Causes and outcome of medication errors in hospitalized patients

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ABSTRACT

Objectives: To develop better understanding of Medication Errors (MEs) in the health care sector, and to improve the error prevention services in the hospital.

Methods: We conducted a retrospective study at the Hera General Hospital, Makkah, Saudi Arabia. The medical records were reviewed for adult hospitalized patients from June 1, 2000 to June 30, 2002. Patients demographic data, types, and causes of MEs, were recorded. The contributing factors, frequency and patient's outcome were also analyzed.

Result: A total of 2627 patient files were analyzed, 3963 errors were studied as follows: 1559 files contain one error, 800 files with 2 errors, and 268 with ≥3 errors. The most common type of error found was wrong strength (concentration) in 914 patients (34.79%), 807 patients (30.7%) had wrong route of administration, and 788 (30%) had wrong dosage form. On the other hand, the most common cause identified for MEs, was human factor, which accounted in 1223 patients (46.49%). Miscommunication was the most common second cause in 920 patients (35.02%), and the third common cause was name confusion [484, (18.43%)]. Medication Errors were classified from a regulatory prospective into actual in 735 patient files (28%), potential in 1866 (71%) and serious in 26 (0.98%).

Conclusion: The study showed that wrong strength was the most common ME found and human factors were the most common cause contributing MEs. Therefore, focusing on these factors will definitely minimize MEs in hospitalized patients.

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The Institute of Medication Errors (MEs) To Err Is Human: Building safer Health System estimates that tens of thousands of people die and hundreds of thousands of people experience non fatal injuries each year in the United States as the result of MEs.[1] Review of just few case reports demonstrates the damaging effect of errors on patients.[2,3] This study was conducted for 2 years. Medication errors were recorded and classified according to the patient demographics, types, causes, frequency and outcome of errors. However, with better understanding of the cause of such errors, pharmacists may be able to improve the error prevention and services they provide. Based on the error types discussed and their causes, recommendations are proposed to decrease the frequency of those errors, thus might enhance patient safety and overall improving healthcare quality since drug related problems could result in decreasing quality of patient's life, morbidity or even mortality.[3]

Methods. This study is a retrospective study reviewing adults (>12 years) hospitalized patient

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files in medical, surgical, and intensive care unit, in Hera General Hospital, Makkah, Saudi Arabia. That is following the Unit Dose System (UDS) as a distribution system. The study focused on types, causes, contributing factors, frequency and patient's outcome. The medical records of 2627 patients had been reviewed from June 2000 to June 2002 including medication orders (prescription), treatment sheets, and discharge medication to detect existing errors. All files of Hajj and Ramadan patients were excluded, as it is temporary files for seasonal patients. Files of patient with multiple admissions had been reviewed once; to prevent duplication in review. Medication Errors were identified and included Adverse Drug Events (ADE).

Results. A total of 2627 patient files amongst 10,000 patient's files were reviewed and identified during the study period; 7373 patient's files had no MEs. The incidence was 26.3%. Medication errors occurred in medical wards in 1979 patients (75.3%), surgical ward in 484 (18.4%), and ICU in 164 (6.2%). **Table 1** shows the distribution of severity by age showed the following: age from 50-59 years 310 patients (11.81%), and between 60-69 years 791 patients (30.11%). Higher rate of fatality identified elderly patients between age 70-79 years 1066 (40.58%), patients between 80-89 years were 93 (3.54%) and patients >90 years of age was 72 (2.7%).

The most common type of errors (**Table 2**) was wrong strength namely confusion between microgram (μg), milligram (mg) and other dosing units such as nitroglycerin, and digoxin; such errors had been occurred in 914 patients (34.8%). Secondly, wrong route of administration was reported in 807 patients (30.7%), which often occurred with the prescription of antibiotics and diclofenac. The third most common type of error was wrong dosage form [788 (305)], which is the prescription of a drug in a dosage form different from the one had been ordered. Furthermore improper dose, which included over, under, and extra doses were found in 24 (0.9%); wrong drug was found in 16 (0.6%); wrong duration 18 (0.7%); and dose omission in 60 (2.3%). The causes of MEs are described in **Table 3**. Human factors were the most common cause of MEs in 1223 patients (46.5%). This cause included performance deficit 1105 (42%); knowledge deficit 118 (4.5%). Miscommunication was the second common cause in 920 (35%), this cause includes misinterpretation of order 2 (0.1%); and written miscommunication 918 (34.9%) such as heparin orders were without identification for type of heparin whether it is calcium or sodium, and insulin, which have unclear order for regular or Isophane

Table 1 - The age wise distribution of patients among Medication Errors (n=2627).

Age (years)	n	(%)
13 - 19	84	(3.2)
20 - 29	126	(4.8)
30 - 39	43	(1.6)
40 - 49	42	(1.6)
50 - 59	310	(11.8)
60 - 69	791	(30.1)
70 - 79	1066	(40.6)
80 - 89	93	(3.5)
≥ 90	72	(2.7)
Total	**2627**	**(100)**

Table 2 - Distribution of type of Medication Errors (n=2627).

Types	n	(%)
Improper dose (n=24 [0.9%])		
Over dose	10	(0.4)
Under dose	11	(0.4)
Extra dose	3	(0.1)
Wrong drug	16	(0.6)
Wrong route of administration (n=807 [30.7%])		
Intramuscular instead of intravenous	38	(1.5)
Intravenous instead of intramuscular	16	(0.6)
Other	753	(28.7)
Wrong Strength	914	(34.8)
Wrong Dosage Form	788	(30)
Wrong Duration	18	(0.7)
Dose Omission	60	(2.3)
Total	**2627**	**(100)**

Table 3 - Distribution of causes of Medication Errors (n=2627).

Causes	n	(%)
Human factor (n=1223 [46.5%])		
Performance deficit	1105	(42.1)
Knowledge deficit	118	(4.5)
Miscommunication (n=920 [35%])		
Misinterpretation of order	2	(0.1)
Written miscommunication	918	(34.9)
Name Confusion	484	(18.4)
Total	**2627**	**(100)**

Table 4 - Number of deaths which suspected to be related to Medication Errors (Serious Medication Errors).

Deaths	n	(%)
Medication Errors		
Adverse Drug Events	18	(69.3)
Drug interaction	6	(23)
Contra- indications	2	(7.7)
Causes		
Misuse	4	(15.5)
Nephro	16	(61.5)
Others	6	(23)

(Humulin N). Miscommunication also contains misuse of zero and decimal points 39 (4.2%); and misreading order in terms of hand writing error 879 (95.8%); such as digoxin (.125 mg) instead of 0.125 was recorded in 32 patient files, Glibenclamide 0.5mg instead of 5 mg in 13 patients, and Co-Amoxiclav (amoxicillin and clavulanic 0acid) 0.375 mg instead of 375 mg in 11 patients. The third most common cause was, name confusion (sound alike and look alike) in 446 (18.43%) such as Cefoxten look like Cefotaxem. Furthermore, these errors were taking into account incorrect drug name and choosing the inappropriate abbreviation such as Kcl for potassium chloride, Fe for ferrous fumarate, or ferrous sulfate, and MV for multivitamin. Moreover, orders for antiviral, antihistamine, and cough syrup without any specification. Wrong abbreviation could include the strength of medicine measurement such as milligram (mg) instead of microgram (μg), milliliter (ml) instead of mg or μg. The prescribers committed 1863 errors (47%) amongst 1234 patients, pharmacist 1347 errors (34%) in 893 patients, and then nurses 753 errors (19%) in 500 patients. Renal impairment and related dose were recorded as a good contributing factors associated with MEs. However, the frequency of MEs could happen 1-2 per patient per day based on checking prescription in each related file. The outcome of this study was divided into actual (may or may not reach the patient) in 735 patients (28%), potential (reports of confusion or an intuition that an error will occur in the future) in 1865 (71%); and serious (causing death, a threat to life, hospitalization, and disability) in 26 (0.98%). Medication errors were possible to be one of the related factors amongst 26 deaths (**Table 4**). However, ADEs such as nephrotoxicity that occurred in 18 (69.3%); patients and antibiotics were a major part of their management regimen. The combination of nephrotoxic antibiotics with lasix in renal impairment or renal failure patient. Consequently antibiotic account the highest frequency of ADEs compared to other drug categories. Furthermore, one case experienced severe gastrointestinal bleeding due to combination of Aspirin (Acetylsalicylic Acid) and Aspegic (Lysine Acetyl Salicylic Acid) injection. We analyzed 6 (23%); patients who had drug interaction (DIs) and 3 (12%) had renal impairment in their diagnosis. Out of 6, 3 received Lasix, Gentamycin, Heparin and Vitamin K (phytomenadione), 2 were on Lasix, Ceftriaxone, and one of them experienced hypoglycemia due to the use of Glibenclamide tablets. The last one was on lasix and 50 mg Captopril tablets 3-times daily, which induced renal impairment. Drug contra- indications (CIs) found in 2 patients (7.7%).

Discussion. We assisted MEs amongst hospitalized patients and we found that wrong strength was the first common type of MEs in this study, second was wrong route of administration, and the third was wrong dosage form. There was a study that demonstrated improper dose as the most common types of MEs, followed by administering the incorrect drug to patient, and the last was wrong route of administration.[4] However, another study showed that wrong drug was the most common type of MEs, then wrong dose, and the third was omission or missing dose.[5] This study showed that the most common medication category involved in MEs was anti-infective agents, and the result was concurring with other study.[6] Two additional studies showed that anti-infective agents were the second category involved in MEs.[4,5] The use of none approved medication abbreviations were considered as a hand writing errors. Zero was placed before decimal point for doses less than one namely digoxin 0.125 mg instead of 0.125 mg, and 0.375 mg instead of 375mg for Co-Amoxiclav (amoxicillin and clavulanic acid), comparing to another study, which has been detected that transcription and handwriting errors were the likely responsible for MEs and over dose fatality.[4] The Adverse Event Reporting System (AERS) database was reported 469 deaths out of 5366 error reports. Three hundred sixty four deaths occurred in United States while 105 deaths distributed throughout 29 nations. The largest numbers of deaths were reported in the United Kingdom (26), France (15), Canada (9), Japan (7), and Germany (7)[4] in contrast with 26 deaths reported in our study. The most common causes of MEs in our study were human factor, miscommunication and name confusion which was similar to other study.[4] Such errors are preventable events and harmless since harm may not reach the

patient. Medication orders in this current study, which have been written after 2 am found with more chance for memory laps and mental slip, which was a good factor to increase MEs. Prescribers during this period were mentally and physically exhausted. Physician inadequate knowledge was found in 2.7%, compared with the study, which elaborated that inadequate physician knowledge was 30%, and memory lapse or a mental slip was found as a good factor to increase MEs, so it is important to consider in designing error prevention initiatives.[6]

We addressed and identified that physicians had been committed the most MEs followed by pharmacists and then nurses. This result was concurring with other result,[5] which showed the prescriber had the highest number of MEs, then pharmacist and nurse at the last. Physician's order was the most frequent reported source of MEs and ADE. We detected that MEs and ADEs had potential cause of adverse outcomes, and may cause death or can result in long hospital stay, because of one or more MEs; this was similar to other studies.[5,8] Geriatric group of patients usually more exposed to MEs since they had chronic diseases treated with complex medical regimens. A review of hospitalized adult patients for 2 years yielded information on the most frequent causes, types of MEs and contributing factors involved in fatalities. The physician, who wrote the prescription, pharmacist who dispensed it, and nurse who received the medicine and administered it to the patient, all play an important role in preventing MEs to reach patient. Medication errors detection needs to develop methods for prevention and reduction of its effects, so it is important to consider designing error prevention initiatives. Additional validation and reliability studies could provide the required support for researchers to use outcome standers in KSA to measure the quality of the drug distribution system.

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