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ORIGINAL ARTICLE

Prescribing Pattern of Pediatric Cardiologists during Clinical Pharmacist Intervention versus Routine Practice: First Comparative Study in Palestine

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ABSTRACT:

Background: Proper drug prescribing can contribute immensely to reducing overall morbidity, mortality, and cost of pharmacotherapy, particularly in the management of heart disease. Currently, no studies have been implemented on the appropriateness of cardiologist prescribing among hospitalized pediatric patients in Palestine. This study aimed to compare the prescribing pattern of pediatric cardiologists during clinical pharmacist intervention versus routine cardiologists' practice at a tertiary care hospital in Palestine.

Methods: A comparative study of 48 pediatric patients who were admitted to the cardiology ward in 2020 and readmitted in 2021 was conducted. This comprised two stages: routine practice stage (S0) of cardiologists without clinical pharmacist intervention, and intervention stage (S1) where clinical pharmacist prospectively involved in cardiology teamwork. Prescribing indicators and length of hospital stay were compared between the two study stages using Pearson's chi- square and paired t-test.

Results: Compared with the routine practice stage, drugs prescribed per patient were significantly lower in the intervention stage (mean 5.98 S1 versus 6.87 S0; P=0.043). Higher drugs prescribed by generic names were found in the intervention stage (97.2% S1 versus 72.1% S0; P= 0.002). Patients in the intervention stage encountered significantly fewer antibiotics than in the routine practice stage (60.4% and 77.1%, respectively; P=0.009). The mean length of hospital stay was significantly reduced from 8.22 days in the routine practice stage to 6.93 days in the intervention stage (P=0.032). There were no significant differences in the prescribing of essential drugs (99.3% S1 versus 95.2% S0; P=0.152) and injections (75.0% S1 versus 73.0% S0; P=0.496) between the two stages.

Conclusion: Clinical pharmacist intervention has optimized the prescribing pattern of pediatric cardiologists and reduced the length of stay for hospitalized pediatric patients. Palestinian health leaders have to support the involvement of clinical pharmacists in cardiology and other disciplines to promote rational prescribing and drug utilization.

Keywords: Prescribing pattern, Pediatric cardiologists, Clinical pharmacist, Palestine

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Introduction

Cardiovascular disease (CVD) is a major pediatric health problem and has become one of the leading causes of death in developing countries (De Ferranti et al., 2019, Bode-Thomas, 2012). Annually, 1.35 million births are born with congenital heart diseases (CHDs) worldwide (Van Der Linde et al., 2011) and it is one of the largest global health burdens, affecting approximately 1 % of live births and alone accounting for up to $6 billion in acute care costs per year (Pasquali et al., 2011). If left untreated, 60 % of pediatric patients with CHD die within the first two years of their life (Bode-Thomas, 2012). Therefore, there is a need to provide appropriate treatment through surgery and rational pharmacotherapy (Ganieva et al., 2016).

Cardiovascular drugs are one of the most complex drug groups due to overlapping indications, comparable therapeutic activity, and adverse effects (Tefera et al., 2019), which necessitated the intervention of clinical pharmacists (Sabry et al., 2016). Prescribing trends for patients with CVD reflect doctors' knowledge of the specific disease and medications (Tefera et al., 2019). Prescribers should consider that “children are not just small adults” because they have variations in weight, body surface area, and renal function, which makes prescribing more complicated than in adults (Bekele et al., 2021). In 2022, a pre-post study evaluated the impact of clinical pharmacist-led interventions on physicians' prescribing among pediatric patients. The authors concluded that these interventions significantly improve physicians prescribing and reduced drug-related problems (Nguyen et al., 2022).

Selecting the most appropriate drug for the patient to achieve the best treatment outcome is a challenge for physicians in their daily practice (Maxwell, 2016). The World Health Organization (WHO) defines rational drug use as "prescribing the right drug, to the right patient, at the right dose, at the right duration, and at the right cost to them and their community" (Organization, 2002). Rational prescribing is the process of ordering drugs safely, effectively, and economically for the benefit of the patient (Organization, 2002). In developing countries, about 20% to 50% of health budgets are spent on drugs (Cole et al., 2015). Therefore, there is a need to improve prescribing practices as a step to improve drug utilization and healthcare delivery (Ofori-Asenso et al., 2016).

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Irrational prescribing exists around the world and is one of the harms observed in the treatment of cardiovascular disorders (Tefera et al., 2021). Typical types of inappropriate drug use include overdose, multiple drug use, inappropriate antibiotic use, injectable drug abuse when oral dosage forms are prominent, non-compliance with treatment guidelines, and self-medication (Wendie et al., 2021). This leads to several consequences in terms of costs, adverse drug reactions, neonatal errors, length of hospital stay, antibiotic-resistance bacteria, and a decline in patient trust in health care service quality (Sema et al., 2021, Umar et al., 2018). It has been reported that about 50% of drugs are improperly prescribed, dispensed and sold, and 50% of patients do not use them appropriately (Organization, 2017).

In the early 1990s, WHO developed a set of "core prescribing indicators" useful for identifying patterns of rational drug prescribing and use in health care settings (Organization, 1993). Prescribing indicators measure the performance of healthcare providers in five key areas: average number of drugs prescribed per encounter, proportion of drugs prescribed by generic name, proportion of encounters with an antibiotic, proportion of encounters with a prescribed injection, and proportion of drugs prescribed from the essential drug list (EDL) (Organization, 1993). These indices are widely recognized as a global standard for assessing the drug profile of health facilities and are recommended for inclusion in any drug use study (Sema et al., 2021; Summoro et al., 2015; Pise et al., 2015; Ragam et al., 2017; Mishore et al., 2020).

Limited reports have been published on prescribing patterns in pediatric patients, particularly in cardiology. Many of these articles were retrospective (Cole et al., 2015**;** Summoro et al., 2015), performed on an outpatient basis (Ahmed, Thomas et al., 2014; Summoro et al., 2015) , and descried only the prescribing pattern without the participation of clinical pharmacists in the care team (Ganieva et al., 2016; Tefera et al., 2019), and most relevant adults (Tefera et al., 2019; Mamo and Alemu, 2020). In countries other than Palestine, the role of clinical pharmacists was already developed and recognized as an integral part of the multidisciplinary workforce (Halvorsen et al., 2011). Clinical pharmacists have

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expanded into a wide range of hospital care areas, not only reviewing drug prescribing but also discussing cases with doctors, nurses, and other healthcare providers and suggesting optimal treatment for patients (Kaboli et al., 2006). In Palestine, the inclusion of clinical pharmacy services in the healthcare system is still in its initial stage (Naseef et al., 2020). Given these facts, this study was planned to compare the prescribing pattern of pediatric cardiologists during clinical pharmacist intervention versus routine cardiologists' practice at Al-Rantisy Specialized Pediatric Hospital in Gaza, Palestine.

Materials and Methods

Study Design and Setting

A comparative pre-post interventional study was conducted over two years between January 2020 and December 2021. This study had two stages: the retrospective pre-intervention routine practice stage (S0) and the prospective intervention stage (S1). The study was undertaken in the cardiology ward of Al-Rantisy Specialized Pediatric Hospital in Gaza, Palestine. This hospital is a governmental tertiary care center equipped with 90 beds and has the best medical services for children.

Ethical Approval

The current study was ethically approved by the Palestinian Health Research Council (No, PHRC/HC/787/20). Written informed consents were also obtained from all participants.

Eligibility Criteria

- Patients with the cardiovascular disease aged 1 month to 12 years old who were hospitalized for more than a day and took at least one drug during hospitalization were included.
- Patients presented to the emergency ward without admission, those admitted for diagnostic criteria, or who died during hospitalization were excluded.

Participants

Forty-eight patients who were admitted to the pediatric cardiology ward in 2020 and readmitted in 2021 were recruited as participants in this study. In the routine practice stage (S0) (January–December 2020), patients received usual cardiologists' management without a clinical pharmacist's intervention.

In the intervention stage (S1) (January–December 2021), the same patients received clinical pharmacist's intervention in addition to the routine cardiologists' management.

Data Collection

Based on the core WHO prescribing indicators (Organization, 1993), a structured collection form was applied to all participants' medical records. Demographics, diagnosis, length of stay (LOS), number of drugs per medication chart, adherence to generic name, number of patients who encountered antibiotics, number of patients encountered prescribed injections, and number of drugs prescribed from the essential drugs list for each patient were gathered in the collection form. The same form was used by the clinical pharmacist to collect data during both stages.

During the S0 stage, data were retrospectively reviewed and recorded over a twelve-month from January to December 2020. The clinical pharmacist had access to all data for previously admitted pediatric cardiology patients. A research focus team consisting of two Professors of Clinical Pharmacy, an Assistant Professor of Biostatistics, and a Pediatric Consultant reviewed and confirmed all identified deviations in prescribing patterns about WHO standards. Discussion and consensus were conducted in the team to reach a final decision on the appropriateness of cardiologists' prescribing. For ethical purposes, the clinical pharmacist demonstrated all unreasonable prescribing to the chief of the cardiology ward.

During the S1 stage, the clinical pharmacist made comprehensive interventional recommendations during daily ward rounds and as needed. These interventions included: performing medication use assessments, conducting patient/parent interviews, optimizing prescribing of generic drugs, antibiotics, injectable drugs, and drugs from the EDL according to WHO indicators, and consulting with cardiologists to resolve inappropriate prescribing. Acceptance of intervention by cardiologists was reported and outcomes were also assessed by the focus research team during stage S1.

Compared with WHO criteria, prescribing appropriateness scores were registered for all patients to discover differences over time and between study stages. All prescribed medications during the two stages were recorded and classified according to the Anatomical Therapeutic Chemical (ATC) Classification System (first level) (Chen et al., 2012). More precisely, the pattern of prescribing for each

drug order was calculated based on "WHO core prescribing indicators", and compared to the WHO stander for each indicator as follows (Organization, 1993):

1. An average number of prescribed drugs per encounter is equal to the total number of prescribed drugs / total number of encounters examined (WHO standard is 1.6–1.8). This is to identify the level of polypharmacy.
2. Proportion of generic prescribed drugs is equal to the number of generic prescribed drugs / total number of prescribed drugs multiplied by 100 (WHO standard is 100%). This is to assess the cost-effectiveness of drug use.
3. Proportion of encounters with an antibiotic is equal to the number of patient encounters with a prescribed antibiotic / total number of encounters examined multiplied by 100 (WHO standard is 20–26.8%). This is to evaluate the extent of inappropriate antibiotic use.
4. Proportion of encounters with a prescribed injection is equal to the number of patient encounters with an injection / total number of encounters examined multiplied by 100 (WHO standard is 13.4–24.1%). This is to identify the costly excessive use of injectable drug therapy.
5. Proportion of drugs prescribed in the EDL is equal to the number of prescribed drugs in the EDL / total number of prescribed drugs multiplied by 100 (WHO standard is 100%). This is to determine the level of adherence to EDL.

Data Analysis

Analysis was performed using the Statistical Package for the Social Sciences (SPSS), version 21.0 (IBM Corporation, Armonk, New York, USA). Descriptive data were obtained for the frequency, mean, and standard deviation of various characteristics. The researchers also analyzed the frequency of all prescribed drugs in the two stages to identify the most prescribed medications. Pearson's chi-square and paired t-test were used to compare prescribing indicators and length of hospital stay between the two stages, respectively. $P < 0.05$ was considered statistically significant.

Results

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Descriptions of the study patients

Of the 315 patients hospitalized in the pediatric cardiology ward for two years between January 2020 and December 2021, 48 were admitted in 2020 and readmitted in 2021 and were selected as the sample of this study. The mean age of the sample at first admission was 2.33 years (range, 4 months –11 years), of which 58.3 % (n=28) were 2 years or younger. Among the patients, 56.2% (n=27) were males and 52.1% (n=25) weighted less than 10 kg. Details of patient demographics are presented in Table 1.

Table 1: Demographic characteristics of the study population (n=48)

Descriptions	**Value**	
Gender		
Male, n (%)	27	56.2
Female, n (%)	21	43.8
Age		
Age in years (mean ± SD), (range)	2.33±2.26	4 months –11 years
>1 month to ≤2 years	28	58.3
>2 years to ≤6 years	13	27.1
>6 years to ≤12 years	7	14.6
Weight		
Weight in Kg (mean ± SD), (range)	11.08±5.15	3 – 34
< 10 Kg	25	52.1
≥ 10 Kg	23	47.9

Descriptive frequency analysis was used

Comparison of prescribing indicators and length of stay in the two study stages

As shown in Table 2, drugs prescribed per patient were significantly lower in the intervention stage compared with the routine practice stage (mean: 5.98 S1 versus 6.87 S0; *P*=0.043). Significantly higher generic drugs were reported in the intervention stage (97.2% [n=279/287] S1 versus 72.1% [n=238/330] S0; *P*= 0.002). No difference in drugs prescribed from the EDL was seen between the two stages (99.3% [n=285/287] S1 versus 95.2% [n=314/ 330] S0; *P*=0.152). Patients in the intervention stage encountered significantly fewer antibiotics than in the routine practice stage (60.4% [n=29/48] S1versus 79.2% [n=38/48] S0; *P*=0.009). However, the number of patients who encountered an

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injection was relatively similar in both study stages (75.0% [n=36/48] and 73.0% [n=35/48] in S1 and S0, respectively; *P*=0.496). The mean length of hospital stay was significantly reduced from 8.22 days in the routine practice stage to 6.93 days in the intervention stage (*P*=0.032). A comparison of prescribing indicators is also illustrated separately in Figure 1.

Table 2: Comparison of prescribing indicators and length of hospital stay in the two study stages

Characteristics	Stage description		
	Routine practice stage in 2020 (*S0, n=48*)	Intervention stage in 2021 (*S1, n=48*)	*P-value*
Total frequency of prescribed drugs, n	330	287	—
Drugs prescribed per patient, mean (SD)	6.87 (2.40)	5.98 (1.82)	0.043
Drugs prescribed by generic name, n (%)	238 (72.1)	279 (97.2)	0.002
Drugs prescribed from the essential drug list, n (%)	314 (95.2)	285 (99.3)	0.152
Patient encounters with an antibiotic, n (%)	38 (79.2)	29 (60.4)	0.009
Patient encounters with an injection, n (%)	35 (73.0)	36 (75.0)	0.496
Length of hospital stay in days, mean (SD)	8.22 (2.85)	6.93 (2.91)	0.032

Pearson's chi-square and paired t-test were used to compare prescribing indicators and length of hospital stay between the two stages, respectively

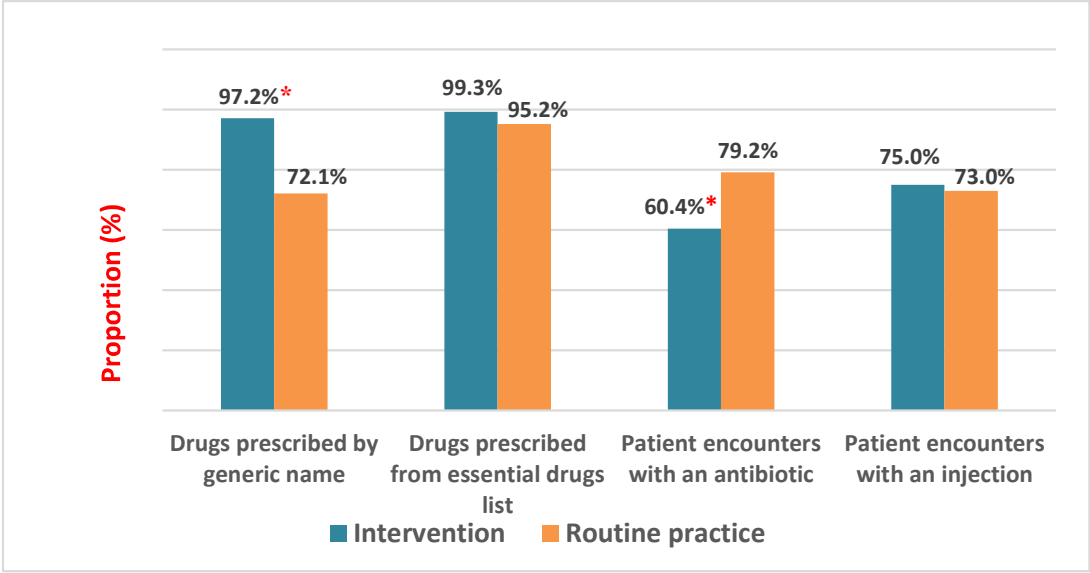

Figure 1: Comparison of prescribing indicators in the two study stages (n=48)

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Types of diagnosis in the study patients

The analysis demonstrated that the most common type of diagnosis was ventricular septal defect (VSD) (25%, n=12), followed by tetralogy of fallout (TOF) (16.6%, n=8) and transposition of the great arteries (TGA) (14.5%, n=7). Regarding the distribution of these diagnosis between male and female groups, it was as follows: VSD (14.6%, n=7 versus 10.4%, n=5), TOF (10.4%, n=5 versus 6.2%, n=3), and TGA (8.3%, n=4 versus 6.2%, n=3). Current data showed that most diagnoses were more common in male patients. The distribution of other diagnosis is given in Table 3.

Table 3: Distribution of diagnosis in the study patients by gender

Type of diagnosis	Frequency (*n*=48)		
	Male *n* (%)	Female *n* (%)	Total *n* (%)
Ventricular septal defect (VSD)	7 (14.6)	5 (10.4)	12 (25.0)
Tetralgy of fallot (TOF)	5 (10.4)	3 (6.2)	8 (16.6)
Transposition of the great arteries (TGA)	4 (8.3)	3 (6.2)	7 (14.5)
Coarctation of aorta (CA)	3 (6.2)	2 (4.2)	5 (10.4)
Patent ductus arteriosus (PDA)	3 (6.2)	1 (2.1)	4 (8.4)
Atrioventricular canal (AV canal) defect	2 (4.2)	2 (4.2)	4 (8.4)
Double outlet right ventricle (DORV)	1 (2.1)	2 (4.2)	3 (6.3)
Pulmonary artery atresia/stenosis (PA)	1 (2.1)	1 (2.1)	2 (4.2)
Congestive heart failure (CHF)	1 (2.1)	1 (2.1)	2 (4.2)
Dilated cardiomyopathy (DC)	0 (0.0)	1 (2.1)	1 (2.1)

Descriptive frequency analysis was used

Pattern of drug groups used in both study stages

Based on the WHO Anatomical Therapeutic Chemical (ATC) Classification System for drugs (Chen et al., 2012), the most commonly used ATC drug group in the routine practice group compared to the intervention group was "Cardiovascular system" (39.1% [n=129/330]) versus 42.5% [n=122/287]), followed by "Respiratory system" (18.8% [62/330] versus 16.4% [47/287]), "Alimentary tract and

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metabolism" (11.8% [39/330] versus 11.8% [34/287]), and "Systemic anti-infective" (11.2 [37/330] versus 10.5% [30/287]). Different drug groups are viewed in Figure 2.

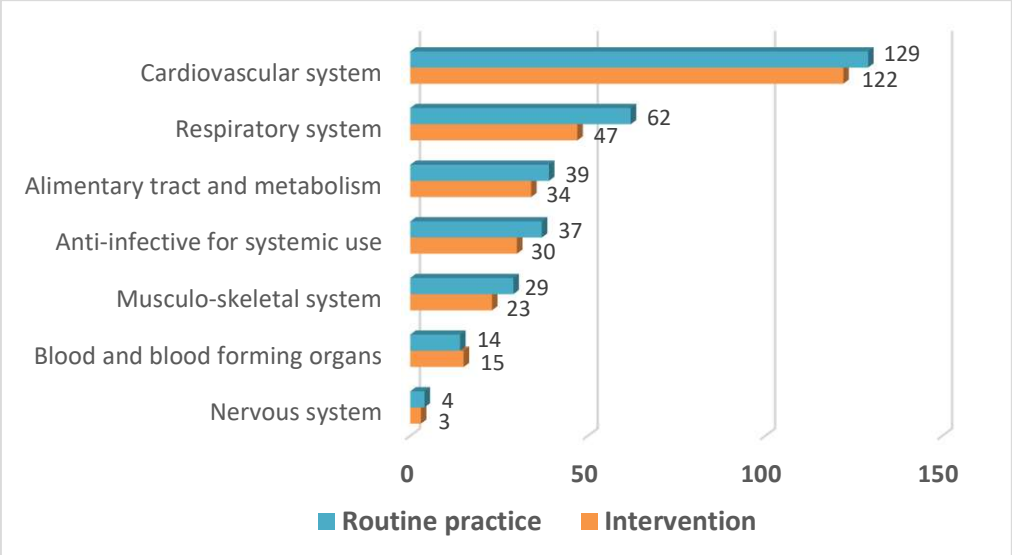

Figure 2: Different drug groups used in both study stages

Frequency of prescribed drugs in both study stages

The most often prescribed drugs in the routine practice group and the intervention group were furosemide (10.6% [n=35/330] versus 10.5% [n=30/287]), captopril (9.7% [n=32/330] versus 9.4% [n=27/287]), and spironolactone (8.5% [n=28/330] versus 8.7% [n=25/287]). Commonly prescribed drugs are summarized in Table 4.

Table 4: Frequency of prescribed drugs in both study stages

N	Drug	Stage frequency	
		Routine practice stage in 2020 *n* (%)	Intervention stage in 2021 *n* (%)
1	Furosemide	35 (10.6)	30 (10.5)
2	Captopril	32 (9.7)	27 (.94)
3	Spironolactone	28 (8.5)	25 (8.7)
4	Omeprazole	26 (7.9)	22 (7.6)
5	Ceftriaxone	24 (7.3)	19 (6.6)
6	Ipratropium	21 (6.4)	17 (5.9)
7	Paracetamol	20 (6.1)	19 (6.6)
8	Salbutamol	19 (5.7)	18 (6.3)

9	Dexamethasone	18 (5.5)	16 (5.6)
10	Acetylcysteine	17 (5.2)	15 (5.2)
11	Sildenafil	14 (4.2)	14 (4.9)
12	Aspirin	12 (3.6)	11 (3.8)
13	Metoclopramide	10 (3.0)	8 (2.9)
14	Ibuprofen	9 (2.7)	5 (1.7)
15	Calcium gluconate	7 (2.1)	6 (2.1)
16	Others	38 (11.5)	35 (12.2)
	Total	**330 (100)**	**287 (100)**

Descriptive frequency analysis was used

Discussion

Evaluation of drug prescribing in adults has been extensively studied, but similar reports in pediatrics, particularly in patients with cardiovascular diseases, are extremely rare. Thus, analysis of prescribing patterns of cardiologists in pediatric patients is essential to promote the rational use of drugs and the quality of patient care.

Compared with the routine practice stage, the mean number of drugs prescribed per patient in the intervention stage was significantly lower (mean: 5.98 S1versus 6.87 S0; P=0.043).However, this number of prescribed drugs is still higher than the WHO standard (≤3), indicating the experience of polypharmacy. A similar result was observed in a study performed on children admitted to the cardiovascular ward in Uzbekistan (Ganieva et al., 2016). Contrastingly, fewer drugs were prescribed to children in Sierra Leone (Cole et al., 2015), Ethiopia (Teni et al., 2014), Saudi Arabia (GUPTA et al., 2013), and Nigeria (Oshikoya et al., 2006). The complexity of the cardiovascular diseases and the comorbidities of the pediatric patients included in this study as well as the families' pressure on cardiologists to prescribe more drugs to treat their children may justify the highly prescribed medications mentioned in this study. Pediatric patients on polypharmacy (taking ≥5 medications daily) are more likely to experience drug-related problems and associated increased healthcare costs compared to patients taking fewer medications (Nguyen et al., 2021).

In this study, scores for generic drugs were significantly higher in the intervention stage than in the routine practice stage (97.2% S1 versus 72.1% S0; *P*= 0.002). These were even higher than most previous pediatric studies conducted in the Gambia (74.8%) (Risk et al., 2013), Sierra Leone (71.0%) (Cole et al., 2015), Nigeria (68.9 % %) (Joseph et al., 2015), Sudan (49.3%) (Ahmed and Awad, 2010),

and India (23.4%) (Pradeepkumar et al., 2017). Current analysis indicated that the clinical pharmacist's interventions have helped cardiologists become more committed to the good prescribing of drugs generically. Generic prescribing is useful for reducing medication errors, reducing the overall cost of medications, and improving communication between healthcare professionals (Pise et al., 2015; Cole et al., 2015).

Writing drugs from the Essential Drugs List (EDL) is an important indicator for rational pharmacotherapy (Cole et al., 2015). Current data indicated that EDL prescribing was relatively high in both study stages (99.3% S1versus 95.2% S0; *P*=0.152). Close to the WHO optimal stander (100%), a very high proportion (99.3%) of EDL drugs were prescribed in the intervention stage. This figure is much higher than in some other countries. According to a pediatric study in Canada (Sharma et al., 2016), 90.8 % of prescribed drugs came from EDL, whereas studies in Sierra Leone (Cole et al., 2015) and India (Ragam et al., 2017) showed only 70.6% and 49.30% of prescribed drugs were generic, respectively. Involving the clinical pharmacist in the prescribing phase support cardiologists' commitment to EDL when prescribing medications.

The aforementioned significant increase in generic prescribing could be due to increased cardiologists' compliance with EDL, which improved treatment and patient outcomes. Essential drugs are those that meet public health priority needs, meet efficacy and safety requirements and achieve cost-effectiveness suitability (Laing et al., 2003). Within 12 months of integrating the clinical pharmacist into the cardiology ward, pediatric cardiologists made remarkable progress in prescribing EDL drugs.

Irrational use of antibiotics remains an ongoing problem worldwide. WHO reported that antibiotic resistance is no longer a predictor of the future; it is now occurring globally and is compromising the treatment of common bacterial infections in the communities and healthcare settings (Antimicrobial Resistance, 2014). The emergence of antibiotic resistance increases the need for new antibiotics and increases the overall cost of drug therapy (Demoz et al., 2020). The present analysis reflected that patients in the intervention stage received significantly less antibiotics than in the routine practice stage (60.4% S1 versus 79.2% S0; *P*=0.009). The proportion (60.4%) of antibiotics in the clinical pharmacist's stage is in line with the Indian study of children in a tertiary care hospital (Pise et al., 2015). This study findings are much better compared to antibiotic prescribing among the pediatric population from

neighboring developing countries such as Jordan (85%) (Al-Niemat et al., 2014), Sudan (81.3%) (Ahmed and Awad, 2010), and Nigeria (71.1%) (Joseph et al., 2015). Implementation of the "Antimicrobial Stewardship Program" in our pediatric cardiology ward in partnership with the clinical pharmacist likely contributed to this aforementioned reduction in antibiotic prescribing from 79.2% before to 60.4% after the clinical pharmacist's intervention. Strict adherence to this program can address antibiotic overuse as documented in several reports (Probst et al., 2021, Bagga et al., 2021). In this regard, incorporating well-trained pharmacists into the healthcare system can contribute to reducing inappropriate antibiotic use and the emergence of antimicrobial-resistant (Sakeena et al., 2018).

The proportion of encounters with injections was relatively similar in both study stages (75.0% and 73.0% in S1 and S0, respectively; *P*=0.496), exceeding the WHO criteria of 13.4%–24.1%. Comparatively, higher injection prescribing rates were observed in India (85.59%) (Mathew et al., 2021) and Ethiopia (84.33%) (Girma et al., 2018). However, the proportion was lower in Sierra Leone (21.1%) (Cole et al., 2015) and India (20.0%) (Kumar et al., 2021). The increase in injection prescribing observed in this study could be due to: First, emergency treatment of severe cardiovascular cases required intravenous medication rather than oral one. The second, the limited availability of pediatric oral formulations. Third, cardiologists have been under pressure to prescribe injections by caregivers for their children. Therefore, it is urgent to implement evidence-based treatment guidelines to control the rate of injection prescribing compared to other formulations.

According to the analysis of the mean LOS in the current study, patients in the intervention stage were discharged significantly earlier with improved clinical status than in the routine practice stage (mean LOS; 6.93 days S1versus 8.22 days S0, p = 0.032). Shorter LOS linked to lower risk of hospital-acquired infections and adverse drug reactions, and better outcomes. Reducing hospitalization times also reduces the burden of medical costs and increases bed turnover, which in turn improves hospital profitability (Baek et al., 2018). Good adherence to evidence-based treatment protocols by cardiologists, coupled with the involvement of clinical pharmacists, may have led to a significant reduction in mean LOS observed in this study.

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The current results showed that ventricular septal defect (VSD) (25%, n=12) was the most commonly noted diagnosis type. Similar findings were reported in studies among cardiology children from Egypt (Sabry et al., 2016) and Iran (Nezami et al., 2021). Differently, in a Brazilian study by Nascimento *et al.,* (2020), the persistence of ductus arteriosus (PDA) (35.6%, n=37) was the most common disease (Nascimento et al., 2020). This difference may be related to changes in population characteristics, environmental factors, and gestational conditions. The current study results also indicated that most diagnoses were more common in male patients. This matched with a recently published study in Iran (Nezami et al., 2021). The available data reflect the high susceptibility of male children to cardiovascular diseases that require priority medical attention.

In this study, the most common drug groups in both study stages were "Cardiovascular system", followed by "Respiratory system", "Alimentary tract and metabolism", and "Systemic anti-infective". These findings relatively correspond with those seen in a study published in Hong Kong (Rashed et al., 2014). The analysis also showed that furosemide, captopril, and spironolactone were the three most frequently prescribed drugs in both stages. However, in a Brazilian study of newborns with heart disease, the drugs most often ordered were gentamicin, furosemide, and dobutamine (Nascimento et al., 2020). The discrepancy between the patient's diagnosis and the treatment protocol used could explain the difference between the two studies.

This study has three strengths. Initially, this is the first study evaluating the usefulness of the clinical pharmacist intervention on the prescribing pattern of pediatric cardiologists in Palestine. Second, the study creatively compared prescribing patterns during clinical pharmacist intervention with routine cardiologist practice, and highlighted differences between the two periods. This has led cardiologists to better understand the importance of the clinical pharmacist in improving their prescribing. Third, the present study was characterized by the inclusion of a multidisciplinary research team that reviewed and validated all identified deviations in prescribing process to ultimately recommend appropriate measures to optimize cardiologists ordering. The adoption of clinical pharmacist interventions by pediatric cardiologists to modify their prescribing behavior has positively contributed to today's optimal outcomes.

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Conclusion

Overall, the prescribing pattern of pediatric cardiologists was significantly improved during the participation of the clinical pharmacist at a tertiary care hospital in Palestine. After clinical pharmacist intervention, significantly optimized generic prescribing and reduced antibiotic consumption was observed. Pediatric cardiologists have shown excellent adherence to the Palestinian EDL when prescribing medications during both stages of this study. Despite being polypharmacy, the number of drugs prescribed has been significantly dropped by involving the clinical pharmacist. Additionally, the shorter LOS reported in the intervention stage can optimize patient safety and reduce the cost of pharmacotherapy. The current report emphasizes that incorporating the clinical pharmacist in pediatric cardiology teamwork not only improves prescribing pattern of cardiologists but also makes optimal drug utilization with better patient outcomes. Health decision makers should adopt the integration of clinical pharmacists into cardiology and various specialties to promote the rational use of limited drug resources and improve the quality of healthcare in Palestine and similar countries.

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