The impact of clinical pharmacist in a cardiac-surgery intensive care unit

Abdulrazaq S. Al-Jazairi, PharmD, BCPS, *Amal A. Al-Agil,* BSc Pharm, MS, *Yousif A. Asiri,* MS, PhD, *Tariq A. Al-Kholi,* MD, PhD, *Nathem S. Akhras,* PharmD, RPh, *Bashar K. Horanieh,* BSc Pharm, MS.

ABSTRACT

الهدف: تقييم التدخلات الإكلينيكية للصيادلة في وحدة العناية المركزة فيما يتعلق بتقبل الفريق الطبي لهم، وتكرار التدخلات ، والأهمية الإكلينيكية ، والنتائج المستهدفة للمريض.

الطريقة: تعتبر هذه الدراسة دراسة استطلاعية مستقبلية غير مقارنة لتقييم التدخلات الإكلينيكية في وحدة العناية المركزية. وقد تم إجراء الدراسة في وحدة العناية المركزة لجراحة القلب(١٩سريراً) بمستشفى الملك فيصل التخصصي ومركز الأبحاث، وهو أحد مستشفيات الرعاية المتقدمة في الرياض بالمملكة العربية السعودية. وقد قام الصيدلي الإكلينيكي بجولات يوميه مع الفريق الطبي مع توثيق جميع تداخلاته. وفي نفس اليوم قام الطبيب ، وهو عضو في نفس الفريق ، بالتحقق من جميع التدخلات لمعرفة مدى شرعيتها وأهميتها الإكلينيكية . وقد تم اعتماد الدراسة من مكتب شؤون البحث العلمي.

النتائج: قام الصيدلي الإكلينيكي بالتدخل بعدد ٣٩٤ مرة في حالة ٦٠٠ مريضاً (أي بمعدل ٠,٦٦ تدخل للمريض الواحد). وقد تقبل الفريق الطبي جميع هذه التدخلات تقريباً (٩٤,٣٪) وكانت المشاكل المتعلقة بالدواء كالتالي: لم يتم وصف دواء للحالة الطبية (٣٣,٣٪)،النظام العلاجي غير ملائما (٢٨,٩٪).لا توجد تعليمات (دواعي) لاستعمال الدواء (١٤,٣٪). وقد هدفت (٥٥,٧٪) من التدخلات لمنع الآثار الجانبية للدواء.وقد مثلت التدخلات التي ربما قللت من الوفيات، منع أو التقليل من عطب الأعضاء ، أو التقليل من مدة البقاء في المستشفى نسبة ٨,١٪ من التدخلات الإجمالية.

خاتمة: إن مساهمة الصيدلي الإكلينيكي في فريق الجولات اليومية في وحدة العناية المركزة من شأنها أن تقلل بشكل كبير الوفيات وتعزز النتائج العلاجية.

Objective: To evaluate the clinical pharmacists' interventions in an intensive care unit (ICU) setting with regard to their acceptance by the medical team, frequency, clinical significance, and targeted patient's outcomes.

Methods: This is a prospective, non-comparative, observational study evaluating the clinical pharmacist interventions in an ICU setting from December 2002 to May 2003. The study was conducted in a 19-bed Cardiac-Surgery ICU at King Faisal Specialist Hospital & Research Center, a tertiary-care hospital in Riyadh, Saudi Arabia. The clinical pharmacist performed daily multi-disciplinary team rounds, with documentation of all his interventions. On the same day, a physician, who is a part of the team, verified all interventions for validity and clinical significance. The institutional Office of Research Affairs approved the study.

Results: The clinical pharmacist intervened 394 times on the 600 patients [0.66 intervention-per-patient]. The medical team accepted almost all interventions (94.3%). The main drug-related problems were the following: no drug prescribed for medical condition (33.2%), inappropriate dosing regimen (28.9%), and no indication for drug use (14.3%). Approximately 55.7% of the interventions targeted enhancing therapeutic outcomes, whilst 21.8% of interventions resulted in the prevention of an adverse drug reaction. The interventions that may have resulted in decreasing mortality, preventing, or reducing organ damage, or decreasing hospitalization, represented 8.1% of all interventions.

Conclusion: Participation of a clinical pharmacist in the daily multidisciplinary team rounds in an ICU setting significantly reduces unfavorable morbidities and enhances therapeutic outcomes.

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From the Departments of Pharmacy Services (Al-Jazairi, Al-Agil, Akhras, Horanieh), Cardiovascular Disease, King Faisal Specialist Hospital & Research Center, and the Department of Pharmacy, King Saud University, Riyadh, Kingdom of Saudi Arabia.

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Address correspondence and reprint request to: Dr. Abdulrazaq S. Al-Jazairi, Assistant Head, Department of Pharmacy Services, King Faisal Specialist Hospital & Research Center, PO Box 3354, MBC-11, Riyadh 11211, Kingdom of Saudi Arabia. Tel. +966 (1) 4427603. Fax. +966 (1) 4427608. E-mail: ajazairi@kfshrc.edu.sa

In the past, clinical pharmacist interventions were inconsistently documented, with the documentation serving no greater purpose than to record workload statistics.[1] However, at the beginning of a period of rapid growth in clinical pharmacy services in a given integrated health-care system, it was realized that there is a need to develop a mechanism to address how pharmacist interventions were processed, evaluated and followed up.[1,2] Numerous challenges exist with the most significant being the fact that pharmacist's role in prescribing is typically reactive: responding to prescription errors long after the decision has been made for patients on whom he or she has little direct clinical knowledge. A pertinent question therefore exists: is the impact of pharmacist interventions more substantial if he or she provides input earlier, at the time of prescribing?

A key requirement in helping to retain pharmacy staff positions is to document the effectiveness of pharmacists in helping to control the drug budget. A number of studies have evaluated the impact of clinical pharmacist on patients' quality of life, drug utilization, including assessment of prescribing behaviors and cost saving or avoidance in both medical wards and intensive care units (ICU), or ambulatory care settings.[3-15] Such activities include correcting or clarifying orders; providing drug information, suggesting alternative therapies, identifying drug interactions and therapeutic drug monitoring.[16,17] Measurable clinical effects of such interventions include reduction in medication errors and adverse effects, all positively impacting the patient rates of morbidity and mortality as well as, a positive impact on pharmaco-economy.[18-20] Recently, Leape et al[10] proposed that utilizing the expertise of a pharmacist in medical team rounds is essential for improving total patient care. As a member of the rounding team in ICU they were able to show a reduction in the incidence of adverse drug events (ADE) by two thirds. Similar results were obtained in general medicine units.[12] The task Force on Critical Care Pharmacy Services recommends: 'fundamental, desirable, and optimal pharmacy services' for the provision of pharmaceutical care to critically ill patients.[17]

At the time where the cost impact of clinical pharmacists interventions was thoroughly evaluated in the literature, few studies focused on the significance of these interventions with regard to patient's outcomes optimization. Our study therefore seeks to evaluate the clinical pharmacist's interventions in a Cardiac-Surgery ICU setting with regard to their acceptance by the medical team, rate, clinical significance, and targeted patient's outcomes.

Methods. This is a pilot, prospective, non-comparative, observational study conducted from December 2002 to May 2003. The study site is an extremely busy 19 bed Cardiac Surgery Intensive Care Unit (CSICU) at King Faisal Specialist Hospital & Research Center (KFSH & RC). The study was approved by both the Clinical Research Committee and the Research Ethics Committee of the institution's Office of Research Affairs. Patients are brought to this unit immediately post-cardiac surgery. The majority of patients are therefore ventilated and received numerous medications to support their hemodynamic status. The patients population was 75% pediatric and 25% adult. Most institutions choose to separate pediatric care from adult, as the mix proves challenging to the majority of clinicians, especially on medication administration and dosing. The unit is extremely fast paced with an average occupancy of 98% reflecting 6-8 surgical cases per day; 1600 surgical cases per year which includes 500-600 neonatal/pediatric cases many of which are corrections of complex congenital heart disease. The only clinical pathway for post-cardiac surgeries that have been approved by the medical administration is for coronary artery bypass graft (CABG). Several medication guidelines/protocols also exist which include, however, not limited to, the anti-platelets/ anticoagulant, antibiotic cardiac surgery prophylaxis, albumin administration, heparin and insulin dose adjustment protocols. At the time of the study, no automated medication dispensing system was in place. The total parentral nutrition (TPN) team followed up all the TPN orders. The multidisciplinary team structure includes 2 consultant physicians, 5 assistant-consultant physicians (namely medical fellows), 19 nurses per shift, 3 respiratory therapists, and one specialized clinical pharmacist. During his vacation, the on-call clinical pharmacist covers the service by consultation only.

Interventions documentation. Each morning from 9-11 am for a total of 600 consecutive patients, the clinical pharmacist performed daily clinical team rounds with physicians, nurses and attending staff. In addition, the clinical pharmacist was available by pager for the rest of the day. At the end of the team round, and for the purpose of the study, the clinical pharmacist completed a data collection form to record each intervention given. On the same day and upon completion of clinical rounds, the team's physician for accuracy, and significance verified all interventions.

Data collection. The pre-designed data collection form (DCF) included details of the date of intervention, initial patient diagnosis, gender, age, type of surgery and laboratory results regarding renal function. Impaired renal function was defined according to the international standard of creatinine clearance of <50 mL/hour for adults and <2.0 mL/Kg/hour for pediatric patients. A drug related data were classified from 1-8 as

follows: 1) No indication for drug use, 2) Inappropriate drug selection, 3) Inappropriate dosage regimen, 4) Prescribed drug not administered, 5) Potential/ actual adverse drug reaction, 6) Potential/actual drug interaction, 7) Change to formulary drug or 8) Duplicate order. A physician ranked each intervention according to its clinical significance to potentially severe/high clinical significance, important/moderate clinical significance, or minor/low clinical significance. The ranking of clinical significance was pre-defined. Severe/high clinical significance was defined as 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. Important/moderate clinical significance was defined as intervention that may have resulted in improved quality of patient care. Lastly, minor/low clinical significance was defined as intervention that may have resulted in improve convenience and /or compliance, and/or cost saving.

Statistical analyses. The total number of interventions for the 600 consecutive patients was calculated. The data were described and stratified using descriptive statistics such as: the frequency, mean ± standard deviation, and percentages. Statistical Package for Social Sciences for Windows version 10.0 (SPSS Inc, Chicago, IL) was used for statistical analysis.

Results. Three hundred and ninety-four interventions for the 600 consecutive patients were documented. The calculated rate of intervention per patient was 0.66. The medical team accepted 328 (94.3%) of all interventions. In the meantime, the rate of modified then accepted was low (2 [0.6%]), and rejected was 11 (3.2%). The rest of the interventions which were accepted however at the time of the delivery were not carried out was 7 (3.2%). Interventions were equally distributed among different demographic variables including, age, gender, and kidney function status. The details of the pharmacist interventions based on patients' demographic variables are summarized in **Table 1**. The 3 highest/greatest drug-related problems included: 33.2% for unprescribed medication for an existing medical condition, 28.9% inappropriate dosage regimen, and 14.3% inexplicable drug order that needed discontinuation (**Table 2**). Preventing adverse drug reaction and toxicity was 3.2% of all interventions. Approximately 8% (8.1%) of clinical pharmacist interventions potentially decrease patient morbidity and mortality by preventing or reducing organ damage or system failure, and/or decreasing hospital stay (**Table 3**). The majority of interventions were classified as moderate in clinical significance (82.3%). More than half of the clinical pharmacist interventions (55.7%)

Table 1 - Clinical pharmacist interventions based on demographic and clinical variables (n=394).

Parameters	No. of interventions (%)
Age (mean ± SD)	
<14	175 (50.6)
≥14	171 (49.4)
Gender	
Males	155 (44.8)
Females	191 (55.2)
Renal status*	
Normal	174 (50.3)
Impaired	172 (49.7)
Diagnosis	
Valvular heart disease	113 (32.5)
Congenital heart disease	149 (2.8)
Congestive heart failure	76 (21.8)
Ischemic heart disease	32 (17.4)
Others	10 (2.9)

*Impaired renal function was defined as creatinine clearance of <50 mL/hour for adults and <2.0 mL/Kg/hour for pediatric patients

Table 2 - Clinical pharmacist interventions stratified by drug-related problems (n=394).

Drug-related problems	No. of interventions (%)
No indication for drug use	50 (14.3)
No order for medical condition	116 (33.2)
Inappropriate drug selection	22 (6.3)
Inappropriate dosage regimen	101(28.9)
Dose	56 (16.0)
Frequency	34 (9.7)
Rate	1 (0.3)
Route	10 (2.9)
Potential/actual (ADR/Allergy/Toxicity)	11 (3.2)
Change to formulary drug	1 (0.3)
Duplicate order	4 (1.1)
Miscellaneous	44 (12.6)

ADR - adverse drug reactions

Table 3 - Clinical pharmacist interventions stratified by clinical significance (n=394).

Clinical significance	No. of interventions (%)
Potentially severe/ high clinical significance	28 (8.1)
Important/ moderate clinical significance	283 (82.3)
Minor/ low clinical significance	33 (9.6)

Table 4 - Anticipated patient's outcomes as a result of the clinical pharmacist interventions (n=394).

Anticipated outcome	No. of interventions (%)
1. Cost saving only	9 (2.6)
2. Adverse drug reactions/Toxicity prevented/ resolved	76 (21.8)
3. Enhanced therapeutic effect	194 (55.7)
Combined outcome of 1 to 3	69 (17.5)

were directed toward optimizing and enhancing the therapeutic effect of the patient regimen rather than direct cost saving (2.6%, **Table 4**). These interventions, directly or indirectly, positively impacted the ADR prevention in 21.8%.

Discussion. In the past few years from the basis of implementing the concept of pharmaceutical care, and due to the increasing demands for health care, pharmacists were obliged to justify their role and contribution to total patient care. This study supports the evidence demonstrating the benefit of having a pharmacist as a key member of the multi-disciplinary team. This study is however, unique not only because it focused on patient's outcome optimization, but also because the quality and significance of the clinical pharmacist's interventions were validated by a key player in the clinical team; the physician.

It is very well known that one of the main obstacles facing clinical pharmacists is the acceptance of their recommendations by the medical staff. However, the evolution of a team-based approach assists significantly in building an environment of collaboration between pharmacists and physicians, nurses and other healthcare providers. The development of this team-based approaches positively impacts communication between members of the team towards determining/ ensuring the patient receives the right medication, dosage and so forth, according to evidence for their existing condition, and improved clinical pharmacist's intervention acceptance.[13] Our study demonstrated this concept very clearly through the high percentage of interventions acceptability by the medical team, approximately 95%. When compared to previous studies, interventions acceptability rate was reported in up to 99%.[11] In our study, the rejection rate was 3% that provide 97% acceptability rate. Considering the fact that the concept of clinical pharmacy practices is not very well established in the region, the rate of clinical pharmacist's interventions acceptability in our study is encouraging. However, it is worth mentioning that the clinical pharmacist in the study is specialized in cardiology and therefore developed trust with his team. In addition, the clinical pharmacist's approach, and communication skills may have contributed to the high level of interventions acceptance.

In our study, the principle reason for pharmacist intervention was the absence of a medication order for a specific medical condition. Because patient's medications are usually discontinued before surgery, physicians might forget to re-initiate these medications after surgery. Furthermore, the clinical pharmacist was very familiar with the institutional guidelines and clinical pathways for specific cardiac procedures. An example of such interventions includes initiating isosorbide dinitrate (ISDN) to minimize radial artery spasm when radial artery is used in CABG and commencing heparin therapy after 48 hours of intra-aortic balloon pump insertion (IABP). The second leading reason for interventions is dose adjustment that represented 29% of all interventions. Clinical pharmacist discontinuation of unneeded medications was the third reason for clinical pharmacist's intervention. A common example of such interventions includes the discontinuation of antibiotic based on culture and sensitivity results, switching to oral dosage form, or the discontinuation of albumin when its use is not consistent with the institutional guidelines. Preventable adverse drug reactions (ADR) encountered 11 times in the 600 patients. This has resulted in approximately 18.33 ADR prevented per 1000 patient. However, the true incidence of prevented ADR was not looked at in our study because of the lack of the control group. Therefore, it is difficult to compare the rate of preventable ADR to the published studies.[11]

In this study we found that clinical pharmacists delivered 28 interventions of high level of significance. This resulted in delivering 46.6 interventions per 1000 patient that either-reduced mortality, morbidity, or length of hospitalization. An example of such intervention included initiating an anti-arrhythmic medication, recommending anticoagulation in high-risk group (namely mechanical valve or Pental procedure), or commencing antibiotics for high-risk patients. Meanwhile, commencing of antibiotic therapy should not be viewed as an increase in the cost of care. The timing of initiating antibiotic therapy is very crucial in avoiding indirect cost increase that might include, hemodynamic support, changing the lines, and prolonging ICU stay.[14] The majority of clinical pharmacist interventions targeted enhancing patient's outcome optimization rather than cost saving per se.

At the time where our study shed some light on the value of clinical pharmacists in optimizing patient's outcomes in ICU setting, the study has some limitations. First, we studied only the impact of clinical pharmacist

in a single ICU in a tertiary care referral institution, where most of the complicated cardiac surgeries are referred. Therefore, the findings should not be generalized to all ICUs or hospitals. Second, we did not have a control unit or group. However, a physician team member confirmed the accuracy and the significance of the interventions; this should improve the validity of the study. It is also difficult to have another control group, because in such a design we needed to measure the patient outcome itself. This can be very challenging due to many confounders that can skew the results. Despite all this, we believe our study clearly demonstrated that participation of clinical pharmacist in medical rounds in ICU settings significantly enhances patients' outcomes. Responsibilities such as dose individualization and assurance of the optimal therapeutic regimen according to institutional guidelines and the overgrowing scientific evidence can be carried out by pharmacists.

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