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Evaluation of Clinical Pharmacist's Interventions in a Specialized Cardiac Center: Impact on Patient's Direct Medication Cost

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***SUMMARY*. The studies related to the impact of clinical pharmacist intervention in the drug-related problem are lacking. Therefore, the aim of this study was to assess the clinical pharmacist interventions and probable impact of these interventions in cost minimization by reducing direct medication costs at a specialized cardiac center in Saudi Arabia. This was a retrospective observational study conducted at Prince Sultan Cardiac Center (PSCC) in Riyadh, Saudi Arabia. A total number of 18,480 clinical pharmacist interventions were recorded between January 2011 and December 2013. The 3 highest causes of clinical pharmacy interventions included 25.4% for disease management, 20.5% for pharmacokinetic and dose monitoring, and 10.4% for drug discontinuation. Total cost reduced after clinical pharmacy interventions were SAR 437,805 (US$ 116,748) during the period of the study. Our study could demonstrate that the participation of a clinical pharmacist during ward rounds is very helpful for the optimization of pharmacotherapy.**

RESUMEN. Los estudios relacionados con el impacto de la intervención farmacéutica clínica en el problema relacionado con la droga son deficientes. Por lo tanto, el objetivo de este estudio fue evaluar las intervenciones farmacéuticas clínicas y el probable impacto de estas intervenciones en la minimización de costos mediante la reducción de los costos directos de medicamentos en un centro cardíaco especializado en Arabia Saudita. Se trata de un estudio observacional retrospectivo realizado en el Centro Cardiaco Prince Sultan (PSCC) en Riyadh, Arabia Saudita. Entre enero de 2011 y diciembre de 2013 se registraron 18480 intervenciones de farmacéuticos clínicos. Las 3 causas más importantes de intervenciones de farmacia clínica incluyeron 25,4% para el manejo de la enfermedad, 20,5% para la farmacocinética y monitoreo de la dosis y 10,4% para la interrupción del fármaco. El costo total se redujo después de las intervenciones de farmacia clínica, siendo SAR 437.805 (US $ 116.748) durante el período del estudio. Nuestro estudio podría demostrar que la participación de un farmacéutico clínico durante las rondas de barrio es muy útil para la optimización de la farmacoterapia.

INTRODUCTION

During the past few decades, clinical pharmacy services have developed around the world [1]. Clinical pharmacy is defined as the part of pharmacy practice "that contributes directly to patient care and develops and promotes the rational and appropriate use of medicinal products and devices" [2]. In many countries, these services have emerged over time, and the involvement of clinical pharmacists in multidisciplinary patient care is beneficial and has been associated with positive patient outcomes [3-6]. A number of studies have demonstrated the clinical and economic benefits of clinical pharmacy interventions in the hospital and primary care settings [7-11].

Conversely, in Saudi Arabia, clinical pharmacy is not fully appreciated. The main hospitals that utilize clinical pharmacists are the specialty hospitals, university hospitals, and other elite medical centers. The studies related to the impact of clinical pharmacist intervention in the drug-related problem are lacking, however, some of the studies conducted in Saudi hospitals reflects the positive impact of pharmacist intervention in reducing drug-related errors and

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over-all patients care. A recent study provides evidence of the economic value of clinical pharmacy services and the appreciation of the medical staff of this unique service [12]. Another study reported that participation of a clinical pharmacist in the daily multidisciplinary team rounds in an ICU setting significantly reduces unfavorable morbidities and enhances therapeutic outcomes [6].

The addition of a clinical pharmacist to the care of patients with cardiovascular disease (CVD) can lead to an improvement in CVD patients in many areas, including a reduction in CVD risk rates, optimizing CVD medications, improving patient knowledge and satisfaction, improving patient adherence, and preventing potential drug-related problems (DRPs). These improvements can lead to increased quality of life for CVD patients, reduced mortality rates, and decreased number of hospitalizations or emergency room (ER)/clinic visits. This, in turn, results in a decrease in total health care costs [13,14].

Due to the indisputable role of clinical pharmacists in patients positive outcomes, decreasing medication error and saving of cost, studies considering different aspects of clinical pharmacist interventions in hospitalized patients have been at the center of attention and interest during the last few years. To the best of our knowledge, no study has been performed in Saudi Arabia so far to evaluate the effect of clinical pharmacy services on decreasing direct medication costs. Hence, we design a study to assess the cause and type of clinical pharmacist interventions, probable impact of these interventions in cost minimization by reducing direct medication costs and clinical significance of these interventions at a specialized cardiac center.

MATERIAL AND METHODS

This was a retrospective observational study conducted at Prince Sultan Cardiac Center (PSCC) in Riyadh, Saudi Arabia which is a specialized healthcare center provides comprehensive cardiovascular services to all Armed Forces personnel, their dependents and other patients referred to the center for further evaluation and specialized treatment and includes about 174 beds dedicated to Adult and Pediatric Cardiac patients. The study was approved by the Institutional Review Board (IRB) of the hospital. The clinical pharmacy service members' interventions performed during the period between January 2011 and December 2013 was extracted from the hospital's electronic documentation system and was analyzed for the cause of intervention, types of intervention, and clinical significance of intervention. The cause of intervention included but not limited to disease management, pharmacokinetic and dose monitoring, drug discontinuation, patient counseling and dose adjustment. The type of intervention included a recommendation for addition, withdrawal or replacement of a drug, advice for a change of dosage, advice for a change of formulation, and drug information.

Clinical significance of clinical pharmacy interventions was evaluated according to the guideline of Society of Hospital Pharmacy of Australia [15]. The clinical significance of intervention was rated as *insignificant* (no harm or injuries), *minor* (minor injuries, minor treatment required, no increased length of stay or re-admission), *moderate* (major temporary injury, increased length of stay or re-admission, cancelation or delay in planned treatment/procedure), *major* (major permanent injury, increased length of stay or re-admission, morbidity at discharge), or *catastrophic* (death or large financial loss).

Calculations of cost savings

The direct medication cost saving was calculated for interventions that cause medication discontinuation due to duplication or improper indication, medication dose adjustment, discontinuing or postponing a therapeutic drug monitoring, switching from intravenous to oral or from an expensive to a cheaper equivalent medication.

A conservative method to calculate cost saving was developed. In the inpatient setting, we adopt an assumption that a medication intervention would automatically be done in a maximum of three days. For example, if a clinical pharmacist manages to intervene before the patient is started on the medication, then we will assume that he/she save the institute an average of three days of medication use. If he/she will be intervened after the patient has received any dose then if in the first day we will assume a cost saving of two days and so on. If the intervention will be made on the third day or after, then there will be no cost saving calculation for this intervention [16]. In the case of patient discharge medications, we calculate the cost saving for the whole prescribed period because the intervention will most probably not take place until the patient's next visit for refill or an appointment.

Direct medication cost savings was calculated by multiplying the medication's average annual unit acquisition price -which was provided by the supply department- times the number of total daily doses and number of days reduced. The results were expressed in Saudi Riyals and US Dollars.

Statistical Package for the Social Sciences (SPSS) version 20 (SPSS Inc., Chicago, IL, USA) was used for descriptive statistical analysis. The data are summarized using descriptive statistics and categorical variables were expressed as a percentage (%).

RESULTS

A total number of 18,480 clinical pharmacist interventions were recorded during the study period. The details of the pharmacist interventions based on patients' demographic variables and location are summarized in Table 1.

Approximately 73.0 % of the pharmacist interventions were for male patients. The interventions were predominantly for patients above 60 years of the age (70.4%). Adult cardiology was the most frequent location, occurring in 63.9 % of the total clinical pharmacist interventions, followed by critical care (18.1%), pediatrics (12.6%) and cardiac surgery (5.4%).

Causes of clinical pharmacy interventions

The 3 highest causes of clinical pharmacy interventions included 25.4% for disease management, 20.5% for pharmacokinetic and dose monitoring, and 10.4% for drug discontinuation and 27.1% for others (Table 2).

Assessment of economic outcomes

Total cost reduced after clinical pharmacy interventions were SAR 437,805 (US$ 116,748) (US$1 is equal to SAR 3.75) during the period of

	Parameters	No. of interventions	Percentage (%)
Age (years)	Less than 30	2323	12,6
	31-60	3142	17,0
	Above 60	13015	70,4
	Total	18480	100
Gender	Males	13490	73,0
	Females	4990	27,0
	Total	18480	100
Locations	Adult cardiology	11809	63,9
	Critical care	3354	18,1
	Pediatrics	2323	12,6
	Cardiac Surgery	994	5,4
	Total	18480	100

Table 1. Number (%) of clinical pharmacist interventions based on demographic details and location.

Category of Intervention	Number (n = 18480)	Percentage (%)	Cost reduced (SR)	Percentage (%)
Disease Management	4698	25.4	35239	8.0
Pharmacokinetic and dose monitoring	3784	20.5	21177	4.8
Drug Discontinuation	1918	10.4	123393	28.3
Patient Counseling	1822	9.8	0	0
Dose Adjustment	1257	6.8	77621	17.7
Others	5001	27.1	180375	41.2
Total	18480	100	437805	100

Table 2. Number (%) of causes of clinical pharmacy interventions and cost reduced.

the study. These costs included a wide variety of interventions causes including Drug Discontinuation (total cost reduced SAR 123,393; 28.3%), Dose Adjustment (SAR 77,621; 17.7%), Disease Management (SAR 35,239; 8.0%), Pharmacokinetic and dose monitoring (SAR 21,177; 4.8%) and others (SAR 180,375; 41.2%) (Table 2).

Interventions recommended by clinical pharmacist

Table 3 gives information about the type of intervention recommended by the clinical pharmacist.

The majority (41.5%) of clinical pharmacy intervention recommendation involved with drug monitoring need. Furthermore, about 10.4% of clinical pharmacy intervention recommendation concerned with drug discontinuation, adding a drug to the treatment regimen (10%), and changing the frequency, dose or doses schedule of drugs (9.6%). Change of treatment drug (0.7%) and change in treatment duration (0.4%) were the least common interventions by clinical pharmacists. Interestingly, all (100%) clinical pharmacist recommendations regarding compatibility/stability of drugs and preventing medication error were accepted by nurses and physicians.

Assessment of economic outcomes

Total cost reduced after clinical pharmacy interventions recommendations were SAR 437,805 (US$ 116,748) (US$1 is equal to SAR 3.75) during the period of the study. These costs included a wide variety of interventions recommendations including Drug Discontinuation (total cost reduced SAR 187,361; 42.8%), Dose Change/Doses Schedule/Frequency Change (SAR 93,249; 21.3%), Drug Monitoring Need (SAR 35,183; 8.0%), Drug Addition (SAR 12,698; 2.9%), Duration Change (SAR 10,551; 2.4%), Drug Change (SAR 2,466; 0.6%) and others (SAR 96,297; 22.0%) (Table 3).

Clinical significance of clinical pharmacist intervention

The clinical significance of clinical pharmacist interventions is shown in Table 4. The significance level of intervention was analyzed based on 3 criteria as minor/low clinical significance, moderate clinical significance, and high clinical significance. The majority of interventions were classified as high clinical significance (62.3%) followed by moderate clinical significance (26.2%) and minor / low clinical significance (11.5%).

Assessment of economic outcomes

Total cost reduced after clinical pharmacy intervention recommendations were SAR 437,805 (US$ 116,748) (US$ 1 is equal to SAR 3.75) during the period of the study. Clinical pharmacist interventions classified as high clinical significance accounted for SAR 357, 687 or 81.7% of the total cost reduced followed by moderate clinical significance (SAR 64,357; 14.7%) and minor / low clinical significance (SAR 15,761; 3.6%) (Table 4).

DISCUSSION

Certainly, clinical pharmacy services have made a positive impact on health care system [17]. Several studies have been carried out to assess the significance of the addition of clinical pharmacy services into the patient care, however; its

Types of intervention	Number (n = 18480)	Percentage (%)	Cost reduced (SR)	Percentage (%)
Drug Monitoring Need	7671	41.5	35183	8.0
Drug Discontinuation	1918	10.4	187361	42.8
Drug Addition	1853	10.0	12698	2.9
Dose Change/Doses Schedule/Frequency Change	1772	9.6	93249	21.3
Drug Change	123	0.7	2466	0.6
Duration Change	65	0.4	10551	2.4
Appropriate Administration	26	0.1	0	0
Others	5052	27.3	96297	22.0
Total	18480	100	437805	100

Table 3. Number (%) of type of intervention recommended by clinical pharmacist and cost reduced.

Clinical significance	Description	Number	Percentage (%)	Cost reduced (SR)	Percentage (%)
High	Any intervention that may result in decreasing patient mortality, preventing or reducing organ damage or system failure, and/or reduced length of stay in hospital	11518	62.3	357687	81.7
Moderate	Intervention that may have resulted in improved quality of patient care	4849	26.2	64357	14.7
Minor/Low	Intervention that may have resulted in improve convenience and/or compliance	2113	11.5	15761	3.6
	Total	18480	100	437805	100

Table 4. Number (%) of clinical significance of clinical pharmacist intervention and cost reduced.

economic impact was very rarely studied. Therefore this study aimed to demonstrate the clinical pharmacist interventions and their economic impact on patient's direct medication cost at a specialized cardiac center in Saudi Arabia.

A recent study by Ramanath *et al.* [18] showed that the impact of clinical pharmacist offered disease managements had a positive impact on medication adherence and Quality of life (QOL) by preventing recurrence of disease, its progression, and minimizing of hospital admissions. In our study, a total of 18,480 interventions by the clinical pharmacist were recorded during the study period. Of these more than one-fourth was related to disease management followed by one-fifth for pharmacokinetic and dose monitoring, drug discontinuation (10.4%) and dose adjustment (6.8%). Moreover, the results of another study demonstrated that knowledge of medications and of disease management in pharmacist intervention group patients improved steadily throughout the study period [19]. A study conducted in a cardiac surgery intensive care unit in Saudi Arabia reported the reasons for clinical pharmacist's intervention as dose adjustment that represented 29% and discontinuation of unneeded medication 14.3% of total intervention [6]. What is more, pharmacists as direct care providers can play an important role in promoting cost-effective disease management programs, a topic that is increasingly a substantive focus among health care policymakers, consumers, payers, and researchers [20].

Therapeutic drug monitoring (TDM) is an important aspect of patient care, and clinical pharmacists are particularly well suited for this role. A typical patient with cardiovascular (CVD) disorder takes ≥ 6 medications and has ≥ 5 chronic conditions, which can potentially lead to drug–drug interactions as well as serious life-threatening adverse events [21,22]. For CVD patients treated chronically with narrow therapeutic index medications such as digoxin and warfarin, dosing adjustments are required when concomitant antibiotics, amiodarone, or other cytochrome P450/P-glycoprotein inhibitors or inducers are prescribed. In our study majority (41.5%) of clinical pharmacy intervention recommendation involved with drug monitoring need. Clinical pharmacists provide pharmacokinetic monitoring and assessment of drug interactions through review of medication profiles, laboratory data, and patient interviews, and make recommendations to the medical team or patient regarding appropriate monitoring tests or dosage adjustments have also been reported in earlier studies [23,24]. Furthermore, our study also reported that about 10.4% of clinical pharmacy intervention recommendation concerned with drug discontinuation followed by adding a drug to the treatment regimen (10%) and changing the frequency, dose or doses schedule of drugs (9.6%). In an overseas study conducted in Iran, the most frequent clinical pharmacist interventions were adding a drug to the treatment regimen (20.9%) and drug discontinuation (19.6%) [8]. Another study, by Dashti-Khavidaki *et al.* [25], demonstrated discontinuation of unnecessary drugs (22.7%), changing the frequency, duration or dose of drugs (22.7%), and adding a drug to the patient's treatment regimen (20.8%) as the most common interventions by clinical pharma-

cist in the nephrology and infectious disease wards of a large university hospital in Iran. Also, a study performed in an intensive care medicine and hematology/oncology wards of a university hospital in Germany reported similar finding [26]. In addition, another study conducted in an intensive care unit in India suggest that cessation of drugs was the most frequent (31.9%) suggestion provided by the intervening pharmacist followed by changes in the frequency of administration (21.3%) and changes in the drug dose (19.1%) [27].

The majority of interventions recommended by the clinical pharmacists in our study was categorized as high clinical significance (81.7%) that may result in decreasing patient mortality, preventing or reducing organ damage or system failure, and/or reduced length of stay in the hospital. In contrast to this finding, a study conducted in a cardiac surgery intensive care unit in Saudi Arabia reported the majority of interventions were moderate in clinical significance (82.3%) [6]. Another study by Al-Aqeel *et al.* [28] reported that eighty-two percent of interventions in their study were rated by pharmacists as of moderate clinical significance.

Our findings indicated that pharmacist recommendations for drug therapy significantly decrease health care costs. Total cost reduced after clinical pharmacy interventions recommendations were SAR 437,805 (US$ 116,748) (US$1 is equal to SAR 3.75) during the period of the study. As anticipated, the cost saving by clinical pharmacist recommendation was greatest for drug discontinuation (SAR 123,393) followed by dose change/doses schedule/ frequency change (SAR 77,621). Similarly, a study conducted in Thailand to describe the characteristics of the interventions and to determine pharmacist's interventions led to change in cost saving and cost avoidance in intensive care unit (ICU) reported that interventions made by pharmacist resulted in a direct cost saving of 1,971.43 US$ over 5 weeks study period [29]. Moreover, an Indian study with the objective to analyze clinical pharmacist interventions in the intensive care units (ICUs) setting of a tertiary care Indian hospital and to assess the pharmacoeconomic impact on drug-related problems concludes that clinical pharmacist interventions had a significant impact on the cost of drug therapy as the total net cost savings made over a 7 months study period was US$ 1,796.73 [27]. A study in Amman, Jordan was designed to determine whether the presence of Clinical Pharmacist affects the cost of drug therapy for patients admitted to the Intensive Care Unit reported that the total reduction of drug therapy cost after applying Clinical Pharmacy practices in the ICU over a period of ten months was 211,574.90 US$ [30].

The findings of this study should be taken with some limitations. The foremost limitations of this study were its retrospective nature, and the study was performed in a single specialized center where most of the complicated cardiac surgeries are performed, therefore the findings might not be generalized to all settings or hospitals and so care should be taken in extrapolating the results to other health care systems. Hence, large, well-designed, multi-ward, and multi-center studies are warranted to determine the precise impact of clinical pharmacy services on patient safety and outcome in Saudi Arabia.

CONCLUSION

Among the interventions performed and documented by a clinical pharmacist in a specialized cardiac center, recommendation for drug monitoring and drug discontinuation activities were associated with the greatest number of interventions recommended by a clinical pharmacist and the greatest potential cost saving. Our study could demonstrate that the participation of a clinical pharmacist during ward rounds is very helpful for the optimization of pharmacotherapy, in terms of choosing the most appropriate drug and/or the suitable dosage and therefore contributes to the improvement of patient care.

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