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Description of medications errors in primary healthcare centers in Riyadh, Saudi Arabia

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Abstract
Introduction: Good healthcare is a key to prevent hospitalization. Contrarily, if approcah of primary healthcare is unsafe, that may cause unnecessary complications, injuries, disability or in severe cases, may result in death. Medications Errors (MEs) are one of those unsafe healthcare approcahes. Pharmacy plays an important role in preventing medication errors and improving patient safety. Reporting of medication errors will hopefully contribute to patient safety.
Objectives: Objectives of the study are:

- To identify frequency and the most common pharmacological class and medication dosage form that led to MEs in primary healthcare centers since 2017.
- To identify the most common patient, physician and clinical characteristics that led to more frequent MEs in primary healthcare centers since 2017.

Methodology: It was a retrospective descriptive study based on reporting forms of medication errors made by pharmacists in Al-Wazarat pharmacy from January 2017 to December 2017. Data of Medication Errors along with clinic, patient and physician characteristics was retreived and descriptive analysis was made by frequency, percentage, mean, standard deviation, and cross-tabulation with Chi-Square tests.
Results: The study results showed: Majority of the errors occurred in morning shift with B outcome category, female patients were more affected by MEs in primary healthcare centers, inappropriate dosage, under and over dose, non-formulary, drug not specified and monitoring error were most frequent MEs which occurred most commonly in general clinics and the clinics of chronic disease with oral and parenteral form of dosage. Most of the errors had been made by the male registrar and the majority of them were Saudis.
Recommendations: Keeping in view the results of study, awareness of reporting medication errors through educational or training workshops among physicians is recommended. Moreover. Formulary should be distributed in all clinics and reporting system of ME should also be improved.

Keywords: Medication errors, pharmacy, pharmacology, primary healthcare, Al-Wazarat, medication dosage

Introduction

Primary health care is the gate to patient safety, therefore delivery of safe primary health care is of ultimate importance. Good primary health care is a key to prevent hospitalizations, contrarily unsafe primary health care can cause unnecessary complication or injury, leading to unavoidable hospitalizations, and in some cases, disability or death. However, the substantial and increased medications use has brought a greater risk of harm [1], which cannot be avoided by efforts can be made to minimize it.

According to World Health Organization "The medication is in the control of health care professionals, patient, or consumer while Medication Errors (MEs) are preventable events that may cause or lead to inappropriate medication use or patient harm. Such events may be related to professional practice, health care products, procedures, or systems, including prescriptions, order communication, product labelling, packaging, nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use" [2]. In Al-Wazarat primary healthcare pharmacy at Prince Sultan Military Medical City (PSMMC), pharmaceutical department has initiated a form for reporting MEs, they used National Coordinating Council (NCC) for Medication Error Reporting and Prevention (MERP) which classifies an error according to the severity of the outcome. When pharmacists report the MEs, they may also intervene in the system to prevent it.

Medication error is a continuing global phenomenon. The errors are well-documented in the scholarly literature and vary significantly depending on location. For example, a study in the

United Kingdom found that annually 12% of all primary care patients are likely victims of either prescribing or a monitoring error. The number increases to 38% in patients who are above 74 years of age. Also, 30% of patients have received more drugs than they should have over a 12-month period due to physician's error. Overall, 5% of prescriptions had prescribing errors [3]. In contrast, a Swedish study found a medication error rate of whopping 42%. Two-thirds of which were related to a failure to state the purpose of the treatment on prescriptions, whereas only 1% of errors resulted in an incorrect dose [4]. A study from Saudi Arabia reported that just under one-fifth of primary care prescriptions contained errors, and only a small minority of errors were considered serious [5]. The same study also reported that prescribing errors were found on 990 out of 5299 prescriptions (18.7%). They analyzed a total of 2463 prescribed drugs from public clinics and 2836 from private clinics [5]. Another study in a Mexico observed that 58% of prescriptions contained errors, with dosage regimen accounting for the highest number at 27.6% [6]. This shows that number of errors cannot be generalized based on geographical locations, there may be other factors playing their role.

Prescribing errors have been defined as MEs initiated during the prescribing process. These include the incorrect selection of medication, wrong dose, strength, frequency, incorrect method of administration, inadequate instruction for the use of a medication and wrong dosage form [7]. All these studies had been enfolded in prescribing errors, which I focused on in my study because all these errors can take place at any primary healthcare setting. For example, a study done in Bahrain primary healthcare shows that 7.7% of prescriptions contained errors; Omission errors (93.6%) and Commission errors (6.3%) [8]. Another study at Bahrain primary healthcare, which focused only on medication errors for infants, found that 90.5% of prescriptions contained errors and 74.5% of medications contained drug errors. Dosing frequency was incorrectly written in 20.8% of prescriptions and dose strength was incorrectly written in 17.7% [9]. Both of these studies had been reported by The Pharmacist. In Palestine (General hospital) all patients with creatinine clearance ≤59 ml/min 63 (80%) had at least one inappropriate medication, 1.5 fold greater than the recommended dose, and poor knowledge of pharmaco-kinetics of prescribed drug [10]. In Egypt Teaching hospital's intensive care unit (ICU), 619 medication-related problems were detected in 213 patients and incorrect dosage (22%) was found to be the most common error in ICU [11].

In Israel (General hospital) prospective prescriptions were reviewed in pharmacy. In results, 160 MEs were detected; 97 (60.6%) were prescribing errors, in which incorrect dosage (44) was the most common type [12]. Also in Iran (teaching hospital) a study had been done on elderly patient medications errors. It found that 829 (27%) patients received at least one inappropriate prescription and 746 (24%) patients had at least one duplicate medicine prescribed [13]. These examples are provided to show that medication errors are a global issue and cannot be isolated to certain regions, nations, or population groups.

Systematic review in middle east shows the rate of prescribing errors ranged between 7.1% and 90.5%. [30]. One systematic review shows that the proportion of serious medication errors in primary healthcare may be judiciously low. However, medications errors in primary healthcare, still had the potential to cause considerable harm. Undesirable outcomes include adverse drug reactions, drug-drug interactions, lack of efficacy, suboptimal patient adherence and poor quality of life and patient experience. In turn, these may have significant health and economic consequences, including the increased use of health services, preventable medication-related hospital admissions and death [16]. It has been estimated that in some countries 6 medication errors, approximately 6-7% of hospital admissions appear to be medication related, with over two-third of these considered avoidable and thus, potentially due to errors [17-18]. The problem is likely more pronounced in the elderly, because of multiple risk factors, one of which is Poly-pharmacy [19].

Medication errors are under-reported in all countries [14] particularly in developing countries. These errors are harming about 1.5 million people every year. Medication errors one of the main causes for adverse events and prolonged hospitalization (20, 21). In addition, MEs costs between US$ 6 billion and US$ 29 billion per year (22). MEs present a universal problem and can cause serious consequences for patients, especially those with acute complex medical conditions [15].

Objectives

Pharmacy plays an important role in preventing medication errors and improving patient safety. Reporting of medication errors will hopefully be initiating patient safety. To keep the data fresh and relevant, we focused our research from 2017 onwards. Following objectives were considered in our study:

- To identify frequency and the most common pharmacological class and medication dosage form that led to MEs in primary healthcare centers since 2017.
- To identify the most common patient, physician and clinical characteristics that led to more frequent MEs in primary healthcare centers since 2017.

Hypotheses

The following Hypotheses were made in relation to objectives in this study:

H_0 Physician's rank and Form of medication dosage is not associated with MEs in PHCs.

H_A Physician's rank and Form of medication dosage is associated with MEs in PHCs.

Methods

This study has been conducted in Al-Wazarat Primary healthcare center under PSMMC in Riyadh, which has been accredited by the Joint Commission International (JCI) twice. Al-Wazarat pharmacy has five clinical pharmacists and twelve pharmacists. Pharmaceutical services are available from 8:00 AM to 4:00 PM, Sunday through Thursday. Al-Wazarat is the largest pharmacy among primary healthcare centers at PSMMC. In 2017 only, a total of 141,128 prescriptions have been issued to patients.

We conducted a retrospective descriptive study based on reporting forms of medication errors made by pharmacists in Al-Wazarat pharmacy from January 2017 to December 2017. One of the main tasks of pharmacists and clinical pharmacists is to document every medication error that occurs on daily bases. During the study period, we collected information from medication errors reporting forms, received by the quality department in the pharmacy, which includes: medication error type, outcome severity, pharmacological class, medication dosage, patient characteristics, physician characteristics, and

clinic characteristics.

We classified the types and causes of medication errors according to the guidelines of the American Society of Health-System Pharmacists (1993) regarding drug prescribing, dispensing, and preparation [23]. The severity of medication errors was determined based on the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) and Index for Categorizing Medication Errors Algorithm (ICMEA). Each medication error was classified into one of nine categories (A to I), according to the potential of the error to cause harm to the patient as: circumstances or events that have the capacity to cause error (category A); an error occurred but the error did not reach the patient (category B); an error occurred that reached the patient but did not cause patient harm (category C) or required monitoring to confirm that it resulted in no harm to the patient and/or required intervention to preclude harm (category D); an error occurred that may have contributed to or resulted in temporary harm to the patient and required intervention (category E) or required initial or prolonged hospitalization (category F); an error occurred that may have contributed to or resulted in permanent patient harm (category G); an error occurred that required intervention necessary to sustain life (category H); and an error occurred that may have contributed to or resulted in the patient's death (category I) [24]. Medication errors classified as category B were considered to be potential errors or near misses. The only medication errors available for research purposes were categories A and B, because others remained outside of the domain and setting of pharmacy.

For the purposes of this study, all reporting forms of medication errors have been reviewed by a pharmacist in order to extract the data. The data was stored, processed, and analyzed using SPSS, version 22. The analysis was conducted after data cleaning and quality testing. Descriptive statistics for categorical variables were summarized as frequencies and percentages. Crosstabs with Chi-Square tests were also made to infer most common characteristics of variables under investigation which led to the medication errors in primary healthcare centers. Null hypotheses were rejected or failed to be rejected by the significance value of Pearson Chi-Square test.

Results

Table 1: Frequency of medication errors in different months, time and outcome category

Month	N	%	Month	N	%
January	6	5.3	July	3	2.7
February	11	9.7	August	4	3.5
March	5	4.4	September	2	1.8
April	14	12.4	October	27	23.9
May	6	5.3	November	20	17.7
June	4	3.5	December	11	9.7
Time			Outcome category		
Morning (8AM-12PM)	70	61.9	A	15	13.3
Evening (12PM-4PM)	43	38.1	B	98	86.7
Total	113	100	Total	113	100

In 2017, there were a total of 141,128 prescriptions issued by the pharmacy in Al-Wazarat Primary healthcare center. Out of these prescriptions, 113 (0.08%) included medication errors (M=7.49, SD=3.7). Table 1 shows that the lowest rate of medication errors occurred in September (N=2), and the highest (N=27) was in October. The majority of these errors (61.9%) occurred in the morning shift (8AM-12PM) while 38.1% occurred in the evening shift (12PM-4PM). Also, most errors were classified as outcome category B (86.7%), followed by outcome A (13.3%).

Table 2: Gender and age of patients Affected by medications errors

Patient Gender	N	%	patient age	N	%
Male	44	38.9	Valid 0-14	14	12.4
Female	69	61.1	15-59	76	67.3
Total	113	100	>=60	23	20.4

Table 2 presents that a total of 113 patients were affected by medication errors. Of those affected, 38.9% were male patient and 61.1% were female patients. The majority of patients (67.3%) were adults (15-95 years old), while 12.4% were pediatric patients (0-14 years old), while 20.4% were geriatrics (60 and above).

Table 3: Errors type in the sample

Error type	N	%	Error type	N	%
Inappropriate Dose Over	17	15	Poor Hand Writing	2	1.8
Inappropriate Dose under	23	20.4	Wrong Patient	2	1.8
Wrong Strength	1	0.9	Drug Not Specified (No Dose)	6	5.3
Wrong Concentration	1	0.9	Drug Not Specified (No Frequency)	6	5.3
Wrong Drug	8	7.1	Drug Not Specified (No Duration)	14	12.4
Non-Formulary	17	15	Monitoring Error (Drug-Drug)	8	7.1
Inappropriate Treatment	5	4.4	Drug Not Specified	3	2.7
Total	113	100			

Table 3 shows type of errors (M=9.2, SD=7.7). The most frequent errors were inappropriate dose (35.5%), under dose (20.4%) and the lowest type of errors, which occurred were wrong strength and concentration (0.9%). These error types were higher than the mean: Non Formulary 15%, and Drug Not Specified-No-Duration (12.4%). Contrarily, Wrong Strength 0.9%, Wrong Concentration 0.9%, Wrong Drug 7.1%, inappropriate Treatment 4.4%, Poor Hand Writing 1.8%, Wrong Patient 1.8%, Drug Not Specified (No Dose) 5.3%, Drug Not Specified (No Frequency) 5.3%, Monitoring Error (Drug-Drug) 7.1%, and Drug Not Specified 2.7% were lower than the mean.

Table 4: Physicians' characteristics according to nationality, gender and rank

Physician Nationality	**N**	**%**
Saudi	60	56.6
Arab Non-Saudi	28	26.4
Non-Saudi Non-Arab	18	17
Physician Gender		
Male	66	62.3
Female	40	37.7
Physician Rank	**N**	**%**
Consultant	29	27.4
Senior Registrar	5	4.7
Registrar	46	43.4
Resident	20	18.9
Dentist	6	5.7
Total	106	100

Table 4 presents physician's characteristics. Most physicians were Saudis (56.6%), while Arab non-Saudi physicians comprised 26.4%, and non-Saudi non-Arab physicians were 17%. Most of the reported errors were made by male physicians (57.5%), while the female made 35.4% errors. Finally, physician's ranks from highest to lowest were: registrar (43.4%), consultant (27.4%), resident (18.9%), dentist (5.7%) and senior registrar (4.7%).

Table 5: Saudi physician outcome category, gender, rank and clinic

Outcome category	**N**	**%**	**Physician gender**	**N**	**%**
A	12	20	Male	34	56.7
B	48	80	Female	26	43.3
Total	60	100	Total	60	100
Physician Rank			**Clinic name**		
consultant	22	36.7	Chronic disease	20	33.3
Senior registrar	4	6.7	General	31	51.7
Registrar	8	13.3	Dental	7	11.7
Resident	20	33.3	Repeat	2	3.3
Dentist	6	10	Total	Total	100
Total	60	100			

Table 5 presents the errors made by Saudi physicians. 60 medication errors were made by Saudi physicians. Most of these errors were in category B (80%) and done by Saudi male physicians (56.7%), while 36.7% were consultant in general clinic (51.7%).

Table 6: non-Saudi physician rank in our sample.

Non-Saudi Physician Rank	**N**	**%**
Consultant	7	15.2
Senior Registrar	1	2.2
Registrar	38	82.6
Total	46	100

Table 6 shows the non-Saudi physician rank in our sample. Non-Saudi Physicians were: 82.6% Registrar, 15.25% consultant, and 2.2% senior registrar.

Table 7: descriptive of the clinic in the sample and medication dosage form in the sample

Clinic Name	**N**	**%**	**Medication Dosage Form**	**N**	**%**
Chronic disease	32	29.4	Oral	83	73.5
General	65	59.6	Parenteral	15	13.3
Dental	7	6.4	Inhalational	3	2.7
Women's health	3	2.8	Topical	7	6.2
Repeat	2	1.8	ophthalmic	1	0.9
total	109	100	Suppository	1	0.9
			Ear Preparation	1	0.9
			Oral+ Parenteral	2	1.8
			Total	113	100

Table 7 shows the clinic characteristic. Four pieces of data were missing. The highest medication errors occurred in the general clinic (59.6%), followed by the chronic disease clinic (29.4%). MEs also occurred in the dental clinic with 6.4%, women's health clinic with 2.8%, and repeat clinic with 1.8% frequency.

Table 5 also shows the medication dosage forms in our sample. There were seven medication dosage forms in which errors had been occurring. Oral medications were reported the most (73.5%), followed by parenteral (13.3%), topical (6.2%), inhalational (2.7%), ophthalmic, suppository and ear preparation (0.9%).

Table 8: Medication pharmacological class in the sample

Pharmacological class	**N**	**%**	**Pharmacological class**	**N**	**%**
Antidiabetic Biguanides	7	6.2	NSAIDs	3	2.7
Antidiabetic 2nd-Generation sulfonylureas	6	5.3	Immunosuppressive Agent	1	0.9
Antidiabetic Long Acting Insulin	5	4.4	Antiviral	1	0.9
Antidiabetic Short Acting Insulin	6	5.3	Antihypertensive ARBs	1	0.9
Antidiabetic DPP-4 Inhibitor	2	1.8	Antihypertensive ARBs/HCTz	3	2.7
Antidiabetic Rapid Acting with Intermediate Acting Insulins	2	1.8	Antihypertensive ACEI	5	4.4
Lipid Lowering Agent HMG-COA Reductase Inhibitor	3	2.7	Antihypertensive Vasodilators	1	0.9
Corticosteroids	2	1.8	Antihypertensive ca++ Channel Blocker	1	0.9
Bronchodilator Beta 2agonisit	1	0.9	Antihistamine 2nd Generation	1	0.9
Lubricant	2	1.8	H. pylori Regimen	2	1.8
Proton Pump Inhibitor	1	0.9	Disinfected & Antiseptic	1	0.9
Iron with Folic Acid	1	0.9	T4 Synthetic	3	2.7
Antibiotic Macrolides	2	1.8	Anti-vertigo	1	0.9
Antibiotic 2n Generation cephalosporin	1	0.9	Bronchodilator Beta 2agonist+Coricostriode	3	2.7
Antibiotic Penicillin, Amino	6	5.3	Antibiotic Dichloroacetic acid Derivative	1	0.9
Anthelmintic	1	0.9	Antihypertensive Beta1selective Blocker	2	1.8
Antifungal	7	6.2	ARBs & ACEI	3	2.7
Fat soluble Vitamins	6	5.3	Antihypertensive, antidiabetic, Lipid lowering Agent	2	1.8
Water Soluble Vitamins B-Complex	2	1.8	T4synthetic, Lipids Lowering Agent	1	0.9
Water Soluble Vitamins Folic Acid	1	0.9	Antidiabitic&T4 synthetic & Lipid Lowering Agent	1	0.9
Water Soluble Vitamins Cyanocobalamin	1	0.9	Anti-Depressant SSRI	1	0.9
Alpha1 Blocker	3	2.7	DPP-4 Inhibitor & GLP1agonists	2	1.8

5-Alpha Reductase Inhibitor	1	0.9	ca++Channel Blocker + ca++Channel Blocker	1	0.9
NSAIDs	3	2.7	Sulfonylurea + Short Acting Insulin	2	1.8
Total	113	100	SNRIs+ SSRI	1	0.9

Table 8 presents forty one Pharmacological classes where errors had been occurring. The two most frequent with 6.2% are antidiabetic Biguanides and antifungal. Four errors had high probability to cause drug-drug interaction, three with 1.8% which are (DPP-4 Inhibitor & GLP1agonists, and Sulfonylurea + Short-Acting Insulin), 2.7% ARBs & ACEI and with (serotonin and norepinephrine reuptake inhibitor + selective serotonin reuptake inhibitor) 0.9%. There were two compaction errors in all of them in T4synthetic, Lipid-Lowering Agent and Antidiabetic&T4 synthetic & Lipid Lowering Agent (0.9%) and the third one in Antihypertensive, Diabetic, Lipid-lowering Agent with 1.8%.

Table 9: Most common patient gender that led to more frequent MEs in primary healthcare centers

Type Error	Male		Female	
	N	%	N	%
Inappropriate Dose Over	7	6.2	10	8.8
Inappropriate Dose under	12	10.6	11	9.7
Wrong Strength	0	0.0	1	0.9
Wrong Concentration	0	0.0	1	0.9
Wrong Drug	2	1.8	6	5.3
Non-Formulary	10	8.8	7	6.2
Inappropriate Treatment	2	1.8	3	2.7
Poor Hand Writing	1	0.9	1	0.9
Wrong Patient	0	0.0	2	1.8
Drug Not Specified (No Dose)	3	2.7	3	2.7
Drug Not Specified (No Frequency)	2	1.8	4	3.5
Drug Not Specified (No Duration)	4	3.5	10	8.8
Monitoring Error (Drug-Drug)	1	0.9	7	6.2
Drug Not Specified	0	0.0	3	2.7
Total	44	38.9	69	61.1
95% Confidence Interval				
Lower Bound		5.35		8.44
Upper Bound		9.67		12.46
Chi-Square Tests	Value	df	Sig.	
Pearson Chi-Square	13.153[a]	13	.436	
Likelihood Ratio	15.927	13	.253	

Table 9 comprised of cross-tabulation regarding patient gender related to MEs in primary healthcare centers since 2017. Results showed that ME 'inappropriate dose over' has occurred more with females (8.8%) than with males (6.2%). Contrarily ME 'inappropriate dose under' occurred more with males (10.6%) than females (9.7%). Wrong drug was given to more females (5.3%) as compared to males (1.8%). MEs 'Drug not specified' and 'monitoring error' were made more frequently with female patients (23.9%) than male patients (8.9%). Non formulary medication was advised to 8.8% males while to only 6.2% females. Chi-square tests significance value ($P = .436 > .05$) indicated that null hypothesis could not be rejected.

Table 10: Most common Physician Rank that led to more frequent MEs in primary healthcare centers

Type Error	Physician Rank					Total
	Consultant	Senior Registrar	Registrar	Resident	Dentist	
Inappropriate Dose Over	3	1	10	2	0	16
Inappropriate Dose under	7	1	10	4	0	22
Wrong Strength	0	1	0	0	0	1
Wrong Concentration	0	0	1	0	0	1
Wrong Drug	2	1	2	2	0	7
Non Formulary	2	0	8	4	0	14
Inappropriate Treatment	1	0	3	1	0	5
Poor Hand Writing	2	0	0	0	0	2
Wrong Patient	2	0	0	0	0	2
Drug Not Specified (No Dose)	2	0	2	0	2	6
Drug Not Specified (No Frequency)	2	0	0	2	2	6
Drug Not Specified (No Duration)	2	1	7	2	2	14
Monitoring Error (Drug-Drug)	3	0	3	2	0	8
Drug Not Specified	1	0	0	1	0	2
Total	29	5	46	20	6	106
95% Confidence Interval						
Lower Bound	7.00	-2.98	5.60	6.17	17.06	
Upper Bound	13.00	15.38	10.01	13.73	18.94	
Chi-Square Tests	Value	df	Sig.			

Pearson Chi-Square	72.220[a]	52	.033			
Likelihood Ratio	58.783	52	.241			

Table 10 identifies most common physician rank which led to MEs in primary healthcare centers since 2017. It was found that MEs 'inappropriate dose over', 'inappropriate dose under', 'non formulary', 'inappropriate treatment' and 'drug not specified' were frequently practiced by registrar physicians (N = 38) whereas consultant physicians were on second place, who practiced these MEs (N = 15). Significance value of Pearson Chi-Square test rejected null hypothesis. Hence registrar and consultant physicians were more responsible for MEs than other ranks.

Table 11: Most common Medication Dosage Form that led to more frequent MEs in primary healthcare centers

Type Error	Medication Dosage Form							
	Oral	Parenteral	Inhalational	Topical	ophthalmic	Suppository	Ear Preparation	Oral + Parenteral
Inappropriate Dose Over	16	1	0	0	0	0	0	0
Inappropriate Dose under	18	5	0	0	0	0	0	0
Wrong Strength	0	0	1	0	0	0	0	0
Wrong Concentration	0	1	0	0	0	0	0	0
Wrong Drug	3	3	0	1	0	0	1	0
Non Formulary	13	0	0	3	1	0	0	0
Inappropriate Treatment	4	0	0	1	0	0	0	0
Poor Hand Writing	1	0	0	1	0	0	0	0
Wrong Patient	2	0	0	0	0	0	0	0
Drug Not Specified (No Dose)	5	1	0	0	0	0	0	0
Drug Not Specified (No Frequency)	6	0	0	0	0	0	0	0
Drug Not Specified (No Duration)	9	1	2	1	0	1	0	0
Monitoring Error (Drug-Drug)	6	0	0	0	0	0	0	2
Drug Not Specified	0	3	0	0	0	0	0	0
Total	83	15	3	7	1	1	1	2
95% Confidence Interval[a,b,c,d]								
Lower Bound	7.03	4.26	-9.28	4.96				
Upper Bound	10.34	14.14	36.61	13.33				
Chi-Square Tests		Value	df	Sig.				
Pearson Chi-Square		154.924	91	.000				
Likelihood Ratio		88.434	91	.557				

a. type error is constant when medication dosage form = opethalmic. It has been omitted from exploring Confidence Interval.
b. type error is constant when medication dosage form = Suppository. It has been omitted from exploring Confidence Interval.
c. type error is constant when medication dosage form = Ear Preparation. It has been omitted from exploring Confidence Interval.
d. type error is constant when medication dosage form = Oral + Parenteral. It has been omitted from exploring Confidence Interval.

Table 11 shows the form of medication dosage leading to MEs in primary healthcare centers since 2017. Frequency values gave the view that MEs have occurred in the form of oral dosage (N = 83) followed by Parenteral form of medication (N = 15). Pearson Chi-Square test rejected null hypothesis (Sig. = .000).

Discussion

Worldwide, medication errors are under reported in primary healthcare centers [14]. This issue is even more present in the Middle East [15]. Al-Wazarat primary healthcare center in Riyadh started documenting medication errors from 2012. Since 2012, the number of medication errors have fluctuated with time. Medication errors were 118 in 2012, 398 in 2013, 436 in 2014, 512 in 2015, 542 in 2016and after this high number, it declined to 113 in 2017, showing that 2017 witnessed the lowest number of medication errors since 2012. This fluctuation in medication error rates might be associated with changes in medication error regulations and incentives. For example, from 2012 to 2016, where high numbers of medication errors were reported, incentives such as getting days off were given to pharmacists who report eight medication errors per month. When these incentives were terminated, the rate declined in 2017 by almost one fifth. This decline in reporting shows the importance of policies and procedures in encouraging pharmacists to report medication errors.

Our study found 113 medication errors out of 141,128 prescriptions (0.08%) in 2017. The low rate of medication errors in our study in comparison to other studies done in Saudi Arabia may be due to two reasons. First, only two medication error outcome categories out of nine were provided by the primary healthcare center for our research study. Second, administrative actions that could be taken against the pharmacists or physicians have an effect on their reporting rates [25-27]. Feelings of guilt, or fear of punishment due to concerns about the consequence of reporting the errors, may have also led to under reporting. It is anticipated that only 25% of the errors are reported by healthcare providers [28]. The only outcome available for research in pharmacy department were A and B, in which, the B outcome category were 86.7% and A outcome were 13.3%. Unavailability of the records of 75% errors may be due to reporting before dispensing or hindrance of clinicians to report errors. This situation can lead to misleading results about medication errors occurred in primary health care centers. So the actual occurrence of medication error is still unknown.

The most common type of medication errors found in our study was incorrect dose (35.4%), which was similar to studies done in the Middle East. For example, a systemic review of forty five studies that was investigating medication errors in the Middle East countries in 2012, found that the most common type of prescribing errors were incorrect dose, wrong frequency and wrong strength [30]. Incorrect dose can have a significant negative impact on therapeutic plans of

chronic patients who are the majority of primary care patients. Also, the second most pharmacological class of medication errors was inappropriate dose of antibiotics, which was around 8% of total pharmacological class. This high rate of inappropriate dose of antibiotics might have a negative effect on antibiotic resistance.

In addition to the relatively high rates of incorrect dose, non-formulary was the second most common error type with 15% of the total share. [37] has conducted a descriptive study in a Brazilian teaching hospital and revealed that prescribing non-formulary medicines to children and neonates was common with 13.4% among total prescriptions over there. This type of medication error is a threat for patients' health. However, it can be minimized by the intervention, introduced by Lee and his colleague, Amy Chan, senior technical specialists in Pharmacy D. They shared that clinicians should add the reason of prescribing non-formulary drug to the Computerized Prescriber Order Entry (CPOE) system of medical centers. Moreover, the involvement of pharmacy can also help in minimizing non-formulary medication errors [38].

There were 7.1% Monitoring Errors (Drug-Drug) identified in this study. These errors had high probability to cause drug-drug interaction, if had been taken by the patient. In the study we found four drug-drug interactions. First, the GLP-1 agonist and a DPP-4 inhibitor. One of the Monitoring Errors (Drug-Drug) errors occurred in the primary healthcare center (1.8%) with B outcome category but did not reach the patient. Although, it was considered one of the serious errors if it had reached the patient [34]. Second, Sulfonylurea + Short-Acting Insulin with 1.8%, they had synergism effect which may cause severe hypoglycemia [35]. Third, ARBs & ACEI with 2.7%, which together can lead to more adverse drug related events that may cause a renal impairment [36]. The Forth one was 0.9% physician prescribed amitriptyline, which is a serotonin and norepinephrine reuptake inhibitor, while fluoxetine is selective serotonin reuptake inhibitor. Both of them would increase serotonin level and increase the adverse events. Kaushal, Bates [39] associated all these medication errors with adverse drug events in pediatric inpatients. For instance, high alert medications have a high risk of causing serious adverse event, increasing harm to the patient when prescribed to the wrong patient or high probability of mortality or morbidity. In our study, 24.8% of errors occurred in high alert medication. However, all of these are preventable because these errors were on ordering or prescribing stage.

In regards to patient characteristics, our study found that 61% of patients affected by medication errors were female patients, while 39% of them were male patients. These differences in rates between male and female patients may be due to the number of female patients being higher than male patients in the Al-Wazarat primary healthcare. The majority of patients were adults 67.3% (15-95 years old), while 12.4% were pediatric patients (0-14 years old). However, 20.4% of patients were elderly (60 and above), which stands high as this age group is more sensitive to medication errors. Inappropriate medication prescriptions is a significant problem among older adults which may contribute to increased morbidity and mortality as well as increased cost of care [29]. In relation to the nationality and gender of physicians, medication errors were made by majority of Saudis (56.6%) as compared to their Non-Saudi counterparts (26.4%) and most of them were males (62.3%). The percentage is reasonable since the hospital under study was among one of the earliest established primary health care center in Riyadh. Riyadh has the majority of Saudi healthcare providers and because the Male Physicians were in majority in Saudi Arabia [33].

Since, this study has provided a comprehensive overview of medication errors in respect to most possible dimensions i.e. types and category of MEs, association of MEs with the form of dose, frequency of MEs in different months and timing as well as characteristics of affected patients and responsible physician were also retrieved, which is considered a strength. However, the absence of unreported ME records in pharmacy department caused this study to have limits, and therefore actual number of errors might not be captured through pharmacy department. In order to eliminate this issue, case studies should be encouraged on physicians, technicians or hospitals.

Conclusion

The study's major objective was to assess the description of medication errors occurred in primary healthcare centers in Riyadh. It was found that majority of the errors occurred in morning shift with B outcome category and female patients were more affected by MEs in primary healthcare centers. Mostly the errors were made by Saudi male physicians and registrars. Among MEs categories, some of those were high in their occurrence i.e. "Inappropriate dosage", "under dose", "non-formulary", "drug not specified" and "monitoring error". These medication errors were most commonly made in general clinics and the clinics of chronic disease and lastly, there were 2 major forms, oral and parenteral, which lead to frequent medication errors.

Recommendations

Based on the results and conclusion of study, following recommendations were made for implications and for further researches:

1. Reporting of MEs is a cornerstone for the future quality improvement project. So, we need to increase the awareness of reporting medication errors among all primary healthcare centers staff.
2. The human resource should do special training for the population that led to MEs, in order to decrease the medication errors.
3. Elimination of the incidence of drug interaction errors should be assured because interactions can result in significant morbidity and mortality if reached the patient.
4. Physician needs to be more accurate and proactive when prescribing medications.
5. Formulary should be distributed in all clinic.
6. It is essential to improve medication error reporting systems and policy among the primary healthcare centers by eliminating barriers, clarifying the significance of reporting and empowering healthcare provider to report medication errors.
7. Clinical consequences of MEs should be assessed and evaluated in future studies
8. Educational and training programs must be continuously conducted in pharmacotherapy for all physician by clinical pharmacists or pharmacologists.

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