

## Research Article

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### Prevalence and Associated Medication Errors in Hospitalized Pediatric Patients in Yemen- Across sectional Study

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#### Abstract:

Drug-related problems (DRPs) present a considerable risk to patient safety, particularly within vulnerable groups such as hospitalized pediatric patients. This study sought to assess the prevalence of DRPs and identify associated factors among pediatric inpatients in Yemeni hospitals. A retrospective cross-sectional study was performed, analyzing medical records of 142 hospitalized children. Demographic data, medication details, diagnoses, and instances of DRPs were collected and evaluated using SPSS software. The study uncovered a notably high prevalence of DRPs (88.7%), with gender identified as a significant risk factor. Other factors such as polypharmacy, co-morbidities, and the absence of a structured medication ordering system were also recognized as contributing elements. These results underscore the imperative need for targeted interventions to enhance medication safety practices in pediatric care settings in Yemen.

**Keywords:** Prevalence, Factors, DRPs, Hospitalized, Pediatrics, Yemen

## INTRODUCTION

Drug-related problems (DRPs), including medication errors, adverse drug reactions (ADRs), and medication non-adherence, are significant contributors to morbidity and mortality globally [1, 2]. A drug-related problem (DRP) is defined as an event or circumstance involving drug therapy that actually or potentially interferes with desired health outcomes [3]. Pediatric patients, who frequently present with complex medical conditions and developing physiological systems, are especially vulnerable to DRPs [4]. The impact of DRPs in this demographic can be severe, potentially leading to extended hospitalizations, increased healthcare costs, and even fatalities [5, 6].

Many risk factors are related with DRPs. These characteristics include female gender, number of drugs, body mass index, extreme age, comorbidity, and length of hospital stay [7]

The prevalence of DRPs in pediatric populations varies significantly across different countries and healthcare systems. While developed nations have reported substantial rates of DRPs, data from low-

and middle-income countries, such as Yemen, remain scarce [8,9,10,11,12,13]. In 96 studies that examined 50 or more samples (67 839 total medication samples), the overall prevalence of poor-quality medicines was 13.6%, with regional prevalence 18.7% in Africa and 13.7% in Asia [9]

Investigating the prevalence and determinants of DRPs in Yemeni pediatric hospitals is crucial for the development of targeted interventions aimed at enhancing patient safety. By identifying DRPs and their key risk factors, healthcare professionals gain valuable insights for mitigating their incidence, ultimately leading to improved clinical outcomes and reduced healthcare costs.

This study aims to fill this knowledge gap by exploring the prevalence of DRPs and identifying associated risk factors among hospitalized pediatric patients in Yemen.

To date, there is no standard or uniform technique for classifying DRPs. Many classifications are used to assess drug related problems. One of the classifications, which we used, Pharmaceutical Care Network Foundation (PCNE) system that divided DRPs into two main categories as treatment ineffectiveness and adverse drug reaction.

## **METHODS**

### *Study Design*

A retrospective cross-sectional study was conducted.

### *Setting*

The study was carried out across three hospitals located in, Aden, Lahj, and Taiz. These institutions were selected to provide a representative sample of various geographic regions and healthcare environments within Yemen.

### *Participants*

The study included medical records of all pediatric patients aged 0-18 [14,15,16] years admitted to the participating hospitals from October 2020 to January 2024. Patients with incomplete or illegible medical records were excluded.

### *Data Collection*

Data were collected in Yemeni hospitals, both private and public, from November 2023 to February 2024. Data was collected through a process of random sampling. Fortunately, most hospitals were considerably cooperative, however, it's important to note that requests for access to patient files were rejected by some hospitals.

According to Gooden et al, sample size correction can be done according to the estimated population (Godden, 2004).

New sample size=  $N / [1 + (N - 1) / \text{Estimated Population}]$

Where: Estimated population = Estimated number of hospitalized pediatric. admitted to inpatients department in one year

New sample size =  $139 / [1 + (139 - 1) / 200] = 83 \approx 83 \pm 10\% = 93$  patients

Data were extracted from medical records using a standardized collection form, capturing:

- **Demographics:** Age, gender, weight, height, and socioeconomic status.
- **Medical History:** Pre-existing conditions, Diagnoses, comorbidities.
- **DRPs:** Documented DRPs, including medication errors, ADRs, and medication non-adherence. DRPs were identified using established criteria and validated by clinical pharmacists.

DRPs were identified and assessed according to a modified form of the PCNE classification system developed by Ruth's et al [17] and confirmed by Abdurahman Egbal [18]. This system categorizes DRPs into six groups and utilizes a data collection form. Validation of the system showed an average of 70% agreement on selecting the appropriate category [19].

The evaluation of drug-related problems (DRPs) was conducted by the research team. This team comprised researchers under the direct supervision of licensed clinical pharmacists. The assessment process was informed by established medical literature and current, evidence-based disease management guidelines. To ensure the accuracy of medication information, details on recommended dosages, frequency, and administration methods were referenced from the American Guideline (2010 edition). Additionally, the team utilized reputable online resources such as Up-to-date, Medscape, the British National Formulary Children (BNFC), and Lexicomp to facilitate the identification of DRPs and potential drug-drug interactions

### *Data Analysis*

Data were analyzed using SPSS version 26. Descriptive statistics summarized the study population and DRP prevalence. Chi-square tests assessed the associations between DRPs and potential risk factors such as gender, age, medication count, co-morbidities, and length of stay.

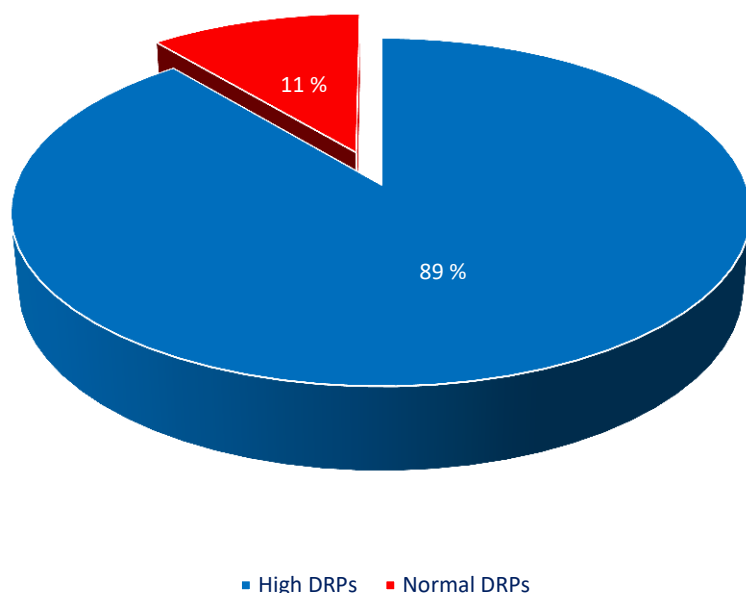
## **RESULTS**

A total of 142 pediatric patients were included in the study. The majority were male (64.1%) and aged between 1 month and 10 years (31.0%). Hospital stay duration revealed that participants were (62.7%) stayed for less than 5 days. Additionally, private hospitals accounted for the majority of hospitalizations (76.8%) table 1.

*Table 1. Demographic characteristics of patients n=142*

	Characters	Frequency, n (%)
<b>Gender</b>	Male	91 (64.1 %)
	Female	51 (35.9 %)
<b>Age</b>		1.11± 0.31
	< 1 month	30 (21.1%)
	1 month – 1 year	44 (31.0 %)
	2-10 year	59 (41.5 %)
	11-18 year	9 (6.3%)
<b>Duration of stay at hospital</b>	≤ 5 days	89 (62.7%)
	> 5 days	53 (37.3%)
<b>Hospital Setting</b>	Private	109 (76.8%)
	Public	33 (23.2 %)

Figure 1 indicated that the overall prevalence of DRPs was (88.7% n=126). Drug selection revealed prevalence of (40 % n= 96/240) followed by treatment duration (20.4% n=49/240), treatment effectiveness (14.5% =35/240). and drug dosing (11.6% n=28/240). Dispensing problems were (3.80% n=9/240) and drug use problems were (3.3 % n=8/240). Unexpectedly, adverse drug reaction showed only (1.7% n=4/240).



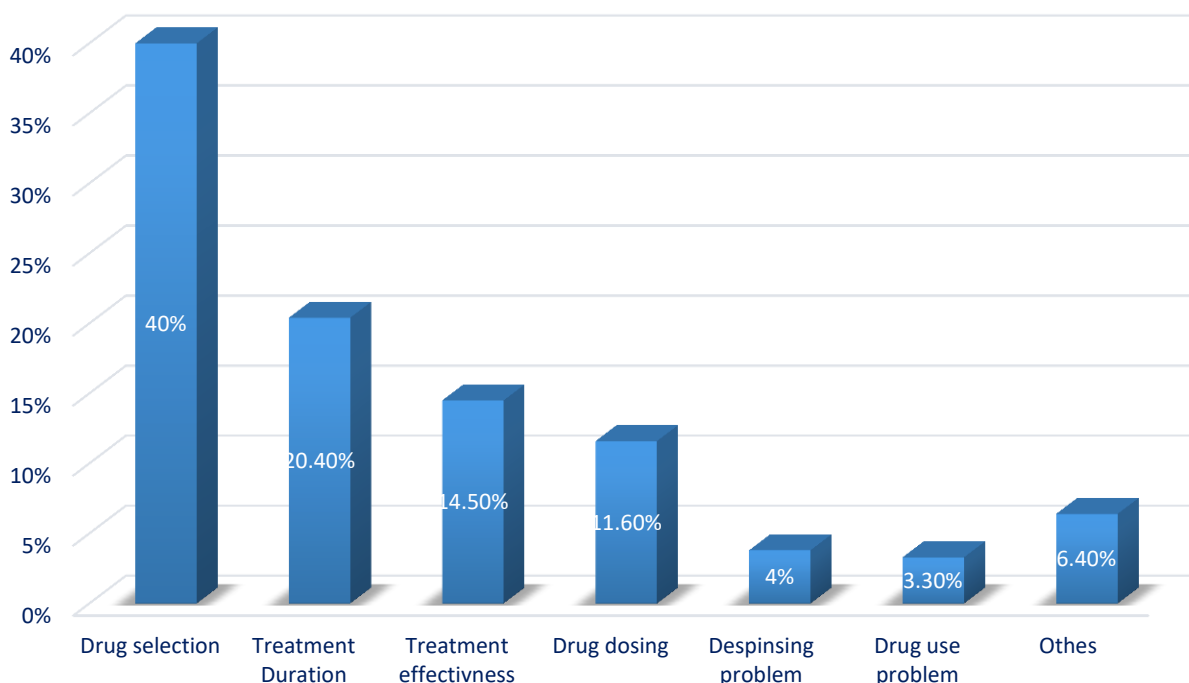
*Figure 1. Prevalence of DRPs among study patients.*

Drug selection problems were the most prevalent category. The most common issue was the selection of inappropriate medications which shower (45.8%) out of drug selection problems. Additionally, drug-drug interactions (DDIs) and polypharmacy were identified in (16.6%) and (27.1%) of DRPs, respectively ( figure 2).

In terms of treatment duration, a significant finding was the high incidence of DRPs in this category). Notably, (91.8%) of these DRPs involved treatment durations considered too short, potentially compromising treatment effectiveness. Conversely, only a small percentage (8.2%) of DRPs involved excessively long treatment durations ( figure 2)..

This study identified a high prevalence of DRPs among hospitalized pediatric. experiencing issues related to treatment effectiveness. These issues fell into two main categories: inadequate response to medication (28.6%, n=10 DRPs) and unnecessary medication use (57.1%, n=20 DRPs). Inadequate response refers to instances where the prescribed medication failed to achieve the desired clinical outcome. Conversely, unnecessary medication use indicates situations where medication was prescribed but lacked a clear clinical justification. Notably, a smaller proportion of cases involved complete treatment failure (14.3 %, n=5 DRPs) ( figure 2)..

Drug dosing problems were another significant category of DRPs, accounting for 28 cases (11.6%) out of 240. These problems involved either under-dosing (39.2%) or over-dosing (28.6%) the medication compared to recommended guidelines based on patient body weight. Incorrect dosing can lead to reduced effectiveness or increased risk of side effects. Additionally, 5 DRPs (17.8%) involved medication being administered too frequently (C3.3), while 4 DRPs (14.3%) involved administration not being frequent enough (C3.4) ( figure 2)..



**Figure 2.** Types and classifications of drug related problems

With regarding of factors associated with DRPs, gender was identified as a significant risk factor for DRPs, with male patients exhibiting a higher prevalence compared to female patients ( $p < 0.05$ ). Other factors such as gender, hospital setting, co-morbidities, and length of stay were not statistically significant in this study ( table 2) .

**Table 2. Demographic Data associated with DRPs n=142**

Variable	DRP		P value <sup>a</sup>
	Yes Frequency, n (%)	No Frequency, n (%)	
<b>Age</b>			
≤ 1 month	28 (19.7 %)	1 (0.7%)	0.474
1 month – 1 year	38 (26.7 %)	6 (4.3%)	
1-10 years	51 (36.0 %)	8 (5.6 %)	
10-18 years	9 (6.3 %)	1 (0.7%)	
<b>Gender</b>			
Male	85 (59.9%)	6 (4.2 %)	<b>0.026</b>
Female	41 (28.8 %)	10 (7.1 %)	
<b>Hospital Setting</b>			
Private	94 (66.2%)	15 (10.6%)	0.118
Public	32 (22.5%)	1 (0.7 %)	
<b>Duration of hospital stay</b>			
Less than 5 days	80 (56.4%)	9 (6.3%)	0.592
More than 5 days	46 (32.3%)	7 (5.0%)	

*Note:* <sup>a</sup> Pearson chi-square Test, P-value ≤ 0.05 indicates level of significance

**DISCUSSION**

This study reveals a high prevalence of drug-related problems (DRPs) among hospitalized pediatric patients in Yemen, a finding consistent with previous research in other low- and middle-income countries. Such as study was done in Ethiopia resulted that DRPs was prevalent in (74.0%) of the pediatrics population [20] However, other study done on pediatric ward have shown comparable results to that study with prevalence (31.57%) and Hong Kong (21%) [21]. A higher incidence was reported in KSA with (45.2 %) DRPs [22]. On contrast, medical errors in different countries have reported less such as USA [23] and Spain [24] ranging from 5 to 10 %. One study conducted by Egbal abdulrahman [18] in Malaysia to identify the prevalence of DRPs among breast cancer patients and the result was 78% which was lower than the results of the current study. The high prevalence in this study of DRPs could be due to several reasons; the lack of awareness among HCPs, deficiency of trained prescriber and non-existence of correction or supervision and clinical pharmacist. In addition, there is a dearth of clinical research that point out this issue. However, availability of computerized provider order entry (CPOE) system would influence enormously the occurrence of DRPs. It will enhance accuracy, reduce prescribing errors, and improve communication regarding medication administration There was a study done in KSA

to determine the impact of CPOE on DRPs incidence in pediatrics setting and resulted the difference in DRPS pre- and post CPOE implementation was significant (44.8% versus 35.8%). [25]

Analysis of potential risk factors for DRPs revealed a significant correlation between gender and DRP occurrence ( $p$ -value  $< 0.05$ ). However, no significant associations were found with age, duration of hospital stay, or hospital setting ( $p$ -value  $> 0.05$ ). Our study observed a higher prevalence of DRPs in males (64.3%) compared to females (35.7%). This finding partially aligns with a 2022 Brazilian study by Oliveira et al. (2020) which reported a higher proportion of DRPs in females than males. However, the contrasting results between our study and others might be attributable to various factors, including: a) Environmental factors, b) Racial/ethnic background, c) Sample size and composition and d) Cultural factors. However, further research is needed to explore the potential underlying mechanisms, including biological differences or variations in healthcare-seeking behaviors and prescribing practices.

Problems in drug selection such as needing additional medications, unnecessary management and /or inappropriate choice of drug were very common comparing to study done in Brazil drug selection was not very common drug related problem which occurred in prevalence (39.75%) of total DRPs [26] A possible explanation for drug selection problems could be lack of educational doctors, absence of expert clinical pharmacy and the scarcity of supervision.

Surprisingly, polypharmacy, a common practice in critically ill children which defined as taking 5 or more medications, was not associated with a higher risk of DRPs. Other study confirmed that there was a link between polypharmacy and an increased incidence of DRPs, such as drug interactions and adverse reactions [27]. As the number of prescribed medications increases, and patients stay in the hospital longer, the likelihood of inappropriate DRPs also rises This underscores the importance of conducting thorough medication reviews and employing strategies to minimize polypharmacy whenever possible even if our results were not significant.

The study identified a higher percentage of patients receiving treatment for a duration deemed too short was higher compared to a similar study in Southwest Ethiopia (11.24%) [18]. Conversely, a surprisingly low percentage received treatment for an excessively long duration. This finding might suggest that duplication of drug therapy is not a common occurrence among hospitalized pediatric., potentially due to a cautious approach to avoid medication errors.

The prevalence of "dose too high" DRPs in this study was lower than those reported in studies from Ethiopia [18] and Hong Kong [20]. Conversely, "dose too low" DRPs were less frequent compared to studies in Ethiopia, Egypt (21.09%) [28], and Saudi Arabia [29]. These discrepancies could be attributed to factors such as weight-based dose calculations, the use of fractional dosing, and a lack of training among prescribers. The absence of qualified professionals and non-adherence to prescribing guidelines could also contribute to the incidence of dosage problems. Staff unfamiliarity with appropriate drug dosing for hospitalized children, particularly during periods with different staffing levels (night shifts, holidays, understaffing), was also identified as a potential factor linked to DRPs.

Unexpectedly, ADRs were observed in a very low percentage of total DRPs. This finding aligns with similar studies conducted in Ethiopia [18] and Toronto [30]. However, due to the reliance on medical records without direct patient interaction, accurately determining adverse effects was likely limited.



Beyond the DRPs identified in this study, other medication-related concerns emerged. These included the need for increased medication monitoring frequency and instances of inappropriate medication documentation (0.8%) of the population. This highlights the potential for under detection in our study and underscores the importance of potentially implementing more comprehensive DRP detection methods.

Incorporation of trained pharmacists within medication decision-making processes has been demonstrated to significantly reduce DRPs through proactive identification and intervention [29, 30]. This finding suggests that integrating pharmacists into the healthcare team for hospitalized pediatric might be a valuable strategy to improve medication safety and reduce DRPs.

To illustrate, the prevalence and types of DRPs may vary based on healthcare systems, cultural contexts, and resource availability. The notably higher prevalence of DRPs in Yemen compared to high-income countries can likely be attributed to limited healthcare access, inadequate infrastructure, and a lack of standardized medication safety practices.

The ongoing conflict in Yemen exacerbates existing healthcare system challenges, including disruptions in medication supply, restricted access to healthcare facilities, and a shortage of trained professionals.

Identifying gender as a significant risk factor opens new avenues for investigation into potential biological or behavioral differences that may contribute to DRPs.

The high incidence of medication errors, which can lead to extended hospitalizations and increased morbidity, emphasizes the necessity for enhanced medication safety protocols. Potential contributing factors include insufficient staff training and suboptimal communication between healthcare providers.

Addressing the high prevalence of DRPs in this context requires a multifaceted approach, including: a) Enhancing medication safety systems, b) strengthening healthcare workforce Training, c) ensuring reliable medication supply and d) addressing socioeconomic determinants.

## ***Limitations and Future Research***

The retrospective nature of this study limits the ability to establish causality between risk factors and DRPs. Additionally, reliance on medical record data may introduce recall bias and inaccuracies.

Future research should address these limitations through prospective studies with larger sample sizes and more detailed data collection. Longitudinal studies could elucidate the temporal relationships between risk factors and DRPs, while qualitative research could provide deeper insights into the perspectives of healthcare providers, patients, and families regarding medication safety.

## **CONCLUSION**

The study's findings reveal a high prevalence of DRPs among hospitalized pediatric patients in Yemen, with gender identified as a significant risk factor. To enhance medication safety, it is essential to implement evidence-based interventions, such as medication reconciliation, electronic prescribing, and patient education programs. Further research is needed to explore the underlying causes of DRPs and develop effective prevention and management strategies.



## Disclaimer

The article has not been previously presented or published and is not part of a thesis project.

## Conflict of Interest

There are no financial, personal, or professional conflicts of interest to declare.

## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript

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