Evaluation of prescribing medication errors in a pediatric outpatient pharmacy

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ABSTRACT

Background: The use of medication is a complex process and the health-care providers discovered more problems facing this process at different many stages including prescriber, pharmacists, and finally patients. It is expected that the rate of errors in prescriptions will be higher for pediatrics compared with other population due to multiple factors (e.g., medications dosing, pharmacokinetics/pharmacodynamics). **Objective:** To evaluate the pattern of medication prescribing errors in the pediatric outpatient clinics and assess the type of prescribing errors. In addition, to evaluate the most prevalent type of medication category that is associated with prescribing errors. **Materials and Methods:** In our study, all outpatient prescriptions that were processed and dispensed for pediatric patients (<14 years old), flagged with medication clarification record were retrieved to be included in the analysis. Demographic data (age, gender, allergy status, and diagnosis), in addition to medication and error characteristics (number of medication per prescription, number of medication prescribing error per prescription, types of medication prescribing error), and medications category (e.g., antimicrobials, cardiac, pulmonary, gastrointestinal, analgesics, electrolytes, and topical) were collected. **Results:** Results showed that the most common type of medication errors was missing diagnosis in the prescription and incorrect dose with 59.6% and 54.1%, respectively. The mean age of both genders was 5.5 years (±4.3). The most common categories of medication involved were neurological medications, antipyretic, analgesic, and antimicrobials with 20.8%, 17.5%, and 15%, respectively. The number of high-alert medications in the detected medication/s error was 0.60%. **Conclusion:** The rate of documented pediatric outpatient prescribing errors by outpatient pharmacists was was 0.57%. In which, missing diagnosis was the most common type of prescribing errors followed by incorrect dose. In addition, the highest medication group that has prescribing error is neurological medications followed by analgesics.

KEY WORDS: Pediatric, Medication Errors; Pediatric Outpatient; Prescribing Errors; Saudi Arabia

INTRODUCTION

Medication errors (MEs) are critical and expensive in addition to patient care for the healthcare. Serious medical errors are devastating to the patient, family, and health-care staff. The most majority of pediatric errors occur in the outpatient setting. It is expected that the rate of errors in prescriptions will be higher for children than for adults, because of the calculations required to determine appropriate medication dosages based on multiple factors (e.g., weight, body surface area). Few studies available addresses the rate of prescribing MEs in pediatric. The aim of our study is to evaluate the pattern of medication prescribing errors in the pediatric outpatient clinics and assess the type of prescribing errors. The aim of our study is to evaluate the pattern of medication prescribing errors in the pediatric outpatient clinics, assess

the type of prescribing errors and to evaluate the most prevalent type of medication category that is associated with prescribing errors.

The use of medication is a complex process, and the health-care providers discovered more problems facing this process at different many stages including prescriber, pharmacists, and finally patients. The ME can easily happen through the health-maintenance system, for example, the ME can happen from prescriber to dispenser to administration, and at the end to patient use, the implied fact is that many mistakes and errors can be prevented, and the pharmacists only fit the suitable use of medications.[1] It is found that MEs are the most common kind of medical error. Most of MEs cannot be detected.[2]

As the definition of ME is not uniform definition through various studies and organizations such as Institute of Medicine, American Society of Health-System Pharmacists (ASHP), and Institute for Safe Medication Practices (ISMP) and others. The ASHP classified MEs such as omission error, wrong dosage-form error, wrong drug-preparation error, compliance error, improper dose error, deteriorated drug error, wrong administration-technique error, wrong time error, monitoring error, as prescribing error, unauthorized drug error, wrong dosage-form error, monitoring error, and any other ME (any ME that does not fall into one of above predefined categories).[2]

By this determination of these MEs, the prescribing error means an error occurred by selection of incorrect drug for the patient (based on indications, contraindications, known allergy, existing drug therapy, and other factors), route, dose, dosage form, quantity, concentration, rate of administration, authorized physician (or other legitimate prescriber), or instruction for use of a drug ordered.[2]

Among pediatric, the rate of potentially dangerous MEs is three times that of adult, the most common one is the outpatient wrong dose ordering errors. Due to the complexity for calculation of the dose based on the weight, there are also more elements that make the pediatric at a higher level of risks for ME, such as the variations in their weight and age, high intra-patient variability, rapid changes in the pharmacokinetic properties of medications in pediatric, and the continuous usage of "off-label" indications in pediatric.[3]

MEs were classified according to the process of medication use, dosing error accounts around 69% of pediatric prescriptions and its happened mostly due to doses miscalculation due to missing weight or changes in weights. It was found that 15% of prescribing error in pediatric was due to "tenfold error," and this happened during dose calculation and transaction while using different units (milligrams instead of micrograms).[4,5]

Different pediatric population are associated with higher risk of prescribing error like ill patients admitted to pediatric

intensive care unit (PICU) and neonatal ICU, patients provided prescription with illegible handwriting at ambulatory care services. Authors found that several environmental and personal factors might associate with the risk of prescribing error such as years of experience, fatigue, and workload.[4]

Children considered vulnerable to medication prescribing errors because of their different ages, weights, and metabolism of drugs, in addition to the risk factors that contributes these types of errors; weight-based dosing, units' conversions from pound to kilograms, and decreased communication ability with the patients and to some extent with the parents.[6-9]

Study shows that 16% of children received their outpatient prescription had at least one prescribing error. Most of the detected MEs were related to prescribing error (improper dosing [8%], inappropriate frequency [3%], dosage strength [3%], and inappropriate abbreviation used 20%), while in Pharmacopeia MEDMARX database, the prescribing error rate was reported to be around 8% in an outpatient pediatric clinics due to illegible handwriting, improper dose, and confused drug name.[10,11]

Despite that children are considered high-risk group for MEs, and health-care provider is aware about the extent of the harm of possible drug events in all settings, there is still gap in the current evidence about the exact extent of the problem in an outpatient setting. Walsh KE et al. in 2008, reported that 18.8% of the reviewed outpatient pediatric oncology prescriptions associated with ME, especially prescribing error (64%), and around 41% of the patients were harmed or injured.[12] At the same year study published from John Hopkins by Michael LR and his group showed that 4.3% of the reviewed outpatient prescription contains at least one prescribing error, 2% of which had dosing error in antimicrobials and analgesics.[13] On the other hand, Michelle Condern and the group in 2010, described that 9.7% of the reviewed pediatric prescription encountered ME with 34% of dosing error.[7]

Different studies reported that ME occurred because of missing information from pediatric patient prescription and this was varying 34-73.3%, that was easily resolved with implementing an electronic prescribing system were the incidence dropped to <2%.[7,14]

ISMP published a survey of pediatric medication safety practices in 2015, this survey consisted the most occurred six errors - preventing strategies related to the prescribing pediatric medications. Most of the respondents about (85%) reported that their organization requires: (1) Using of metric doses at ordering pediatric liquid medications. (2) Before entering medication orders, it should be checked the weight of the patients in the physician (CPOE) system. The remaining respondents reported that the implementation of these practices is less consistently because it could result in dangerous dosing errors.[15]

Almost all systematic medication categories are involved in causing harm to pediatric patients if ME occurred at any stage of the medication process. Chemotherapy, antiepileptic, antimicrobials, and analgesics are considered the top four categories that might be involved in MEs and cause patient harm or injury.[5]

Analgesics (opioid and none opioid) are prone for MEs because of the nature of the medication and variety of weight-base dosing ranges.[16]

Little is known about the incidence of all types of MEs in pediatric population Saudi Arabia. Few studies addressed the extent of different type of MEs in pediatric inpatient setting and almost none for pediatric outpatient setting. For this reason, this study has been conducted in which the aim is to evaluate the rate of medication prescribing error in pediatric outpatient clinic, assess the type of prescribing error following ASHP definition, evaluate the most prevalent type of medication category that is associated with prescribing errors, and to estimate the percentage of prescribing error per drug category.

MATERIALS AND METHODS

This is a retrospective chart review, in which all dispensed pediatric prescriptions at ambulatory care at King Abdulaziz Medical City (KAMC)-CR in 2014 with medication clarification record (MCR) at KAMC has been reviewed. A total of 842 prescriptions were detected to have ME and reported by outpatient pharmacists. All the prescriptions were screened to match the inclusion and exclusion criteria patients at age of 14 and below and received a prescription from ambulatory care clinic with minimum of one item between January and December 2014 were included in the study. On the other hand, any pediatric medication prescriptions without MCR, nonmedication-related prescriptions (i.e., equipment or formula) and/or duplicated prescription(s) were excluded from the study. All demographic variables (age and gender), allergy status, diagnosis, number of medication per prescription, and type and number of ME per prescription were recorded according to ASHP classification Microsoft Excel sheet was use to analyze all the collected data, descriptive statistics was used to present demographics, error type, and medications, and continuous data was expressed as mean ± standard deviation (SD).

Settings and Design

KAMC-CR is a tertiary care facility with1800 beds serving both adult and pediatric patients pharmaceutical care services providing care to pediatric population through different settings in the institution, inpatient and outpatient. In Ambulatory Care Centre (ACC), the pediatric clinics are opened 5 days a week, all disease conditions are being managed in these clinics except cardiac cases which are followed at the cardiac center. ACC pharmacy operates 5 days a week from 8:00 a.m. to 17:00 p.m., where approximately "2000" prescriptions are received and around "20" pharmacists and technicians. In case of ambiguity, pharmacists are authorized to contact the prescribing physician to clarify the orders, and dispense the medications after documenting their intervention on MCR that's usually attached to the prescription.

Statistical Analysis Used

Statistical analysis was done, in which descriptive statistics for patient's gender, medication number per prescription, types of error, and medications category presented as frequencies, percentages, patients age presented as mean or median ± SD or standard error of mean.

RESULTS

A total of 136,474 pediatric prescriptions were identified for the study duration, 783 prescriptions met the inclusion criteria, and included in analysis. Of our study population, mean age of 5.5 years (±4.3) (Table 1). The average number of medication(s) per prescription is shown in Tables 2 and 3. Prescriptions that contain more than 7 medications have unexpected results with the least MEs (0.25%) while prescriptions that contains 2-4 medications were the highest MEs (56.1%). Missing diagnosis on the prescription and incorrect dose was the most common prescribing error reported among the study population 59.6% and 54.1%, respectively (Figure 1). The most common medication categories were neurological medications (phenobarbital with 46.5% followed by clonazepam with 14.96%), antipyretic and analgesic drugs (non-Opioids 93%) and antimicrobials with 20.8%, 17.5%, and 15%, respectively (Figure 2 and Table 4).

DISCUSSION

Our study showed that the most common prescribing errors were the missing diagnosis followed by incorrect dose with 59.6% and 54.15, respectively (Figure 2). In comparison with another local study in-inpatient setting conducted in Saudi Arabia by Al-Jeraisy et al. in 2011, 2380 orders examined in general pediatric ward and PICU, all errors rate was 56% as medication orders (95%, confidence interval: 54.2-57.8), the most prevalent were the dose errors (22.1%), followed by route errors (12%), errors in clarity (11.4%) and frequency errors (5.4%).[17] Moreover, Condren et al. in 2010, described

Table 1: Demographic data

Gender (male) n (%)	409 (52.7)
Age (mean±SD)	5.5 years (±4.3)

SD: Standard deviation

Table 2: The top 3 medications category involved in prescribing error

Category	Frequency (%)
Analgesics and antipyretic	
Opioid	7
Non-opioid	93
Neurological	
Phenobarbital	46.5
Clonazepam	14.96
Clobazam	8.62
Methylphenidate	13.21
Others	16.6
Antimicrobials	
Penicillins	28
Macrolides	25.6
Cephalosporins	14.4
Sulfonamide derivatives	4
Antifungal	13.6
Antiviral	1.6
Anti-tuberculosis	0.8
Others	12

Table 3: Number of prescribing error (MCR) per prescription

One MCR per prescription	92%
Two-five MCR per prescription	8%

MCR: Medication clarification record

Table 4: Number of medication (s) per prescription

One medication/s per prescription	36.27%
2-4 medication/s per prescription	56.19%
5-7 medication/s per prescription	7.27%
More than 7 medications per prescription	0.25%

that 9.7% of the reviewed pediatric prescription encountered ME with 34% of dosing error.[6]

Missing diagnosis and important information (e.g., Weight, height, allergy) in the prescription can lead to many MEs, and this issue can be resolved by the implementation of computerized physician order entry (CPOE) which enforced the physician for entry any missing information before proceeding the order.

Antiepileptic medications were the most common category of medications encountered prescribing errors (21%). Phenobarbital (47%) was the most common medication prescribed with error, followed by clonazepam (15%) and clobazam (9%). In addition, our findings indicate that antipyretic (acetaminophen) prescriptions encountered at least one prescribing error (7%), while analgesics (Ibuprofen) were reported to have more prescribing error (14%). In our
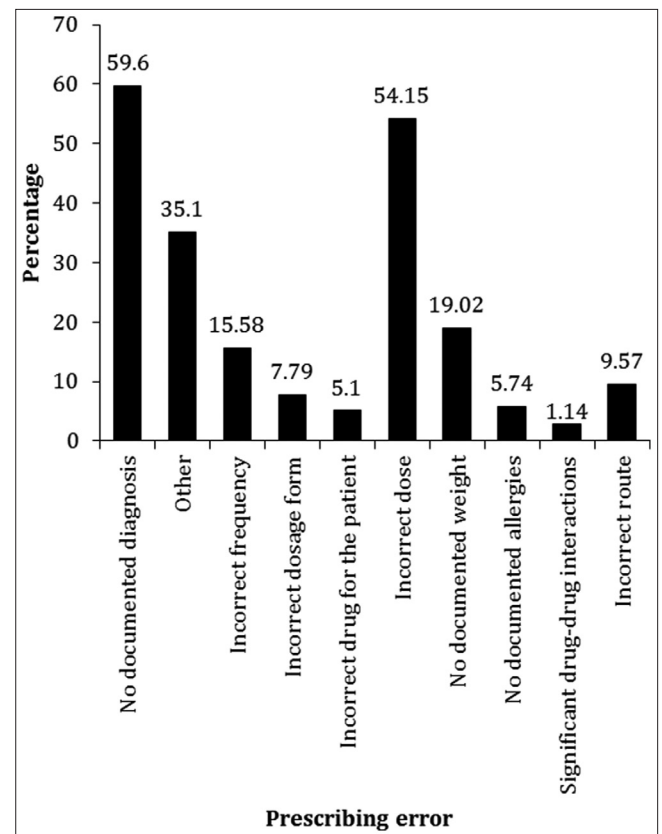

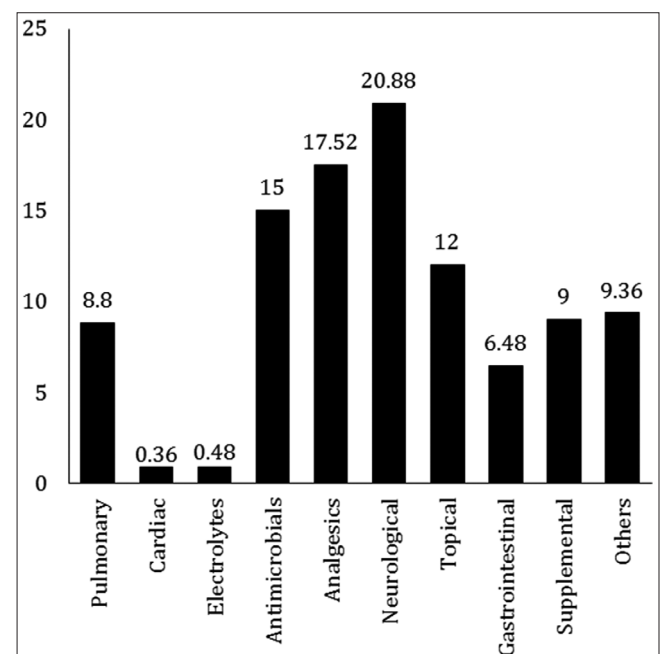**Figure 1:** Type of prescribing error

Figure 2: Medications category

population compared to what was reported by Al-Balushi et al., in in-patient setting were acetaminophen and ibuprofen prescribing error were reported in 23% and 16% of the orders, respectively.[18] In addition, they found in their study that paracetamol was most prescribed (13%) followed by salbutamol (8%), while ibuprofen was the most widespread among those aged ≥12 years.[18]

Rinke et al. in 2008, showed that 4.3% of the reviewed outpatient prescription contains at least one prescribing error, 2% of which had dosing error in antimicrobials and analgesics.[12] Compared this results with our finding, results show that the neurological category (20.88%) was the most common category due to restriction and not usual prescribed (phenobarbital: 46.5%, clonazepame:14.96%, clobazam: 8.62%, methylphenidate: 13.21%, others: 16.6%) followed by analgesics and antipyretic (17.52%) (non-opioids was the most common with 93%) and antimicrobials (15%). In which, penicillin group and macrolide group were the most common groups among the antimicrobial category with 28% and 25.6%, respectively.

Strengths and Limitations

The study was conducted in a tertiary hospital with a big sample size 783 pediatric prescriptions were included, by a convenient sampling technique which is collecting patients' medications clarification records randomly from the pharmacy department. Using a descriptive statistics analysis through Microsoft Excel to analyze the data.

The major limitation we have in this study was the poor handwriting by the physicians, prescriber ID was not clear to identify the qualification, we met a difficulty when collecting the data because there is a poor report from the pharmacist through reporting system and incomplete patients' data in the prescription (e.g., body weight, diagnosis, and absence of treatment duration).

CONCLUSION

Errors are possible at any step of the medication administration process, from medication selection until administration. Furthermore, differences between a medication dosage for an adolescent and that for a preterm neonate can exist by a 100-fold. By comparing, a pediatric dose to an adult's dose might be one tenth but still be 10 times the appropriate dose for a preterm neonate. Therefore, MEs in this population could be easily helped by all of these challenges.[19]

MEs has been detected and reported by pharmacist; however, the true number may be much higher. There are many factors that can cause the pharmacists not to report MEs, which include workload, complication of reporting system, no motivations, etc. Therefore, pharmacist should be encouraged to report any errors which will result of awareness of the medical team to the most common type of MEs and how to prevent it in the future.

The prescribing errors can be reduced by provide standard booklet for the most common and the rarely used medication in this population with doses ranges, way of administration, and other polices for health-care team. In addition, intensify the number of in-service presentations to health care,

interventions that improve prescribers' awareness and knowledge of pediatric pharmacotherapy, aids to the cognitive process of ordering medication (calculators, computer programs, tables of doses by weight), elevating awareness of the problem of medication ordering and by monitoring medication orders, along with structured communication and standardized, unambiguously labeled drug preparations.

Further studies with different study design and larger sample size need to be conducted.

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