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Investigation of Medication Errors in a Tertiary Care Hospitals in the Qassim Region, Saudi Arabia

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Abstract

BACKGROUND: Medication errors (MEs) have been defined as "any preventable event that may cause or lead to inappropriate medication or patient harm when the medication is in the control of the health care professional, patient, or consumer."

AIM: The aim of this study is to identify, analyze, and compare the common types of errors encountered in prescriptions, as well as the factors associated with the root causes of these errors, in a large tertiary hospital in the Qassim region of Saudi Arabia.

METHODS: The design used is a retrospective cross-sectional analysis conducted in tertiary care hospitals in the Al-Qassim region of the Kingdom of Saudi Arabia. MEs were reported by nurses, pharmacist, and physicians through "hospital-based incident medication error reports" collected from January 2016 to December 2016.

RESULTS: During the study period, 2123 MEs were reported for 213,489 prescriptions, of which 1282 (60.38%) were errors by a physician followed by nurses and then pharmacists. Analysis of the outcome of error types revealed that error types B and C were the most common, with only few type A errors identified (0.14%). The most common type of error was incomplete data (34.27%) followed by prescription in illegible handwriting (14.88%). The least common ME was prescription of the wrong strength (0.17%).

CONCLUSION: This study revealed multiple prescription errors across 213,489 prescriptions, most commonly originating with physicians. The incidence of serious errors was low at 0.14%, and the major outcome of prescription errors was "Near miss." "Incomplete data" and "Illegible handwriting" were the most common types of MEs detected. Despite the low number of MEs recorded during the study period, some of the errors were indeed serious. Based on the findings of this study, policy-makers should consider strategies for increasing efficiency in the hospital setting.

Introduction

Medication errors (MEs) occur when patients are harmed or inappropriate medication use happens due to avoidable reasons while the medication is in the possession of health-care providers or patients [1]. The definition of MEs is broad, involving different aspects of any type of medication-related issues including dosage, selection of drug, time, or method of administration, omission of prescribed medication, or the administration of a medication without a valid order [2]. Different systems exist for classifying prescription errors. For example, the Institute of Medicine has categorized three types of medical errors related to patient utilization: Underuse (failure to prescribe when benefit would be likely), overuse (prescribing when benefit is unlikely), and misuse (an actual error or mistake) [3]. Neville *et al*. have classified prescription errors into four categories on the basis of potential clinical outcomes, ranging from serious to patients (A) to inconsequential (D) [4].

MEs are underreported in all countries, particularly in developing countries [5]. The Institute of Medicine estimated that MEs are linked with approximately 7000 patient deaths each year [6]. Makary and Daniel (2016) have suggested that MEs are the third leading cause of death in the United States, but the issue is underreported due to the fact that the data usually focus on medical conditions rather than medical mistakes in cases of reported death [7]. In Saudi Arabia, over 40,000 medical error complaints are filed annually [8]. The rate of prescribing errors has been estimated to involve 11% of prescriptions in primary care in contrast to 1.5% in hospitals. Errors resulting in preventable adverse drug events occurred most often at the stages of ordering (56%) or administering (34%), whereas transcribing (6%) and dispensing errors (4%) were less common [9].

These errors can have profound implications for patients, families, and health-care providers. The human and societal suffering of patients experiencing costly and prolonged hospital stays can be significant, and some patients never fully recover to their premorbid

status. Errors erode patient, family, and public confidence in health services [7]. Moreover, health care-associated errors, regardless of the type, cast a great financial burden on the health-care budget. It was estimated that errors in health care in the United States accounted for over $17 billion in cost in 2008 [10].

Literature exploring MEs in the Kingdom of Saudi Arabia is limited and has mainly focused on the Riyadh region [1], [6]. The main goal of the study was investigation of MEs in a tertiary care hospitals in the Qassim region, Saudi Arabia. To achieve this goal, two objectives were identified, to detect the prevalence of MEs in 2016 and to describe factors associated with MEs.

Methods

This is a quantitative study that utilized a retrospective cross-sectional design conducted in 2016 in tertiary care hospitals in the Al-Qassim region, Kingdom of Saudi Arabia. Approval was obtained from the Research and Ethical Committee of the tertiary hospitals (maternity and children's hospitals) in 2019 with IRB number 1440-1676342.

Medical error was the main variable for the analysis and was identified using two methods. The first involved examining a 2016 report on hospital-based incidents of MEs where it is mandatory for health-care staff to report MEs. The second method relied on two pharmacists to manually review written prescriptions from January 2016 to December 2016.

All medical charts and incident reports in 2016 were reviewed for MEs. On identifying an incidence of ME, the reviewer classified the ME by severity, type, and stage of error. The definitions of ME severity were based on Neville's classification: Type A (potentially life threatening), type B (non-life threatening), and type C (minor nuisance or trivial) [4]. The error description type was partially taken from the National Coordinating Council for ME Reporting and Prevention [11]. The stages of error included prescribing, preparing, dispensing, transcribing, administering, and monitoring [12].

Medical charts and incident reports were used to identify other factors (independent variables) such as those related to patients, hospital, and/or treatment as well as error descriptions. These factors included patient's age, health-care specialty associated with the error, time, route of administration, type of package container, and department source. Hospital departments were classified according to the studied hospital and were divided into neonatal intensive care unit, pediatric intensive care unit, pediatric medical ward, critical care fetal unit, high dependency unit, operating room, pediatric health organizations, pediatric emergency room, obstetrics and gynecology (OB-GYN) emergency room, pediatric surgery ward, gynecology, OB-GYN ward, delivery room, and outpatient department (OPD).

Data comprised a series of descriptive statistics and trend frequencies of MEs for each month in 2016. All parametric statistical analyses were conducted using RStudio: Integrated Development for R (RStudio, Inc., Boston, MA). The threshold of significant was sat at value, $p < 0.01$.

Results

During the study period, 2123 MEs were reported for 213,489 prescriptions. The data recorded for the study population included age of patient, source of ME, time of error, route of administration, package container, outcome of error, department source, type of error, and stage involved. Table 1 presents MEs by patient age. The greatest number of prescription errors was associated with adult patients aged 18–40 years (46.82%) followed by patients aged 1 month–6 years (35.94%).

Table 1: Patient factors

Factor	Frequency (%)	p-value
Age of patient associated with ME		<0.0001
1–30 days	70 (3.30)	
1 month–6 years	763 (35.94)	
6–12 years	193 (9.09)	
12–18 years	29 (1.37)	
18–40 years	994 (46.82)	
40 years or older	74 (3.48)	

Table 2 lists MEs' frequency by associated health-care specialty, time, and department. MEs most commonly originated with physicians (1282; 60.38%) followed by nurses (755; 35.58%) and then pharmacists (86; 4.05%; $p < 0.0001$). The rate of MEs was higher for morning shifts, at 1837 (86.53%), versus night shifts, at 21 (0.79%). Most observed MEs occurred in the OPD (905; 42.45%) followed by the obstetric–gynecological ward (407; 19.09%).

Table 2: Hospital factors

Factor	Frequency (%)	p-value
Health-care specialty associated with ME		<0.0001
Physician	1282 (60.38)	
Nurses	755 (35.58)	
Pharmacist	86 (4.05)	
Time of ME		<0.0001
Morning	1837 (86.53)	
Afternoon	256 (12.54)	
Night	21 (0.79)	
Department*		<0.0001
OPD	905 (42.45)	
OBW	407 (19.09)	
GYNE	192 (9.01)	
PMW	180 (8.44)	
P-ER	96 (4.50)	
OB-ER	72 (3.38)	
NICU	63 (2.95)	
Pharmacy inpatient	55 (2.58)	
Pharmacy OPD	41 (1.92)	
PICU	31 (1.45)	
Pharmacy IV/TPN	27 (1.27)	
PSW	20 (0.94)	
OR	14 (0.66)	
PHO	13 (0.61)	
HDU	13 (0.61)	
CCFU	3 (0.14)	

*Multiple departments might contribute to a single error. NICU: Neonatal intensive care unit. PICU: Pediatric intensive care unit, PMW: Pediatric medical ward, CCFU: Critical care fetal unit, HDU: High dependency unit, OR: Operating room, PHO: Pediatric health organizations, PSW: Pediatric surgery ward, Gyne: Gynecology, OPD: Outpatient department.

Out of the 2123 errors, prescribing errors were the most frequently observed in the prescribing stage; the other stages are summarized in Table 3. Categorization by route of administration reveals that the IV route was the most commonly involved (1143; 53.84%) followed by the oral route (761; 35.85%). Similarly, single dose, vial, and ampoule were the most common sources of MEs (1149; 54.04%) followed by unit dose and oral (727; 34.21%).

Table 3: Treatment factors

Factor	Frequency (%)	p-value
Stage		<0.0001
Prescribing	1271 (59.87)	
Administration	732 (34.48)	
Dispensing	84 (3.95)	
Transcribing	33 (1.55)	
Monitoring	3 (0.14)	
Route of administration		<0.0001
IV	1143 (53.84)	
Oral	761 (35.85)	
SC	170 (8.00)	
Others	49 (2.31)	
Package container		<0.0001
Single dose/vial/ampoule	1149 (54.04)	
Unit dose/oral	727 (34.21)	
Syringe	113 (5.36)	
Bottle	68 (3.24)	
IV piggyback	65 (3.10)	
Intravenous solution	1 (0.05)	

Analysis of the outcome of error types (Table 4) revealed that error types B and C were the most common, with only few type A errors identified (0.14%). For the categories of prescription MEs identified, the most common error was incomplete data (34.27%) followed by prescription in illegible handwriting (14.88%). The least common ME was prescription of the wrong strength (0.17%). Trend of MEs during 2016 year by month was condcuted. Total of prescriptions, Total ME reports and percentage of MEs reports were collected (Table 5).

Table 4: Error descriptions

Factor	Frequency (%)
Outcome of error*	
A (potential risk)	3 (0.14)
B (near miss)	1733 (81.63)
C	387 (18.23)
Type of error $	
Incomplete data	790 (34.27)
Illegible handwriting	343 (14.88)
Dose omission	302 (13.10)
Improper dose	225 (9.76)
No double check	159 (6.89)
Wrong frequency	159 (6.89)
Wrong abbreviation	88 (3.82)
Wrong duration	61 (2.64)
Drug-drug interaction	33 (1.43)
Wrong time of administration	25 (1.08)
Pregnancy risk drug (category C)	23 (0.99)
Therapeutic duplication	20 (0.86)
Given without documentation	18 (0.78)
No label	13 (0.56)
Wrong drug	10 (0.43)
Wrong drug preparation	10 (0.43)
Wrong rate	9 (0.39)
Wrong route of admin	9 (0.39)
Wrong documentation	4 (0.17)
Wrong strength	4 (0.17)

*No errors reported with outcomes classified as D, E, F, G, H, and I. $A single prescription might contain multiple errors.

Discussion

This study was designed to investigate of MEs, particularly to identify, analyze, and compare common types of medication prescription errors, and the factors associated with the root causes of these errors, in a large tertiary hospital in the Qassim region. It revealed that most MEs were associated with adult patients, in line with the findings of Zakharov *et al*. (2012) who reported that about half of cases associated with MEs in a local hospital were adults [13]. This is not surprising, considering that adult patients have more medical prescriptions than younger and older patients [14].

Although we found that MEs most commonly originated with physicians followed by nurses and then pharmacists, no consensus is present in the literature. On the one hand, Neyaz *et al*. (2011) reported that physicians failed to provide information necessary for the safe dispensing and administration of drugs [1], but on the other hand, Wirtz *et al*. (2003) reported that a third of MEs were associated with nurses [15]. Motluk (2018), notably, suggested that burnout is the main factor behind health-care providers' errors [16].

The majority of MEs occurred at morning and in the OPD, suggesting that health-care providers encounter high workloads in these particular settings – workload having been shown to be correlated with missed care in general [12]. Similarly, Saghafi *et al*. (2014) found that morning shifts in the outpatient clinic contributed to more than 50% of reported MEs [12].

Error types B and C were the most common, consistent with reports in the literature [12]. Our analysis highlighted incomplete data, illegible handwriting, and dose omission. All can lead to serious errors, and health-care practitioners should take an active role in minimizing these MEs. For instance, we found that IV injections or infusions were the route of administration most vulnerable to ME, due to their sensitive nature, with a small error in IV injection potentially leading to a fatal outcome [17]. Nurses who deal with IV medication must thus combine caution with knowledge of administration technique and packaging [17].

An error rate of 0.99% of prescriptions per month was detected, but the ratio of errors was higher during summer (June–August), increasing from 1.19% to 1.25%. A review of other studies revealed that summer is marked by increase in mortality and morbidity and a decrease in therapeutic outcomes in teaching hospitals, being a time of year associated with physician changeover [18]. Health-care staffs are more likely to change workforce or go on vacation during

Table 5: Trend of MEs during 2016

Category	January	February	March	April	May	June	July	August	September	October	November	December	Year
Total prescriptions	17,852	17,528	18,216	17,986	18,522	16,963	18,276	17,584	16,843	17,284	18,453	17,982	213,489
Total ME reports	104	128	143	159	184	202	211	219	193	206	201	173	2123
% of ME reports*	0.58	0.73	0.78	0.88	0.99	1.19	1.15	1.25	1.15	1.19	1.09	0.96	0.99

*Percentage of MEs from total prescriptions for each month.

the summer, causing an association between summer breaks and low health-care outcomes that have been called the “July Effect” [19]. This study provides robust methodology in identifying MEs with a specific focus on certain categories. However, this study was conducted in a local hospital specialized in maternity and children’s, therefore, the results only represented to similar hospitals.

Conclusion

Despite the low number of MEs recorded during the study period, some of the errors were indeed serious. Based on the findings of this study, policy-makers should consider strategies for increasing efficiency in the hospital setting.

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