitution for carboplatin Toxicity and management. Cancer 1993; 72(12):3707–14.
11. Tournel G, Becart-Robert A, Courtin P, Hedouin V, Gosset D: Fatal accidental intrathecal injection of vindesine. J Forensic Sci 2006; 51(5):1166–8.
12. Dettmeyer R, Driever F, Becker A, Wiestler OD, Madea B. Fatal: Myeloencephalopathy due to accidental intrathecal vincristine administration: a report of two cases. Forensic SciInt 2001; 122(1):60–4.
13. Patiroglu T, Unal E, Ozdemir MA, Karakukucu M, Mutlu FT: Accidental intramuscular overdose administration of vincristine. Drug Chem Toxicol. 2012 Apr; 35(2):232-4.
14. LetarteN, Gabay MP, et al: Analyzing temozolomide medication errors: potentially fatal. J Neurooncol. 2014 Oct; 120(1):111-5.
15. Delpeuch A, Leveque D, Gourieux B, Herbrecht R: Impact of clinical pharmacy services in a hematology/oncology inpatient setting. Anticancer Res 2015 Jan; 35(1):457-60.
16. Van Leeuwen RW, Brundel DH, et al: Prevalence of potential drug-drug interactions in cancer patients treated with oral anticancer drugs. Br J Cancer 2013 Mar 19; 108(5):1071-8.
17. Ranchon F, Moch C, You B, et al: Predictors of prescription errors involving anticancer chemotherapy agents. European Journal of Cancer 2012; 48: 1192–1199.
18. Hamza N, Sallam S and El-Nimr N: Rates and Types of Prescribing Errors and Related Interventions in Oncology. Int.J.Curr.Microbiol.App.Sci 2013; 2(12): 435-445.
19. Mathaiyan J, Jain T, Dubashi B, Reddy KS, Batmanabane G: Prescription errors in cancer chemotherapy: Omissions supersede potentially harmful errors. Journal of Pharmacology & Pharmacotherapeutics. 2015; 6(2):83-87.
20. global rph (1993-2015) available via http://www.globalrph.com
21. Bccancer agency. BCCA cancer drug manual available via http://bccancer.bc.ca/HPI/Drugdatabasedefault.htm.
22. Drug site trust drugs .com tm .drug information online. available via http://drugs.com
23. Riechelmann P, Ian F, et al.: Potential Drug Interactions and Duplicate Prescriptions Among Cancer Patients. jnci.oxfordjournals.org 2007; 99(8).
24. http://www.who.int/topics/risk_factors/en/
25. Kraemer H and Offord D: Risk factors and prevention. Evid Based Mental Health 2000;3:70-71
26. Dhamija M, Kapoor G, JunejaA: Infusional chemotherapy and medication errors in a tertiary care pediatric cancer unit in a resource-limited setting. J Pediatr Hematol Oncol 2014 Oct; 36(7):e412-5.
27. Oberoi S, Trehan A, Marwaha RK: Medication errors on oral chemotherapy in children with acute lymphoblastic leukemia in a developing country. Pediatr Blood Cancer 2014 Dec; 61(12):2218-22.
28. Aita M, Belvedere O, De Carlo E, et al: Chemotherapy prescribing errors: an observational study on the role of information technology and computerized physician order entry systems. BMC Health Serv Res 2013 Dec 17;13:522
29. Ranchon F, Salles G, Spath HM, et al: chemotherapeutic errors in hospitalized cancer patients: attributable damage and extra costs. BMC Cancer 2011; 11(1):478.
30. Gandhi T , Bartel S , Shulman, L, Verrier D , Burdick E, et al: Medication safety in the ambulatory chemotherapy setting. Cancer 2005; 104 (11):2477-83.
31. Weingart S , Toro J, Spencer J, Duncombe D ,et al: Medication errors involving oral chemotherapy. Cancer 2010; 116 (10): 2455-64.
32. Rinke M, Shore A, Morlock L, Hicks R, and Miller M: Characteristics of pediatric chemotherapy medication errors in a national error reporting database. Cancer 2007; 110 (1): 186-95.
33. Díaz-Carrasco M, Pareja A, Yachachi A, Cortés F, and Espuny A: Prescription errors in chemotherapy. Farm Hosp 2007; 31 (3): 161-4.
34. ASHP Guidelines on Preventing Medication Errors with Chemotherapy and Biotherapy.
35. Hekelle PG, Wachter RM, Pronovost PJ, et al: Making healthcare safer II: an updated critical analysis of the evidence for patient safety practices. Comparative Effectiveness Review No.211. (Prepared by the Southern California-RAND Evidence-based Practice Center under Contract No. 290–2007-10062-I.) AHRQ Publication No. 13-E001-EF. Rockville, MD: Agency for Healthcare Research and Quality, March 2013.

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