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Original Research

Current pattern of off-label drug use among hospitalized pediatric patients: a cross-sectional study

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Abstract

Background: Many hospitalized pediatrics receive off-label drugs that are not tested prior to being put on the market. Objective: To assess the prescribing pattern of off-label drug use among hospitalized pediatric patients in Punjab, Pakistan. **Method:** A cross-sectional study was conducted from October 2023 to February 2024 from 3 governments and 3 private hospitals of 5 most populated cities (Faisalabad, Lahore, Gujranwala, Multan, Islamabad) of Punjab, Pakistan. Stratified random sampling was applied to select samples from pediatric wards of hospitals. All the drugs were classified as off-label or on-label on the basis of package insert and BNF. Off-label drug use was categorized on the basis of route of administration, indication, frequency, formulation, dose and age. Frequency distribution is used to explore the data. Chi-square test was used to explore the association between on-label and off-label categories against various variables. Finally, Multiple logistic regression models were used to find the determinants of off-label drugs. **Results:** Of 2100 prescriptions, a total of 472 (22%) patients received off-label drugs. Most off-label drugs were found in Faisalabad (55.2%). In all age groups, children were more prone to off-label use (30.60%). The presence of chronic illness was significantly associated with off-label drug use ($p<0.05$). Off-label drug use in children general ward was 2 times more than the other wards. A statistically significant correlation ($p<0.001$) was found between the on-label and off-label drug use within the diagnostic category. In all prescribed drug categories, anti-infective for systemic use accounts highest off-label use followed by systemic hormonal preparation (13.5%) and the most common off-label drug category was off-label by indication. **Conclusion:** High level of off-label drug prescriptions was found in children as compared to neonates. Off-label drugs showed poor results in patients with chronic illness. The number of drugs prescribed by an MBBS physician increases the chances of off-label prescriptions.

Keywords: Hospitalized pediatrics; Off-label use; Prescribing pattern; Pediatric patients

INTRODUCTION

Only one-third of pediatric drugs have undergone adequate study for their targeted population, with proper usage information included on the product label. However, the remaining two-thirds sufficiently or entirely lack safety and efficacy data for pediatric patients[1-3]. Pediatrics disease profiles and drug dosing requirements are distinct from adults due to variations in their absorption, distribution, metabolism, and excretion. Consequently, tailored formulations are often necessary to facilitate the administration of appropriate drug quantities. This shortage of pediatric data may result in either beneficial treatments or the administration of potentially harmful ones[4,5]. Physicians responsible for administering drugs to pediatrics often find themselves forced to deviate from the labeled indications. This may involve actions such as altering a drug's formulation to achieve a "pediatric" dose, or adjusting the route of administration, such as avoiding intramuscular injections in pediatrics[6].

Off-label use refers to the-use-of-a-drug that-is-authorized but not within the parameters of its manufacturer's approved formula i.e. not in terms of suggested dose, indication, age, and method[7]. Off-label drug use is an example of empirical therapy and both are related to each other in medical setting since medications are not used in accordance with standards[8]. The use of off-label drugs is not illegal or incorrect, and it can sometimes lead to beneficial outcomes or have no therapeutic effect. For example, amoxicillin is licensed for use in pediatrics at a suggested dose of 40-50 mg/kg/day. When taken at a higher dose (80–90 mg/kg/day), amoxicillin demonstrated effectiveness against strains of Streptococcus pneumonia that were relatively resistant to penicillin[9]. However, evidence indicates an elevated risk of undesirable side effects linked to the utilization of off-label drugs such as off-label use of cisapride to treat gastric-motility in newborns and babies was discontinued due to concerns about life-threatening arrhythmias[10].

Several studies showed that the prevalence of off-label drugs use in pediatrics and adolescents varies widely from 3.2% to 80%[11]. The difference in prevalence arises from several factors,

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encompassing variations in study designs, methodologies, and the diverse definitions of off-label drugs employed across these studies[12]. The issue of off-label drug use is prevalent globally and impacts pediatrics in both hospitalized and outpatient settings. Most of the physicians have a moderate level of knowledge regarding off-label drug use[13]. In Pakistan, being a developing country, the economic burden of off-label drug use can further deteriorate the situation. Despite numerous studies tackling this concern, limited information exists regarding the magnitude of the problem in Pakistan. The objective of this study was to assess the pattern of off-label drugs prescribed to hospitalized pediatrics in Punjab, Pakistan.

METHODS

Study setting and design

This was a cross-sectional study performed in hospitals from October 2023 to February 2024. Stratified random sampling was applied to select pediatric patients. The study was conducted in three governments and three private hospitals of five most populated cities (Faisalabad, Lahore, Islamabad, Gujranwala and Multan) of Punjab, Pakistan. We conducted our study in pediatric wards of these hospitals.

Inclusion criteria

Medication prescriptions for hospitalized pediatric patients.

Exclusion criteria

(i) Incomplete prescriptions, spare medicines; (ii) Prescriptions of healthcare products and transfusion or injection liquid; including 0.9% sodium chloride injection, 5% or 10% glucose injection, sterilized liquid for injection.

Data source and data collection

Information of patients was acquired from medical records of hospitalized pediatrics and stored in electronic database. The recorded data encompassed demographic details (such as age, weight and gender, presence of chronic illness), clinical information (including diagnoses and hospitalization ward), and details of prescribed medication (such as dosage form, frequency, and route).

Ethical approval

Ethical approval for this study was submitted to the Ethics Review Board of Government College University, Faisalabad for review, and after a thorough evaluation, the approval was granted with ref number GCUF/ERC/368. Following the ethical approval procedure, initial contacts were made with hospital officials of Faisalabad, Lahore, Islamabad, Gujranwala, Multan to obtain formal permission.

Criteria for identification of off-label drugs

Based on the package insert approved by the Food and Drug Administration (FDA) and the British National Formulary (BNF), all included prescriptions were classified as either off-label or on-label. Even though the drugs may have different trade names from various pharmaceutical companies, if they share the same generic name, their usage is considered on-label. To assess the off-label conditions of all included prescriptions, we used following six indexes: indication (if any of the diagnoses doesn't align with an indication that is approved by FDA), age (if-the-age of any children-is below the age at which the FDA would approve the drug), dose (dose that has not been approved), route (use of alternate administration routes other-than the-ones-specified in the product information), frequency (other than the recommended frequency), formulation (drug other than its recommended dosage form).

Drug and disease classification

All the drugs that were prescribed to patients were classified according to Anatomical Therapeutics Classification (ATC) of WHO. All the diseases were classified according to International Statistical Classification of Diseases (10th revision), also known as ICD-10.

Age group

According to the Guideline of the International Conference on Harmonization, patients were divided into the following four age groups: (i) neonate (0 to 27 days); (ii) infant (28 days to 23 months); (iii) children (2 to 11 years); and (iv) adolescence (12 to 18 years)

Dependent variable

Off-label drug category was the dependent variable for the study. On the basis of information provided by the pediatric patients about drug (dose, route, indication, frequency) and patient characteristics (age, weight), a comparison was made with British National Formulary. If there was any disparity in drug usage, then it was considered as off-label.

Independent variable

Independent variables include demographics data for each pediatric patient (city, age, weight, gender). Presence of chronic illness in patients and primary payer (government or private) of city, number of medicines per prescription and length of stay in hospital were included. Wards such as children general, children emergency, children intensive care unit, neonatal intensive care unit and physician qualification (MBBS, FCPS), dosage form of drug and route of administration were also considered as independent variables.

Statistical analysis

Data was recorded and statistical analysis was performed in SPSS version 25.0. Frequency distribution was used to understand the distribution of the categories. Chi-square test was used to measure the association between on-label and off-label categories against various variables. We used a multiple logistic regression model to measure the determinants of off-label drugs.

RESULTS

Table 1 shows a comprehensive overview of off-label drug use across various categories, including city, age, weight, gender, presence of chronic illness, dosage form, and route of

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administration. A total of 2000 hospitalized pediatric patient's medical records from government and private hospitals were include in the study where 37.6% were children, followed by infants (31.7%), neonates (18.1%), and adolescents (12.8%). Male population was predominant over female (52.6%). Only 22.2% of the population suffered from chronic illness. Suspension was the least use dosage form (0.4%) and intravenous route was more common (65.6%) than oral route of administration (17.9%) in hospitalized pediatric patients.

A chi-square test was used to assess the patterns and associations of the factors influencing off-label prescribing practices in clinical settings. Significant associations in off-label drug use exist across different cities (*p<0.001*) indicating that of off-label drug prescribing was more frequent in Faisalabad (55.2%) than Multan (31.3%), Gujranwala (22.4%), Islamabad (18.0%), and Lahore (13.5%). A significant association was found between age groups and off-label drug use *(p = 0.036)*. Off-label drugs were prescribed in 30.6% children, 30.3% infants, 24.9% neonates and 23.1% adolescents.

The strong association of gender with off-label drug use (*p=0.023*) indicated that males have high off-label use (30.7%) as compared to females (26.1%). The presence of chronic illness in pediatric patients is significantly associated with off-label drug use (*p=0.002*). Different dosage forms had strong association with off-label prescribing (*p<0.003*). Injectable drugs had high off-label use (30.5%) as compared to syrups (29.4%), nebulizers (23.5%), tablets (16.7%) and suspensions (14.3%). The route of administration also exerts a significant influence on off-label drug use *(p=0.001*) such as 31.4% drugs were given as off-label via intravenous (IV) route in comparison with oral (24.3%), inhalation (23.8%) and intramuscular (IM) route (16.5%).

Association between off-label and on-label category

The pediatric population residing in Faisalabad showed a positive coefficient with off-label drugs that was statistically significant (*p<0.01*). The odd ratio of off-label prescriptions in Faisalabad was more than two times as compared to Multan

Table 1: Demographic and clinical characteristics of respondents for the prescription pattern.

Variable	Category	On-label	Off-label	Total	*p-value*
		n (%)	n (%)	n (%)	
City	Faisalabad	195 (44.8%)	240 (55.2%)	435 (21.8%)	<0.001
	Gujranwala	316 (77.6%)	91 (22.4%)	407 (20.4%)	
	Islamabad	297 (82.0%)	65 (18.0%)	362 (18.1%)	
	Lahore	360 (86.5%)	56 (13.5%)	416 (20.8%)	
	Multan	261 (68.7%)	119 (31.3%)	380 (19.0%)	
	Neonate	271 (75.1%)	90 (24.9%)	361 (18.1%)	
	Infant	441 (69.7%)	192 (30.3%)	633 (31.7%)	
Age	Children	521 (69.4%)	230 (30.6%)	751 (37.6%)	
	Adolescent	196 (76.9%)	59 (23.1%)	255 (12.8%)	0.036
Weight (kg)	<10	746 (70.5%)	312 (29.5%)	1058 (52.9%)	0.586
	Oct-20	350 (71.1%)	142 (28.9%)	492 (24.6%)	
	20-30	237 (73.8%)	84 (26.2%)	321(16.1%)	
	30-40	96 (74.4%)	33 (25.6%)	129 (6.5%)	
Gender	Male	728 (69.3%)	323 (30.7%)	1051 (52.6%)	0.023
	Female	701 (73.9%)	248 (26.1%)	949 (47.5%)	
Presence of chronic illness	Yes	291 (65.5%)	153 (34.5%)	444 (22.2%)	
	No	1138 (73.1%)	418 (26.9%)	1556 (77.8%)	0.002
Dosage form	Injectable	975 (69.5%)	428 (30.5%)	1403 (70.2%)	
	Nebulizer	182 (76.5%)	56 (23.5%)	238(11.9%)	
	Syrup	151 (70.6%)	63 (29.4%)	214 (10.7%)	
	Suspension	6 (85.7%)	1(14.3%)	7 (0.4%)	0.003
	Tablet	115 (83.3%)	23 (16.7%)	138 (6.9%)	
Route of administration	Oral	271 (75.7%)	87 (24.3%)	358 (17.9%)	0.001
	Intravenous	899 (68.6%)	412 (31.4%)	1311 (65.6%)	
	Intramuscular	76 (83.5%)	15 (16.5%)	91(4.6%)	
	Inhalation	183 (76.3%)	57 (23.8%)	240 (12.0%)	

*Significant at *p < 0.05; **Chi-square association

and other cities. Drugs prescribed off-label were insignificantly associated with age groups (*p>0.05*) indicating that age may not be a significant predictor of the outcome.

The positive and statistically significant (*p<0.05*) association of off-label drugs with presence of chronic illness with odd ratio (1.6) was observed. Similarly, significant association was found between number of prescribed drugs and off-label prescriptions (*p<0.05*). However, off-label prescriptions and primary payer of hospital showed negative correlation but it was not significant. A positive correlation *(p<0.05)* of patients stayed at hospital for <5 or 5-10 days with off-label drug use was also observed. The significant coefficient for pediatrics who were admitted to children general ward was positive with odd ratio (2.203). A strong correlation of off-label drug use was assessed with physician qualification (*p < 0.05*). None of the coefficients for frequency of drug administration were statistically significant with off-label drugs as shown in table 2.

Association of off-label drug use within the diagnostic category

The diagnoses were categorized into different groups based on

Table 2: Demographic clinical factors associated with off-label drugs using multiple logistic regression

Variables	Categories	B	S.E.	Sig.	OR	95% CI for OR	
						Lower	Upper
City	Faisalabad	0.853	0.16	<0.001	2.346	1.714	3.213
	Gujranwala	-0.51	0.175	0.004	0.6	0.426	0.846
	Islamabad	-0.732	0.189	<0.001	0.481	0.332	0.696
	Lahore	-1.162	0.192	<0.001	0.313	0.215	0.456
	Multan	Ref		<0.001			
Age	Neonate	0.377	0.361	0.295	1.459	0.719	2.957
	Infant	0.244	0.192	0.205	1.276	0.876	1.859
	Children	0.103	0.184	0.576	1.108	0.773	1.59
	Adolescent	Ref		0.508			
Gender	Male	0.202	0.11	0.067	1.224	0.986	1.519
	Female	Ref					
Presence of chronic illness	Yes	0.441	0.177	0.013	1.554	1.099	2.198
	No	Ref					
No. of prescription medications	2 medicines	-0.791	0.213	<0.001	0.453	0.299	0.689
	3 medicines	-0.417	0.151	0.006	0.659	0.49	0.886
	4 medicines	-0.679	0.157	<0.001	0.507	0.373	0.691
	>4 medicines	Ref		<0.001			
Primary payer	Government	-0.278	0.111	0.012	0.758	0.609	0.942
	Private	Ref					
Length of stay in hospital (days)	<5	0.805	0.377	0.033	2.236	1.068	4.681
	05-Oct	0.581	0.345	0.092	1.787	0.909	3.513
	Oct-15	Ref		0.088			
Ward	Children general	0.79	0.355	0.026	2.203	1.098	4.422
	Children emergency	0.262	0.37	0.48	1.299	0.629	2.683
	Critical intensive care unit	0.342	0.351	0.33	1.407	0.707	2.8
	Neonatal intensive care unit	Ref		0.001			
Physician qualification	MBBS	0.462	0.11	<0.001	1.587	1.278	1.969
	FCPS	Ref					
Frequency	Once a day	-0.281	0.342	0.411	0.755	0.386	1.476
	Twice a day	-0.02	0.34	0.954	0.981	0.503	1.911
	Three times a day	-0.092	0.338	0.784	0.912	0.47	1.768
	After every 4 hours	-0.708	0.405	0.081	0.493	0.223	1.09
	When required	Ref		0.054			

*Significant at *p < 0.05;* *95% CI is 95% confidence interval; *multiple logistic regression

their ICD codes. "on-label" likely refers to diagnoses for which the prescribed treatment is consistent with FDA-approved uses. "Off-label" refers to diagnoses where prescribed treatments are not approved by the FDA. This off-label pattern was highest among diseases of respiratory system (22.9%). A statistically significant association ($p < 0.001$) was found between the on-label and off-label use within the A00-B99 (certain infectious and parasitic diseases) diagnostic category as represented in table 3.

Off-label drug use within the prescribed drug category

Table 4 showed the distribution of prescribed drugs on the basis of ATC classification, comparing the proportion of drugs prescribed on-label versus off-label. In all prescribed drug categories, anti-infective for systemic use accounted highest off-label use followed by systemic hormonal preparation (13.5%) and other classes. The on-label/off-label drugs have significant association with prescribed drugs according to ATC classification.

Correlation of off-label category with outcome of patient

Outcomes of patients given off-label drugs showed a negative and statistically significant ($p < 0.05$) association with city, resulting improved condition of patients. Conversely, presence of chronic illness demonstrated a significant positive association ($p < 0.05$) with patient outcomes when given off-label drugs, with an odds ratio of 2.06, suggesting that the patient's condition did not improve. However, the correlation between patient outcomes and hospital stays of less than 5 days was negative but not statistically significant. Children general ward showed positive association ($p < 0.05$) with outcome of patients as compared to other wards. Patient outcomes were strongly associated with physician qualification ($p < 0.05$). The coefficient for outcome of patients given continuous off-label drugs was significant and positive with odd ratio (102) as shown in table 5. 60% of drugs were continued in off-label

Table 3: Percentage of pediatric patients in each diagnostic category who received off-label drugs

Variable	Diagnosis codes	On-label	Off-label	*p-value*
		n (%)	n (%)	
Diagnosis	A00-B99	216 (15.1%)	92 (16.1%)	<0.001
	C00-D49	1 (0.1%)	8 (1.4%)	
	D50-D89	5 (0.3%)	11 (1.9%)	
	E00-E89	52 (3.6%)	7 (1.2%)	
	G00-G99	136 (9.5%)	59 (10.3%)	
	I00-I99	92 (6.4%)	18(3.2%)	
	J00-J99	380 (26.6%)	131 (22.9%)	
	K00-K95	188 (13.2%)	83 (14.5%)	
	L00-L99	54 (3.8%)	19 (3.3%)	
	M00-M99	17 (1.2%)	2 (0.4%)	
	N00-N99	95 (6.6%)	46 (8.1%)	
	O00-O99	0(0.0%)	1 (0.2%)	
	P00-P96	44 (3.1%)	29 (5.1%)	
	Q00-Q99	0 (0.0%)	6 (1.1%)	
	R00-R99	118 (8.3%)	55 (9.6%)	
	S00-T88	31 (2.2%)	29 (0.4%)	

*Significant at $p < 0.05$; *multiple logistic regression

A00-B99: Certain infectious and parasitic diseases
C00-D49: Neoplasm
D50-D89: Diseases of blood and blood forming organs
E00-E89: Endocrine, nutritional and metabolic diseases
G00-G99: Diseases of nervous system
I00-I99: Diseases of circulatory system
J00-J99: Diseases of respiratory system
K00-K95: Diseases of digestive system
L00-L99: Diseases of skin and subcutaneous tissue
M00-M99: Diseases of musculoskeletal system and connective tissue
N00-N99: Diseases of genitourinary system
O00-O99: Pregnancy, childbirth and puerperium
P00-P96: Certain conditions originating from perinatal period
Q00-Q99: Congenital malformations, deformations and chromosomal abnormalities
R00-R99: Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified
S00-T88: Injury, poisoning and certain other consequences of external causes

Table 4: Percentage of prescribed drugs that were given as off-label

Variable	Prescribed drug codes	On-label	Off-label	*p-value*
		n (%)	n (%)	
Prescribed drug (ATC classification)	Alimentary tract and metabolism	90 (6.3%)	38 (6.7%)	<0.001
	Blood and blood forming agents	14 (1.0%)	6 (1.1%)	
	Cardiovascular system	110 (7.7%)	16 (2.8%)	
	Systemic hormonal preparations excluding insulin	268 (18.8%)	77 (13.5%)	
	Anti-infective for systemic use	723 (50.6%)	316 (55.3%)	
	Antineoplastic & immunomodulating agents	3 (0.2%)	1 (0.2%)	
	Musculoskeletal system	0 (0.0%)	10 (1.8%)	
	Nervous system	110 (7.7%)	61 (10.7%)	
	Respiratory system	111 (7.8%)	44 (7.7%)	
	Various	0 (0.0%)	2 (0.4%)	

* Significant at $p < 0.05$ using Chi-square test

Table 5: Clinical factors associated with outcome of patients given off-label drugs using multiple logistic regression.

Variables	Categories	B	S.E.	Sig.	OR	95% CI for OR	
						Lower	Upper
City	Faisalabad	-0.71	0.315	0.024	0.492	0.265	0.912
	Gujranwala	-1.282	0.373	0.001	0.277	0.133	0.577
	Islamabad	-0.798	0.412	0.053	0.45	0.201	1.011
	Lahore	-1.697	0.481	<0.001	0.183	0.071	0.47
	Multan	Ref		0.001			
Age	Neonate	1.069	0.644	0.097	2.913	0.824	10.298
	Infant	0.399	0.401	0.319	1.491	0.68	3.27
	Children	0.664	0.388	0.087	1.943	0.907	4.16
	Adolescent	Ref		0.215			
Presence of chronic illness	Yes	0.725	0.324	0.025	2.065	1.094	3.9
	No	Ref					
Length of stay in hospital (days)	<5	-1.728	0.91	0.058	0.178	0.03	1.057
	05-Oct	-1.444	0.874	0.099	0.236	0.043	1.309
	Oct-15	Ref		0.152			
Ward	Children general	1.396	0.628	0.026	4.039	1.18	13.827
	Children emergency	1.09	0.679	0.109	2.975	0.785	11.266
	Critical intensive care unit	0.98	0.643	0.127	2.665	0.756	9.389
	Neonatal intensive care unit	Ref		0.109			
Physician qualification	MBBS	0.949	0.228	<0.001	2.584	1.653	4.037
	FCPS	Ref					
Off-label continuity	Yes	4.627	0.706	<0.001	102.244	25.621	408.027
	No	2.376	0.75	0.002	10.763	2.475	46.807
	Stop Within 24h	Ref		<0.001			

*Significant at $p < 0.05$; *multiple logistic regression

manner leaving only 14% drugs for stoppage within a day due to any adverse effect or some other reason as shown in figure 1 (B). Though a large number of drugs were given off-label, it still resulted in improve condition of the patient (figure 1 (C). This reflects the positive aspect of the study showing that 54.5% of the total observed population condition improved by unapproved treatment.

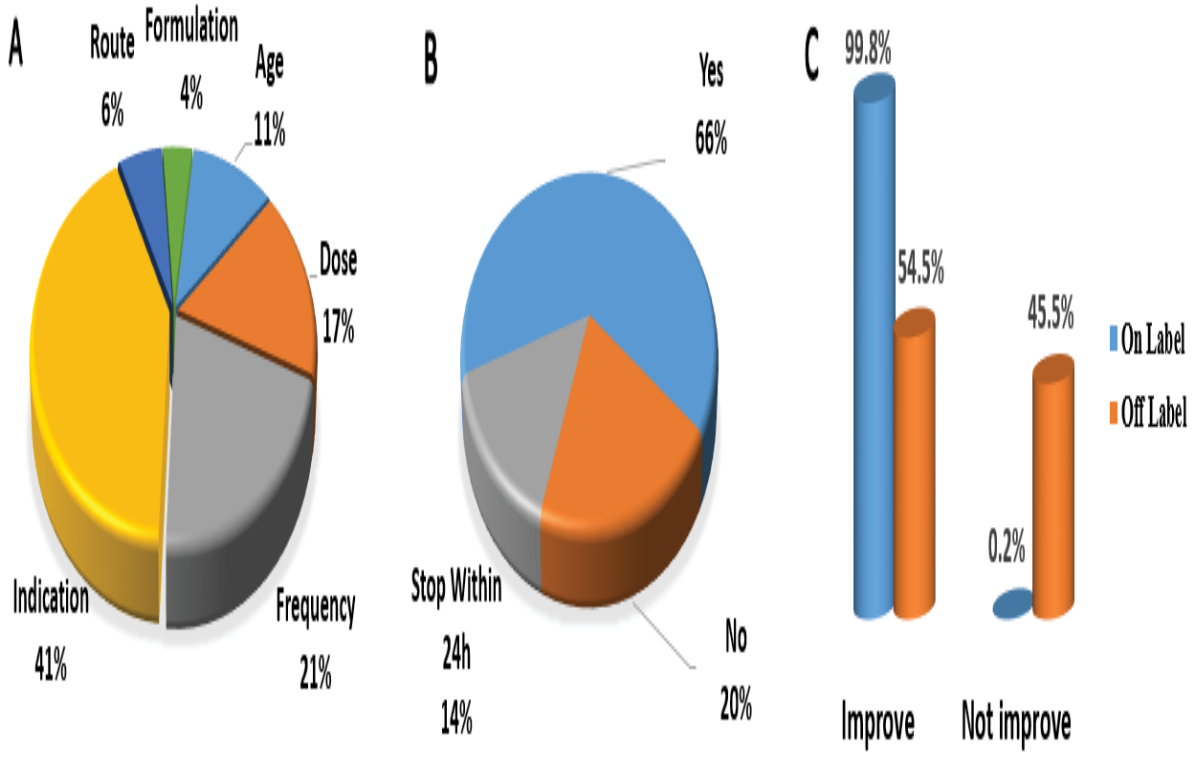

Figure 1. Off-label drugs administered to hospitalized pediatrics and outcomes of patients with off-label drugs
Categories of off-label drugs prescribed to hospitalized pediatrics (A). Continuity of off-label drugs in treatment of patients (B) and conditions of patients after treatment with off-label drugs (C).

DISCUSSION

The present study aimed to investigate the prescribing pattern of off label drugs among pediatrics.

Our study highlighted that prescription pattern and number of off-label drugs varied in different cities of Punjab, Pakistan. Our study is concomitant with the study conducted by Ishizaki where prescription pattern changed alongwith cities[14]. This correlation might be due to different medical practices in different cities, healthcare infrastructure, access to latest medical research and disease prevalence in different cities. Our findings reported that patients given off-label drugs showed improved outcomes within each city. Our results align with the studies conducted in Europe where patients showed improved condition, when treated with off-label drugs[15].

The study revealed the variation of prescription pattern of drugs along with gender. This can be attributed to differences in disease prevalence, and individual responses. We didn't observe any improvement in patients suffering from chronic illness when given off-label drugs. However, our results are contradicted with other studies, conducted in Nigeria, where off-label drugs didn't impart any impact on chronic illness[16]. In our results, number of prescribed drugs increases the chances of off-label drugs in hospitalized pediatric patient. Our study is comparable with the findings of Eguale, T., *et al.,* where positive correlation was observed between polypharmacy and off-label drugs increase in necessity of unapproved drugs to treat medical condition[17].

Our study showed that dosage form and route of administration influence the prescription pattern of drugs. However, these results correlate with results of Nepal where significant influence of dosage form and route of administration of drug on prescription pattern was observed[18]. The high trend of off-label drugs in children general ward was observed. These findings contradict with the studies conducted in Iran, Estonia and Italy where off-label drug use was more prevalent in neonatal ward[19-21]. This might be due to diverse medical treatment in children, limited pediatric testing and more cautious treatment in neonates. The results of the study revealed that FCPS specialists prescribed less off-label drugs as compared to MBBS physician on basis of their better clinical judgement that resulted in improved patient outcomes. This strong impact of off-label drugs on physician qualification was also reported by Shah, S.S., *et al.,* where low prescription pattern of off- label drugs by specialized physicians was observed[22]. This might be due to less experience and limited prescribing practice. Therefore, enhancing physician education and training on evidence based prescribing practices can mitigate inappropriate off-label use, promoting patient safety and therapeutic efficacy.

This study suggests that patients that suffer from chronic illness should be treated with appropriate treatment. Personalized treatment approaches should be made that account for individual patient needs to reduce the trend of off-label prescriptions. Hospitals should implement drug protocols to minimize polypharmacy and chances of off-label drugs in hospitalized pediatric patients. To limit the use of off-label drugs in children general ward, hospitals should prioritize comprehensive training for healthcare staff on pediatric drug guidelines and ensuring adherence to approved indications and dosages for prescribed medications. Interventions should focus on close monitoring of drugs that are prescribed to hospitalized pediatrics.

Limitations

The limitation of this study is its exclusive focus on pediatric patients hospitalized in secondary and tertiary care children's hospitals. As a result, the conclusions drawn may not accurately reflect practices in other healthcare settings. Furthermore, the clinical significance of off-label drug use cannot be assessed based on our findings since the prevalence of adverse drug reactions within each category was not monitored.

CONCLUSION

The present study highlighted the prescribing pattern of off-label drugs among hospitalized pediatrics. Addressing the issue necessitates targeted interventions and policy changes. Our findings revealed that gender, presence of chronic illness, physician qualification and prescribed drug variables were significantly associated with off-label prescriptions. Recognizing and addressing these factors is vital for developing comprehensive strategies to further reduce off-label prescriptions. Raising awareness among physicians regarding off-label drugs, in collaboration with policy makers and pharmaceutical companies can improve this issue.

AUTHOR CONTRIBUTIONS

- Mehreen Aslam conceived and designed the experiments, performed the experiments,
- authored or reviewed drafts of the article, and approved the final draft.
- Shahid Shah conceived and designed the experiments, prepared figures and/or tables,
- authored or reviewed drafts of the article, and approved the final draft.
- Ghulam Abbas performed the experiments, authored or reviewed drafts of the article,
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- Haris Khurram analyzed the data, authored or reviewed drafts of the article, and
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COMPETING INTERESTS

The authors declare there are no competing interests.

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