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# Assessment of Medication Errors in Pediatric Patients: Systematic Studies on Associated Variables

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## ABSTRACT

**Background:** In hospitals, medication errors involving young patients such as infants and children have grown to be a serious issue. Such errors may have fatal consequences for patients. Mostly, these errors occur due to inattentiveness of physicians and health care providers. The current investigation was based on assessment and prevalence of characteristics errors in medications by focusing neonatal and pediatric patients to evaluate the possible interventions in medication errors.

**Methods:** A cross sectional observational study was done to analyze the medication errors reported in pediatrics and children at National Institute of Child Health (NIH), Karachi from the period January 2021 till December 2021. Only infant patients were included while adult and elder aged patients were excluded. The acquired data was processed through Statistical Package for Social Sciences (SPSS) 16.

**Result:** In one year, 1039 medication errors were reported; fourteen distinct hypotheses pertaining to paediatric medication errors were considered. Compared to older patients, younger patients (ages 00–2.0) experienced a higher percentage of illness (43%), with the most common drugs being analgesics and antipyretics (21%), proton pump inhibitors (14.5%), and cephalosporin antibiotics (12.3%).

**Conclusion:** More challenges and precautions are required for safe and effective pediatric medications than adults. When giving antibiotics, analgesics, and antipyretics to children, extra caution is needed because either a high or low dose of the medication can cause adverse consequences or resistance respectively.

**Keywords:** Medication Error, Pediatrics, Assessment, Prevalence, Interventions.

## INTRODUCTION

Medication error can be described as "any incident involving improper medicine use that results in patient harm when medication is under the control of healthcare providers, patients, or consumers"[1]. Such errors can have a variety of effects, from clinically trivial to a life-threatening situation[2]. These errors pose a negative influence on patient as well as health care professionals due to cost implications and long stays in hospitals. Moreover there is a question mark on healthcare services. Medication errors are known to cause morbidity, mortality and increased heath care cost. In hospitals, the importance of this problem is widely recognized. However, outside the hospitals, the magnitude of medication error may be even larger[3,4].

Among all the population mostly medication errors appear in children. They are at higher risk. Medication

errors can occur at any point during the therapeutic process including prescription, dispensing, dose calculation and administration[5,6]. The exposure of newborns especially those with underdeveloped renal and hepatic functions, the requirement for weight-based dosing, the dilution of stock medication, and other variables are the prime factors for medication errors in infants and children[7].

The published researches on medication errors suggest dosing errors to be the most common type of medication error observed in pediatric population[8]. In pediatric patients, 5% to 27% of all prescriptions goes wrong or improper. Prescription constitute the most common errors which further followed by in-correct dispensing and administration of drug[9]. Preparing a prescription is first step of medication use. Therefore, for detecting and preventing adverse impact on patients is critical for pharmacist and nurses by reviewing order and prescription. In comparison to adults, inpatient pediatric patients are found to have two times more prescription errors[10].

In hospitalized pediatric patients, prescription error take place at a rate of 3 to 20 % while around 10% are seen in emergency department[11,12]. Most errors are likely to occur in prescribing or ordering phase usually dosing error following administration phase. Despite from this dose error may be the result of physician, pharmacist or nurse act in hospitals during any stage of patient's stay. Pharmacists which are clinically trained are assumed to have more responsibility for safe and rational drug therapy[13].

Pediatric health providers and institutions must implement interventions to reduce this preventable harm that is causing significant mortality and morbidity in pediatric patients[14]. With respect to rational drug prescribing, pediatric patients constitute a susceptible group as many new drugs released in market are being exposed to them without any benefit[15]. Cost, responsibilities and regulations frequently act as major obstacles in conduction of controlled clinical trials in children. Moreover, few clinical trials had been conducted recently involving children in which safety of drug was rarely monitored[16]. Inappropriate prescribing pattern and increased rate of high prevalence can be the major concern of health care system which allows adverse drug reaction to take place which are often preventable.

**Potential Reasons and Preventions of Medication Error in Pedriatic Patients**

Number of medication errors can be caused by lack of pharmacovigilance and drug information in basic care. To encourage rational drug prescribing, development of a national drug policy and pharmacovigilance program should be suggested. The required interventions must also be applied by looking at the results[17,18].

The possible causes behind the overprescribing and incorrect antibiotic prescriptions to infants are the lack of clinical supervision and collaboration between the physician and pharmacist[19]. The potential emergence of microbial drug resistance could be overcome by cautious use of antibiotics. Prescribing antibiotics for short time frame raises the possibility of resistance. Significant clinical overlap between viral and bacterial illnesses exists, which can result in the inappropriate prescription of antibiotics[20,21]. Although antibiotics are the most common class of medication provided to infants and children, health care professionals must exercise caution when writing prescriptions for them.

To ensure that the prescription is accurate or right, the pharmacist can play a significant part in preventing and intercepting medication errors in infants and children. It is the responsibility of the pharmacist to ensure that the bottle's label is correct while dispensing medicine, to check whether the medication has expired, to consider dose, and to keep an eye on the patient throughout their stay in the hospital. For outpatients, pharmacists can advise parents and guardians on how to administer and store medications properly[22].

Also, healthcare professionals should turn to paediatric resources such as NeoFax, Micromedex, Harriet Lane, and LexiComp. 'Medication Prescription in Renal Failure' is a reliable source for drug doses in relation to children with renal failure. Moreover, 'Medicines in Pregnancy and Breastfeeding, a reference book on fetal and neonatal danger should be consulted by expecting and nursing mothers[23,24].

**Aim of Study**

The goal of study is to report medication errors appeared in infants and children in child health care hospital. The current study provides a starting point for doing more therapeutic audit with other parameters of analysis such as outputs of strong coordination between physician and pharmacist,

which will provide frequent input to researchers and prescribers.

## MATERIAL AND METHODS

### Study Design

A cross sectional observational study was done to analyze the medication errors appeared in infants and children at National Institute of Child Health (NIH), Karachi from the period January 2021 till December 2021.

### Inclusion/Exclusion Criteria

All medication errors such as wrong dose, wrong prescription, missing dose, wrong route and wrong frequency related to infants and children at NIH from the period January 2021 till December 2021 were included while errors appeared in adults and geriatric patients were excluded.

### Data Collection

On specially created forms, information from the pediatric ward was gathered. Clinical Pharmacist completed the forms using patient progress charts and doctor directions. Vitamins, electrolytes and dietary supplements were not regarded as medications and were not documented. The information gathered included the patient's demographics, including age, weight, gender and all other relevant facts needed to evaluate the suggested regimen.

### Statistical Analysis

The acquired data underwent a descriptive analysis for variables like frequency and percentages. Overall, Statistical Package for Social Sciences (SPSS) 16 was used to conduct a comprehensive descriptive evaluation.

## RESULTS

In this study, total 1039 medication errors were reported in one year period from which fourteen different hypotheses related to pediatric medication errors were taken into account. The mean age group of pediatric patients in this research was 2.66±1.80 and the age group of children ranges from 0-14 years. All the hypotheses, Chi-square value, p-value and conclusions are given in Table **I**.

**Patient Age Group and Gender of Patients:** Among all ages 0-2 years children were majorly affected from these errors (43%) and most targeted gender was Male (56%), the p-value of chi-square test is not less than 0.05 so we accept the null hypothesis that is patient age group (years) and pender of Patient are independent variables and relationship is non-significant. The graphical presentation is shown in Figure **I**.

**Table I. Tabular Representation of Null Hypothesis and Their Respective Chi-Square and P-Values.**

| Null Hypothesis Ho | Chi square value | p value | Results |
|---|---|---|---|
| **Patient Age Group (yrs) * Gender of Patient are independent** | 10.149[a] | 0.119 | Non-Significant |
| **Type of error * Gender of Patient are independent** | 6.524[a] | 0.687 | Non-Significant |
| **Patient Age Group (yrs) * Type of error are independent** | 79.805[a] | 0.013 | Significant |
| **Patient Age Group (yrs) * Gender of Prescriber are independent** | 6.847[a] | 0.335 | Non-Significant |
| **Patient Age Group (yrs) * Medicine Classification are independent** | 3.270E2[a] | 0 | Significant |
| **Patients Age group * Wrong dose(high/low) are independent** | 11.694[a] | 0.069 | Non-Significant |
| **Gender of Prescriber * Type of error are independent** | 37.944[a] | 0 | Significant |
| **Gender of Prescriber * Medicine Classification are independent** | 56.988[a] | 0.001 | Significant |
| **Prescriber Gender * Wrong dose(high/low) are independent** | .425[a] | 0.514 | Non-Significant |
| **Type of error * Medicine Classification are independent** | 1.707E3[a] | 0 | Significant |
| **Classification of medicines * Wrong dose(high/low) are independent** | 1.340E2[a] | 0 | Significant |
| **Pharmacist * Type of error are independent** | 2.227E2[a] | 0 | Significant |
| **Pharmacist * Medicine Classification are independent** | 3.975E2[a] | 0.012 | Significant |
| **Wrong dose(high/low) * Pharmacist are independent** | 23.119[a] | 0.027 | Significant |

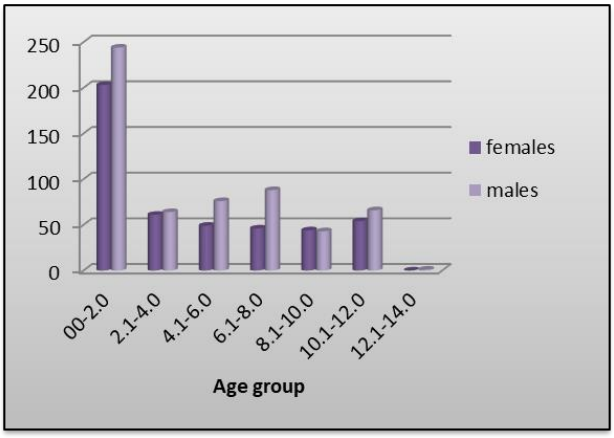


**Figure I.** Graphical representation of patient age group and their genders.

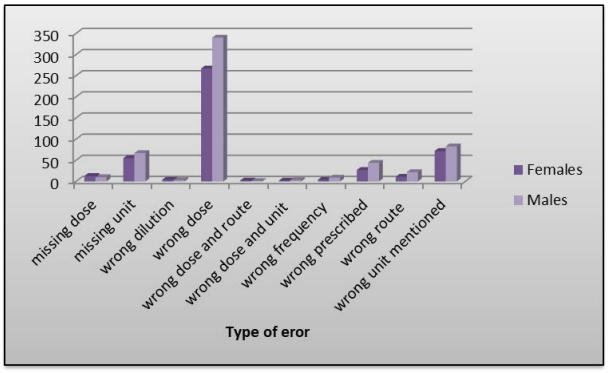


**Figure II.** Relation between gender of patient and type of error

**Type of Error and Gender of Patient:** It is found that wrong dose error was the maximum reported error irrespective of gender which can be seen in Figure **II**, subsequently wrong unit and missing unit were prominently arose and the p-value of chi-square test is not less than 0.05. It means type of error and gender are independent variables so we accept the null hypothesis.

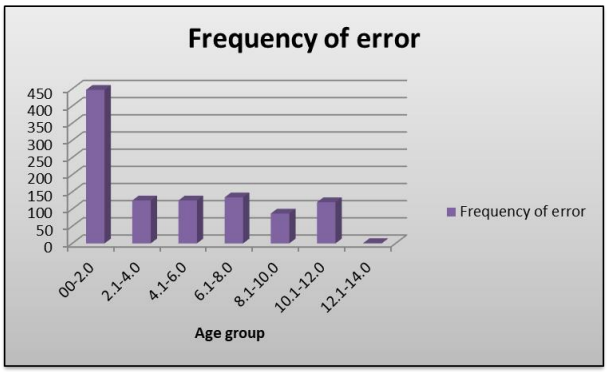


**Figure III.** Frequency of error in different age groups

**Patient Age Group and Frequency of Error:** Age group 00-02yrs are highly compromised as discussed in earlier hypotheses, after that 6-8yrs (12.99%) and with least affectivity between12-14 (0.09%). Results are shown in Figure **III**. The p-value of chi-square test is less than 0.05. It means we reject null hypothesis which confirms the significant association between the variables.

**Patient Age Group and Gender of Prescriber:** It is found that in majority of errors, female prescribers were greatly engaged than male (728 Vs 311 errors) and p-value of chi-square test is greater than 0.05. It means we accept the null hypothesis.

**Patient Age Group and Medicine Classification:** The p-value of chi-square test is not less than 0.05. It means we accept the null hypothesis.

**Patient's Age Group and Wrong Dose (High/Low)**: Two variables were taken which gave p value in higher region showed acceptance of null hypothesis. Moreover it can be clearly predicted that most of patients were prescribed at low doses. While 00-2.0yrs is the age which is more prone for wrong dose Figure **IV**.

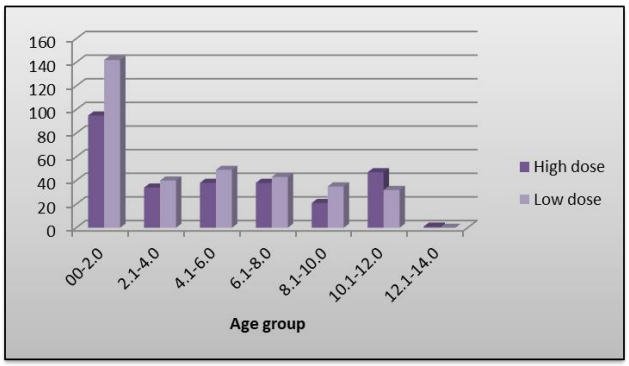


**Figure IV.** Appearance of wrong dose in different age groups.

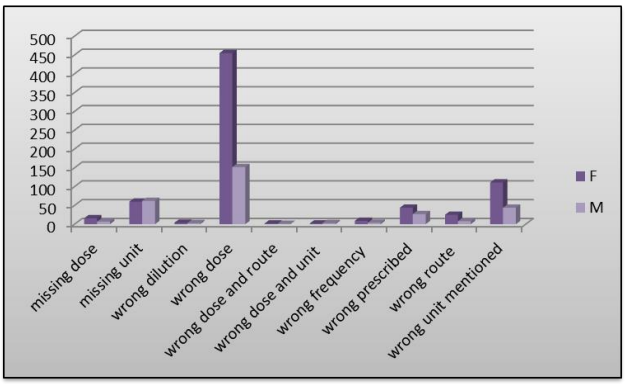


**Figure V.** Type of error by male/female prescriber.

**Gender Of Prescriber and Type of Error:** Both variables were taken which gave p value in lower region showed rejection of null hypothesis. Both Prescribers (Male, female) did wrong dose error recurrently as shown in Figure **V**.

**Gender of Prescriber and Medicine Classification error**: Results displayed p value in lower region showed rejection of null hypothesis. Antibiotics were the leading medications, later analgesics and antipyretics were frequent among them.

**Prescriber Gender and Wrong Dose (High/Low) Error:** Are two parameters for study which gave p value in higher region (i.e. 0.514) showed acceptance of null hypothesis. As Figure **VI** demonstrated that compared to male prescribers, female prescribers made more incorrect dose errors. Furthermore, reports of low dose were abundant.

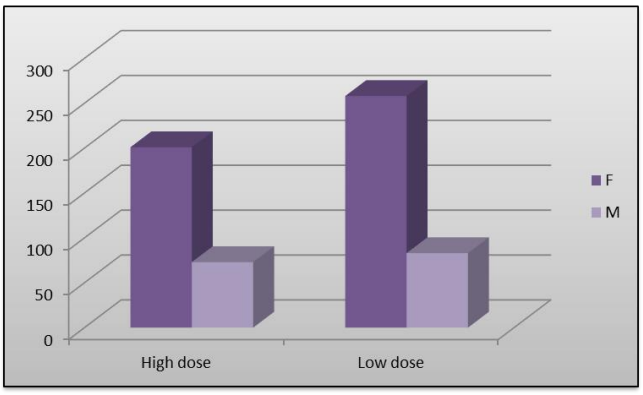


**Figure VI.** Comparison of male or female prescriber for wrong dose error.

**Type of Error and Medicine Classification:** The p value confirmed significant affiliation among the variables (p= 0) with rejection of null hypothesis with main error wrong dose and class 2 medication i.e., antibiotics.

**Classification of Medicines and Wrong Dose (High/Low)**: The results portrayed significant results as p value lies in lower region showed rejection of null hypothesis. Low doses were dominantly occurred throughout this research with highest frequency in antibiotics.

**Pharmacist and Type of Error:** The p value showed significant relation among the two variables with reject the null hypothesis. Furthermore, wrong doses were often stated by all pharmacists.

**Pharmacist and Medicine Classification:** Two variables were taken which presented p value 0.012 showed rejection of null hypothesis. The reporting frequency of antihistamins was greater by majority of pharmacy experts.

**Wrong Dose (High/Low) and Pharmacist:** Are independent as analysis provided significant connectivity as p value is 0.027 that is rejection of null hypothesis. The ratio of Low doses medication errors reported by pharmacists were higher than high doses.

## DISCUSSION

Medication errors are expectable at any phase regardless of ages, but infants and children are more likely to be the victim of these flaws which could cause serious health consequences(25). Therefore, it is important to find different perspectives involved in these errors based on the pediatric care we design our research including various parameters like ages, genders, class of medicines, types of errors, prescriber gender and reporting pharmacist.

The present investigation found that pediatric patients between the ages of 00-2.0 years, particularly those who were male, were more susceptible to medication errors. Furthermore, when it comes to prescribers, we can state that female prescribers committed more drug errors than male prescribers. Different types of errors were reported but the frequency of wrong dose error was more than others. As far as wrong dosing with respect to low or high proportion, analgesics and antipyretics low doses (20.97%) were often prescribed while Anti-histamines at high doses (14.1%) found usually. Low dosages typically have less therapeutic effect in babies, which leads to the eventual shift to other medications that, even with the right dosage, are not really necessary(26). Less than 2.0 years babies were affected more (43%) comparatively to older ones with highest frequency of medications belongs to analgesics and antipyretics (21%), proton pump inhibitors (14.5 %) and cephalosporin antibiotics (12.3%). Besides, in the prevalence of prescribed errors the ratio of female prescribers was found to be more than doubled with respect to male doctors with three medication classification discussed earlier but wrong dose was prevailing in both genders. It is the high time to correct the dosing pattern in infants and keep an eye while prescribing medications to infants. Undoubtedly pharmacist played significant role in correcting the medication errors appeared in infants and reporting them to rectify the errors which could be fatal to patients.

## CONCLUSION

Medication errors are common in pediatric patients. From this study we can conclude that we need attention towards wrong dosing with special considerations in infants. As in this research wrong dosing were most frequent error with majority of cases had prescribed low dose. In- addition our prescribers need to acquire appropriate knowledge among the dosing of analgesics and antipyretics because most of pediatrics had received in-accurate dose of this class. Apart from this, antibiotic dosing information should be considered in infants as any negligence can lead to serious resistance in infants. In future, the same research design may be used to examine different patient populations, including younger and older patients. Additionally, the present study's report might be forwarded to the organisation in order to rectify the mistakes that keep happening to infants.

### Ethical consideration

The researchers made assurance that the research complied with the Pakistan Pharmacy Council's (PCP) code of ethics. The privacy guidelines specified in the professional code of ethics for pharmacist and healthcare professionals were also followed with regard to all patient information that was made available as part of the study's data collection process.

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## CONSENT FOR PUBLICATION

Data collection form is included as supporting information

## CONFLICT OF INTEREST

No conflict of interest

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