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Medication errors in pediatric hospitals

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Abstract
Background: Drugs are a dualistic therapeutic tool, they are intended to cure, prevent or diagnose diseases, but improper use leads to patient morbidity or mortality. *Aim*: The present study was designed to evaluate medication errors (MEs) in Sulaimani Pediatric Hospital. *Method*: Prospective study was performed in Sulaimani Pediatric Teaching Hospital, Sulaimani City, Kurdistan Region, through which the physician medication orders for newly admitted patients from 6th February to 10th June 2013 were evaluated for MEs. A standardized questionnaire (especially adopted for the present study) was utilized to identify all expected types of MEs that appeared in the follow up sheets of randomly selected pediatric patients (n=100), admitted to the hospital due to different causes. Parents, usually mothers, answer some of the questions. 85% MEs were reported during prescribing practice. *Results*: They involved medications include bronchodilators 45%, anti-emetics 33%, antibiotics 32%, and analgesics and antipyretics 29%. The most frequently used antibiotics involved in the MEs were ceftriaxone 24%, ampicillin+cloxacillin 12% followed by cefotaxime and amikacin. The highest percentage of errors was 75% belonged to the use of teicoplanin followed by amikacin 60%. *Conclusion*: The percentages of MEs in Sulaimani Pediatric Hospital are very high, and there is irrational use of antibiotics. Most of MEs are avoidable utilizing the roles and activities of clinical pharmacists to provide maximum health care services.

1. Introduction

Drugs are a dualistic therapeutic tool, intended to cure, prevent or diagnose diseases, but improper use can predispose to patient morbidity and even mortality (1). It is important to understand the risk factors and causes of pediatric medication errors (MEs) so that effective reduction strategies can be proposed. Individualized dosing is one of the causes of pediatric MEs, where doses in the pediatric population are usually calculated individually, based on the patient's age, degree of prematurity in neonates, weight or body surface area, and clinical condition. This may leads to increased opportunities for dosing errors (2,3). Many evidences confirm that some healthcare professionals have difficulty to calculate the correct dose (4-6). This might be complicated by the fact that

many formulations are designed for use in adults, with few drugs being commercially available in suitable dosage forms (7), or more importantly, the correct strength for children. Clinicians should not prescribe for children if they are not familiar with the pediatric population, and/or the drugs they are using (8,9). Good communication between the hospital, the community pharmacy and the medical practitioner is essential in order to maintain an appropriate supply of the child's medicine (10). Creating a prescription is an early step in medication use; therefore, reviewing orders and prescriptions by pharmacists and nurses is critical for detecting errors and preventing adverse impacts on patients. Prescription errors occur at a rate of 3 to 20% of all prescriptions in hospitalized pediatric patients, and 10.1% of children seen in emergency departments (11). Accumulating studies suggest that pharmacist interventions have major impact on reducing MEs in pediatric patients, thus improving the quality and efficiency of care provided (12). In traditional hospital practice most of the burden of drug therapy decision-making falls on the physician. However, studies have shown that physicians sometimes make errors in prescribing drugs (13,14). While most errors are harmless or are intercepted, some may result in adverse drug events (ADEs). For hospitals with a system of pediatric clinical pharmacists, the non-intercepted errors represent the potential risk for patient harm, and would ideally be targeted by the institution of additional medication safety systems (computerized physician order entry, barcoding, and automated dispensing devices) (15). However, the pharmacist's impact might be substantially great, if he or she could provide input earlier at the time of prescribing. It has been shown that pharmacist consultation with physicians and others resulted in reduced drug coast, provide continuity in individualized pharmaco-therapeutic care, and serve an important educational function (16). A recent study of pediatric MEs and ADEs has shown that pediatric ward-based pharmacists could intercept 94% of near misses, but this assumption has not yet been adequately tested [17]. The present study was designed to evaluate MEs in Sulaimani Pediatric Hospital.

2. Methods

2.1. Study Design and Setting

This was a prospective study performed in Sulaimani Pediatric Teaching Hospital, Sulaimani City, Kurdistan Region. The physician medication orders for newly admitted patients, during a period of four months (6^{th} February to 10^{th} June, 2013), were evaluated for drugs prescribing errors. The total capacity of Pediatric hospital was approximately 334 beds (including emergency and neonatal intensive care unit). The cases were collected in three wards (excluding cases from emergency and neonatal intensive care unit), which represent approximately 61% (207 beds) of the hospital. A standardized questionnaire, especially adopted for the present study was utilized to identify all the expected types of MEs appeared in the follow up sheets, which belongs to randomly selected pediatric patients admitted to the hospital due to different causes. Parents, usually mothers, answer some of the questions.

2.2. Main Outcome Measures

The medication orders were hand-written, on daily bases and whenever an additional order or change is requested, by the authorized physicians, including rotators, permanents, and consultants. Information on each patient profile including age, weight, gender, residency, educational status, diagnosis upon admission, reason and frequency of admission, any reported allergies, and a complete medication profile for the present hospitalization, were reviewed. All of the medication orders were reported, reviewed and carefully assessed according to the standard criteria globally followed elsewhere. After collection of data, the types of prescribed medication classes and the associated MEs were evaluated, in addition to the types MEs associated with the prescription of antibiotics.

3. Results

The data indicates that 73% of patients have information about the orally taken medications and 23% have information about parenterally administered medications. Regarding their knowledge about the medication and disease, only 10% have enough information (Table1). Figure 1 shows that 55% of the evaluated case sheets include clear diagnosis of the disease, while 45% of the case sheets do not. Figure 2 shows that the most frequent medication classes involved in this study were as follow: 32.4% antibiotics, 17% analgesics, 13.2% I.V. fluids, 9.3% potassium chloride, 8.8% corticosteroids, 5.8% antihistamines, 5.6% bronchodilators, 3.7% tonics and vitamins, 2.2% and 2 % anxiolytics and anti-emetics, respectively. In the current study, evaluation of 587 medication orders revealed the presence of 499 MEs (85%) (Figure 3). Figure 4 shows the distribution of the selected cases of pediatric patients according to the educational state of their parents, in addition to the frequency of hospital admission and having information about the medication and diseases. The current study showed that the bronchodilators represent the medication class with highest reported level of errors (45%), followed by the antiemetics and antibiotics. The data also showed that analgesics, antipyretics, and potassium chloride represent the third level regarding the reported MEs. Other medication classes involved in reporting MEs are as follow: anxiolytics 15%, corticosteroids, tonics and vitamins are 14%, antihistamines and cough preparations 9%, and IV fluids 8% (Figure 5). Regarding the errors during the prescription of antibiotics, figure 6 shows the most frequently prescribed types of antibiotics, and the percentage of error that occur with each type.

Table 1. *The information regarding the route of administration of the prescribed drugs and those related to the disease and type of medications*

	Rout of administration		Medication and Disease		
Patient information	oral	Parenteral	No information	Few information	Enough information
	73%	23%	24%	66%	10%

Table 2. *The types of prescribing errors reported in the followed pediatric patients*

Type of Error	%
Omission	1%
Delay in services	2%
Prescription incomplete	29%
Incorrect dose	33%
Incorrect duration	2%
Incorrect dosage form	2%
Drug-drug interaction	6%
Adverse reactions	4%
Allergy and past history information	6%

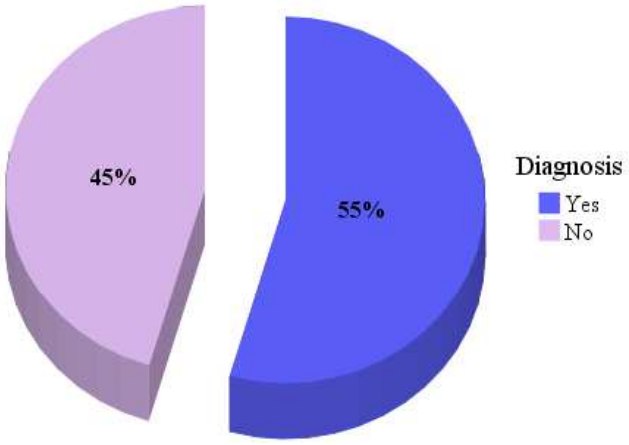

Figure 1. *Information regarding diagnosis of the disease in the patients' case sheets.*

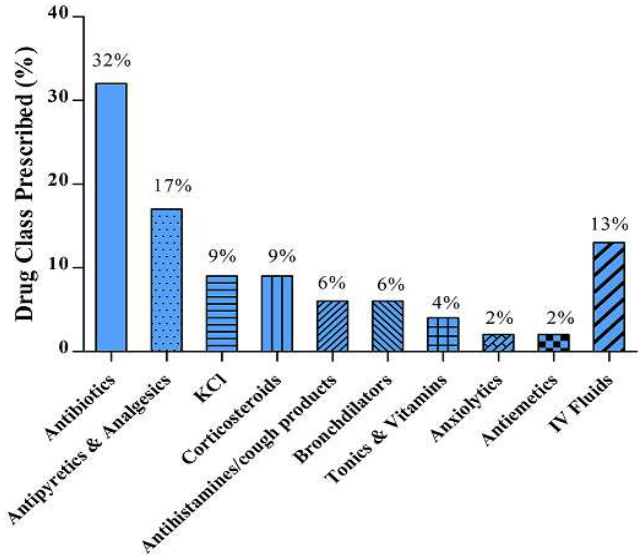

Figure 2. *The classes of frequently prescribed medication that appeared in case sheets of pediatric patients.*

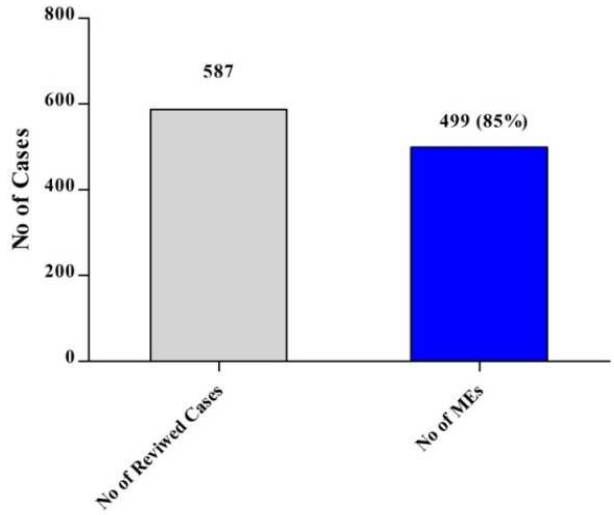

Figure 3. *Total Number of prescribing Errors reported in the case sheets*

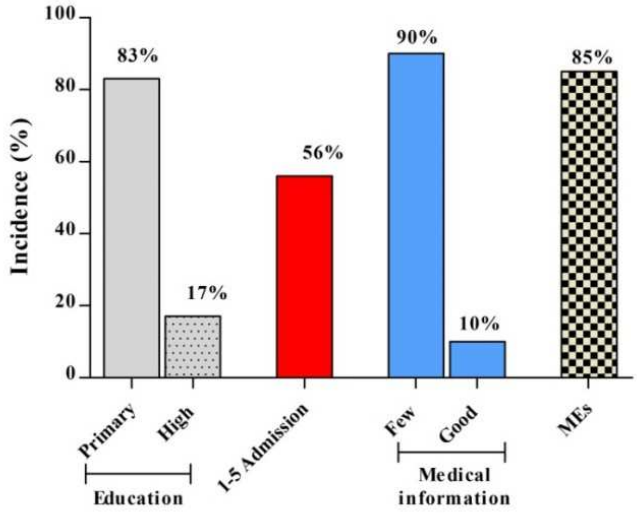

Figure 4. *The educational statuses of the pediatric patients families, their information about the disease and medications, frequency of admission and percentages of medication errors*

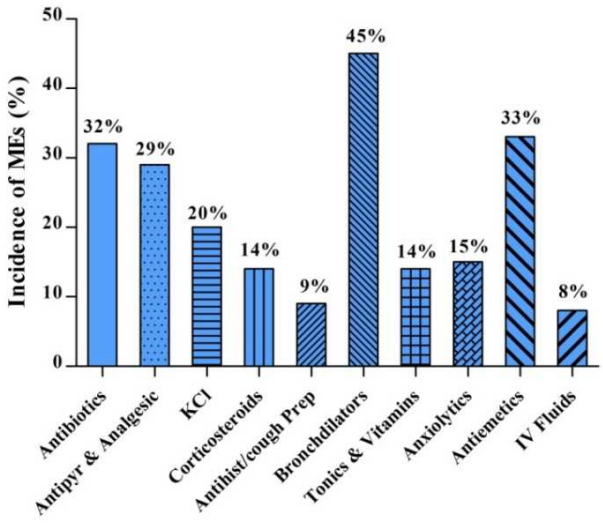

Figure 5. *Incidence of medication errors according to the drug classes involved*

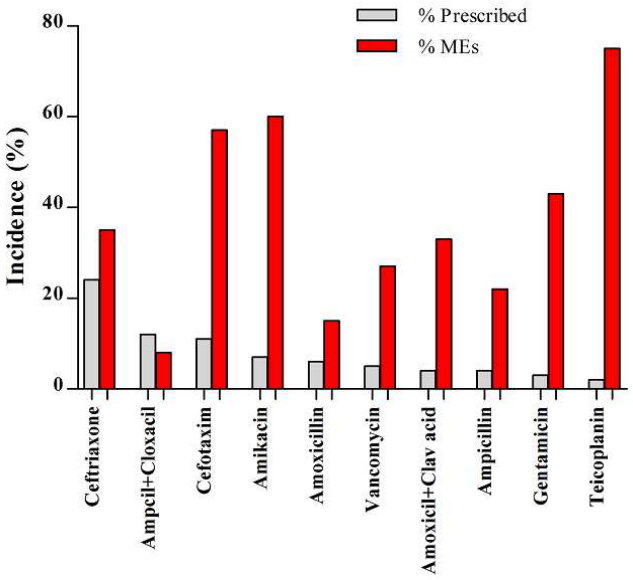

Figure 6. *Percentages of most frequently prescribed antibiotics and percentage of errors involved with each type.*

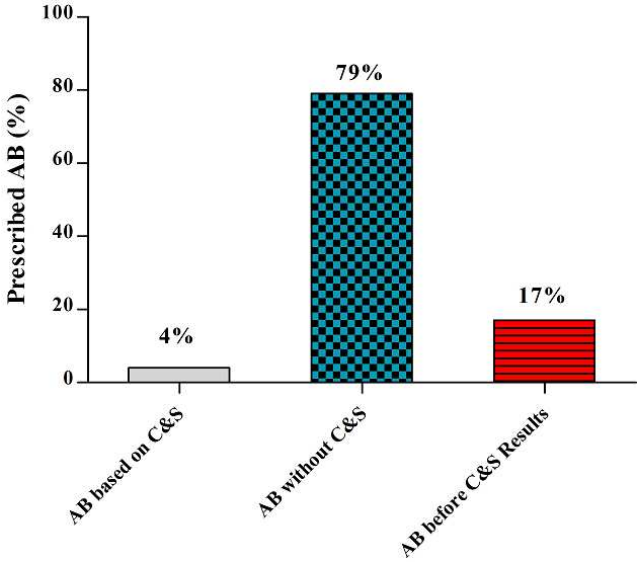

Figure 7. *State of culture and sensitivity of prescribed antibiotics*

4. Discussion

Hospitalized children are more susceptible to prescribing errors and mistakes made during dosage calculation than adults, because of their lower body weight and other physiological characteristics (17). The data of the current study revealed that 73% of parents have enough information about the orally administered medications, while only 23% have such information about parenterally administered medications. This may be due to their educational status. Additionally, most of parents had only primary level of education. Another reason for such finding may be the inactive role of ward pharmacists, or lack of communications between the pharmacist and the parents, regarding patient education about the proper use of medications. There is evidence from projects, based on analysis of the types of MEs, that improved communication could potentially reduce medication-related errors (18,19). Pharmacists and nurses should check the drug, the dose, patient identity and any other relevant information before administering medicine. When a query arises, as to whether the drug should be administered, the patients or their parents in case of children should be listened to attentively, and their questions should be answered; the prescription should be double-checked with the prescriber (20). Although the ward pharmacists routinely checked all case sheets included in the present study, MEs were not identified or corrected. Therefore, the main causes behind these problems are the absence of appropriate role of pediatric clinical pharmacist, shortage in number of clinical pharmacists, work overload, and poor communication between physician and pharmacists. Recently, a study done by Fortescue *et al*. showed that monitoring MEs by a clinical pharmacist may prevent 58% of all errors, and 72% of potentially harmful errors; meanwhile, improving physician-pharmacist communication may prevent 47.4% of errors (18). Other factors that contribute to these problems are children's low body weight and other physiological characteristics, which render them more vulnerable than adults to prescribing errors during dosage calculation. Other factors include decreased communication abilities of children, inability to self-administer medications, and the high susceptibility of young critically ill children to injury from medications, particularly those with immature renal and hepatic systems (21). Drug therapies are considered as major component of pediatric management in health care settings like hospitals. Effective medical treatment of a pediatric patient is based upon accurate diagnosis and optimum course of therapy, which usually involves a medication regimen. Infants and children are among the most exposed population groups to contact illnesses. At the same time, infancy and childhood are periods of rapid growth and development. Most of these are self-limiting (22) and often treated not only inappropriately, but also resorting to polypharmacy (23,24). The result of the current study shows that the most common classes of medications involved are antibiotics (32.4%), followed by antipyretics and analgesics (17%), then I.V. fluids (3.2%), and to lesser extent potassium chloride, corticosteroids, antihistamines, bronchodilators, tonics and vitamins, anxiolytics and antiemetics. The percentage of prescribed antibiotics in the present study is higher than other classes. Many other studies support this finding, and concluded that antibiotics are most commonly prescribed drugs to children, followed by drugs for respiratory ailments or analgesics and antipyretics (23,25). Other studies reported that 18.5-29% of the medications used in pediatrics are antimicrobial agents (26,27). It is important to consider the fact that only 4% of prescribed antibiotics were prescribed depending on the results of culture and sensitivity, while 79% were prescribed without performing culture and sensitivity test. Antibiotics can be used empirically without awaiting definite identification of the causative organism after ordering investigations aimed at making a microbiologically-based diagnosis (if available and feasible). It is particularly

important to send cultures, diligently collected, before the first dose of any antibiotic is administered except in sick neonates or intoxicated child, where one cannot wait for culture reports and need to start antibiotic urgently (28)**.** Overuse of antibiotics is known to cause drug resistance, increased side effects and make the treatment expensive (26,27). Furthermore, in a study conducted in USA, the most common type of prescription drugs were bronchodilators for children and central nervous system stimulants for adolescents (26). The most common medication classes detected during recording of errors in the present study were bronchodilators, anti-emetics, antibiotics, antipyretic and analgesics, respectively. These data are in tune with that reported by Kaushal *et al*., where the most common drugs involved in MEs are anti-infective agents, analgesics and sedatives, electrolytes and fluids, and bronchodilators (17). Al-Jeraisy *et al*.**,** found that error rates are highest in prescriptions for electrolytes (17.17%), antibiotics (13.72%) and bronchodilators (12.97%) (29). Meanwhile, Folli *et al*. reported that antibiotics are the class of drugs mostly commonly responsible for dosing errors. Orders for bronchodilators, analgesics, and fluid and electrolytes were also frequently predispose to prescribing errors (15).

5. Conclusions

The percentages of MEs in Sulaimani Pediatric Hospital are very high, and there is irrational use of antibiotics. Most of MEs are avoidable utilizing the roles and activities of clinical pharmacists to provide maximum health care services.

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