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Research Article / Araştırma Makalesi

IMPACT OF A NEW CLINICAL PHARMACY CONSULTATION SYSTEM: A RETROSPECTIVE STUDY AT A TRAINING AND RESEARCH HOSPITAL IN TÜRKİYE

YENİ KLİNİK ECZACILIK KONSÜLTASYON SİSTEMİNİN ETKİSİ: TÜRKİYE'DEKİ BİR EĞİTİM VE ARAŞTIRMA HASTANESİNDE YAPILAN RETROSPEKTİF ÖN ÇALIŞMA

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ABSTRACT

Objective: *The clinical pharmacy specialization program (CPSEP), initiated in 2018, aims to train expert pharmacists for clinical pharmacy services in hospitals. No study has yet evaluated medication therapy recommendations within the first "clinical pharmacy consultation system (CPCS)" integrated into Türkiye's hospital framework. This study aims to assess the clinical pharmacy services delivered through the CPCS.*
Material and Method: *This study was conducted on a tertiary-level hospital in Istanbul between February 2024-January 2025. The first 11 months of CPCS integration were evaluated.*
Result and Discussion: *Sixty-nine patients were consulted, mostly adults (59.4%), primarily in hospital wards (65.2%) and intensive care units (26.1%). Common diagnoses included acute kidney injury (34.8%), infections (29.0%), and hematological malignancies (18.8%). Patients had a median of 9 medications (IQR, 8–15) and 2 comorbidities (IQR, 1–3). Common consultation reasons were adverse drug reactions (39.1%), potential drug interactions (27.5%), medication errors (14.5%), and inappropriate drug selection (5.8%). Eighty recommendations were provided, mostly regarding drug/laboratory monitoring (44.9%), dose adjustments (15.9%), and drug initiation/substitution (15.9%). Most consultations (84.1%) involved a single recommendation. These findings indicate that CPCS is actively used in drug therapy management within the national healthcare system. Although around five similar systems have been integrated in Turkish hospitals since 2023, this study presents the first published results of CPCS.*
Keywords: *Clinical pharmacy, clinical pharmacy consultation system, drug-related problems, specialization in pharmacy*

ÖZ

Amaç: *2018 yılında başlatılan klinik eczacılık uzmanlık programı (KEUP), hastanelerde klinik*

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eczacılık hizmetleri için uzman eczacı yetiştirmeyi amaçlamaktadır. Türkiye'nin hastane çerçevesine entegre edilen ilk "klinik eczacılık konsültasyon sistemi (KEKS)" kapsamında ilaç tedavisi önerilerini değerlendiren henüz bir çalışma yoktur.
Bu çalışma, KEKS aracılığıyla klinik eczacılık hizmetlerini değerlendirmeyi amaçlamaktadır.
Gereç ve Yöntem: *Bu çalışma, Şubat 2024-Ocak 2025 tarihleri arasında İstanbul'da üçüncü basamak bir hastanede yürütülmüştür. KEKS entegrasyonunun ilk 11 ayına ait süreç değerlendirilmiştir.*
Sonuç ve Tartışma: *KEKS üzerinden 69 hasta danışıldı, hastaların büyük çoğunluğu yetişkindi (%59.4). KEKS'e en sık konsültasyon gönderen bölümler yatan hasta servisleri (%65.2) ve yoğun bakım üniteleri (%26.1) oldu. Hastalarda yaygın görülen tanılar akut böbrek hasarı (%34.8), enfeksiyonlar (%29.0) ve hematolojik maligniteler (%18.8) idi. Hastaların ortanca ilaç sayısı 9 (5-28) ve ortanca komorbidite sayısı 2 (1-7) idi. En sık konsültasyon nedenleri advers ilaç olayları (%39.1), olası ilaç etkileşimleri (%27.5), ilaç kullanım hataları (%14.5) ve uygunsuz ilaç seçimi (%5.8) idi. Konsültasyonlarda ilaç/laboratuvar takibi (%44.9), doz ayarlamaları (%15.9) ve yeni ilaç başlanması/ilaç modifikasyonu (%15.9) üzerine odaklanılmış, toplam 80 öneri yapılmıştır. Konsültasyonların çoğunluğu (%84.1) tek bir öneriyle sonuçlanmıştır. Bulgular KEKS'in ulusal sağlık sistemi içerisinde, özellikle ilaç danışmanlığı için aktif olarak kullanıldığını göstermektedir. Türkiye'de 2023'ten itibaren yaklaşık beş benzer sistem hastanelerde faaliyette olmasına rağmen, bu çalışma KEKS'den elde edilen ilk sonuçları temsil etmektedir.*
Anahtar Kelimeler: *Eczacılıkta uzmanlık, ilaçla ilgili problemler, klinik eczacılık, klinik eczacılık konsültasyon sistemi*

INTRODUCTION

Clinical pharmacy is defined by the American College of Clinical Pharmacy (ACCP) as "the health science in which pharmacists contribute to patient care by optimizing drug therapy, improving health and well-being, and preventing disease" [1]. The role of clinical pharmacists has gained increasing significance globally in recent years, as the number of available medications has grown and treatment regimens have become more complex [2]. According to the American Institute of Medicine, medication errors affect at least 1.5 million individuals in the United States annually [3]. Clinical pharmacists help mitigate the risk of medication errors by reviewing patients' medication lists, monitoring adverse drug reactions (ADRs), and educating both patients and other healthcare providers [4-6]. Additionally, clinical pharmacists collaborate closely with other healthcare professionals to enhance patient outcomes, reduce medication errors, and decrease healthcare costs [5,7-11].

In addition to providing recommendations regarding medication therapy to the healthcare team, clinical pharmacists are frequently consulted for advice on medication-related issues [6]. Numerous studies have evaluated medication-related inquiries directed to clinical pharmacists in hospitals that have established a systematic clinical pharmacy consultation process [12-16]. Himanshu et al. reported that 784 consultations requests were made to clinical pharmacists from various hospital units over a 12-month period. Of these requests, 48% concerned the evaluation of suspected drug reactions, 20% involved individualized drug therapy and dose calculations, 18% related to drug counseling, 8% addressed drug-drug interactions, 4% concerned safe drug use during pregnancy, and 3% were related to drug therapy selection for high-risk conditions [13]. In a study by Assiri et al., a consultation system provided counseling for 508 active substances across 358 patients over a 12-month period. Nearly half of these interventions involved the addition of a new drug, and 28.1% involved recommending the discontinuation of an existing drug. This study also reported that 39.4% of all interventions led to cost savings [12].

Despite these findings in the literature, although the foundational principles of clinical pharmacy education were established in our country many years ago at the graduate level, specialized education aimed at training pharmacists to provide clinical pharmacy services in hospital settings began in 2018 [17]. This specialty training includes theoretical courses, intensive clinical training, case presentations and the completion of a specialty thesis, lasting a total of three years. Clinical pharmacy specialists who complete this program are appointed to hospitals where positions are available through the Turkish Ministry of Health and subsequently provide healthcare services. The first appointments of clinical pharmacy specialists in Türkiye took place on April 14, 2023 [18]. To date, no prior studies have

evaluated drug therapy recommendations within the clinical pharmacy consultation system in our country. This study aimed to assess the frequency and classification of drug-related problems (DRPs) and the interventions of clinical pharmacists through the clinical pharmacy consultation system at a tertiary hospital in Istanbul, Türkiye.

MATERIAL AND METHOD

This descriptive and retrospective study was conducted at a tertiary hospital (Istanbul/Türkiye) between 8th February 2024- and 8th January 2025. All patients recorded in the "clinical pharmacy consultation system (CPCS)" during the specified period were included in the study. The patients consulted by the clinics to a specialist clinical pharmacist through the hospital automation system were included in the study. Patients' demographics (age, gender, hospitalization ward, diagnosis, comorbidity, existing acute kidney injury (AKI), and number of comorbidities) were obtained from the hospital's system and recorded. Acute kidney injury was defined by any of the following: an elevation in serum creatinine (SCr) of at least ≥ 0.3 mg/dl (≥ 26.5 µmol/l) within a 48-hour period; an increase in SCr to 1.5 times or more from the baseline, presumed or known to have developed in the past 7 days; or a reduction in urine output to less than 0.5 ml/kg/h sustained over 6 hours [19].

The type of consultation was classified as following: drug selection, dose adjustment, drug-drug interaction, and ADRs. DRPs were classified via Hepler-Strand classification system [20]. Upon review of the data for all patients in the CPCS, DRPs were classified by the authors, who are specialized in clinical pharmacists.

The consultation process was integrated into the hospital's clinical workflow. Physicians requested drug-related consultations for their patients via the Hospital Information Management System (HIMS). Clinical pharmacists were notified of these requests through the HIMS interface and simultaneously via SMS alerts. Upon notification, the clinical pharmacist evaluated the patient either at the bedside or through electronic medical records, depending on the urgency and nature of the request. This system enabled timely and effective pharmaceutical care interventions.

Clinical pharmacist interventions were classified as adding a new drug or changing a drug, stopping a drug, dose adjustment (including change in frequency of administration and treatment duration), change in route of administration, change in time of administration, drug or laboratory monitoring, optimization of the method of administration (duration of administration and solvent).

Statistical Analysis

Statistical analysis was performed using SPSS 25.0 (Armonk, New York: IBM Corp.). The normality of the data distribution was assessed using the Shapiro–Wilk test. Chi-square analysis was used to compare categorical data. For continuous variables, the two-group parametric t-test was applied when the distribution was normal, while the non-parametric Mann-Whitney U test was used for non-normal distributions. The relationship between relevant parameters was assessed using Pearson or Spearman correlation analysis. A p-value of less than 0.05 was considered statistically significant, with a 95% confidence interval.

RESULT AND DISCUSSION

A total of 69 patients were consulted. Of these, 40.6% were pediatric patients (n = 28, 10.3±6.4 years old) and 59.4% were adults (n = 41, 54.5±20.4 years old). The median number of comorbidities was 2 (IQR = 1–3), and the median number of medications was 9 (IQR = 8–15). Infection disease was the most frequently diagnosed condition and the majority of the patients **(**65%**)** were inpatients and had AKI (65.2%**)** (Table 1).

In the DRPs assessment**,** ADRs were identified as the most common reason for consultation and intervention. The most frequently consulted clinics were the pediatric bone marrow transplantation unit, anesthesia and reanimation intensive care unit, general pediatrics, and internal medicine (Figure 1). Two interventions were made for 16% of the patients. The mean number of interventions was found to be 1.2 ± 0.4, with only one intervention made per consultation in both intensive care and outpatient settings. A statistically significant difference was identified (p = 0.001). The most frequently interventions included

drug/laboratory monitoring (44.9%), the addition of a new drug/drug modification (15.9%), and dose adjustment (15.9%)**.** The distribution of DRPs and pharmacist interventions was illustrated in Figure 2A and Figure 2B.

Table 1. Demographic and general clinical characteristics of patients

	n	**%**
Gender		
Female	38	55.1
Male	31	44.9
Diagnosis		
Infection Diseases	33	47.8
Hematologic Malignancy	13	18.8
Epilepsy	3	4.3
Brain Tumor	3	4.3
*Others**	17	24.4
Healthcare Setting		
Inpatient	45	65.2
Intensive Care Unit	18	26.1
Outpatient	6	8.7
Acute Kidney Injury		
No	45	65.2
Yes	24	34.8
Reason of consultation		
Adverse Drug Reaction	29	42
Drug-Drug Interaction	18	26.1
Drug Dose Adjustment	11	15.9
Drug Administration	6	8.7
Pregnancy/Lactation	4	5.8
Drug Appropriateness	1	1.4

n: number of patients, *Acute kidney injury, cirrhosis, combined immunodeficiency, Crohn's disease, cystic fibrosis, dermatomyositis, diabetic ketoacidosis, gastric cancer, granulomatosis, malignancy investigation, Maffucci syndrome, mechanical valve replacement, nephrostomy procedure, stroke, transplantation, vasculitis, and Wiskott-Aldrich syndrome

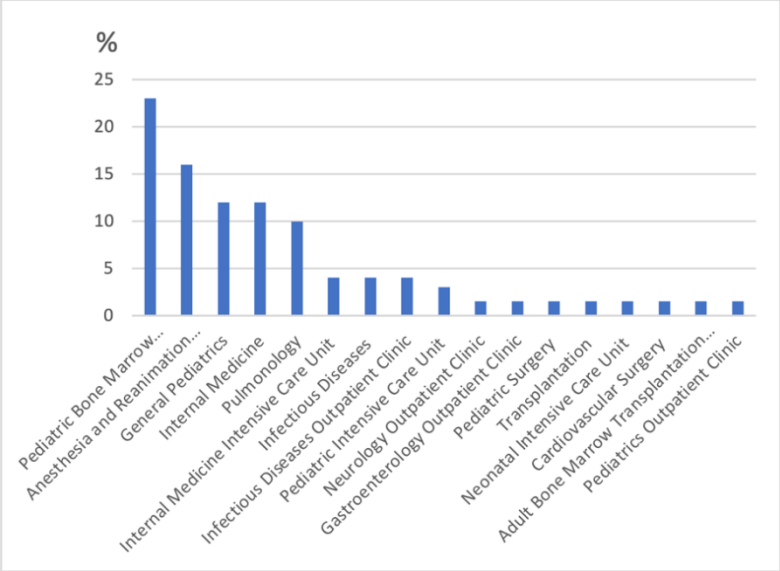

Figure 1. Clinical distribution of consultations

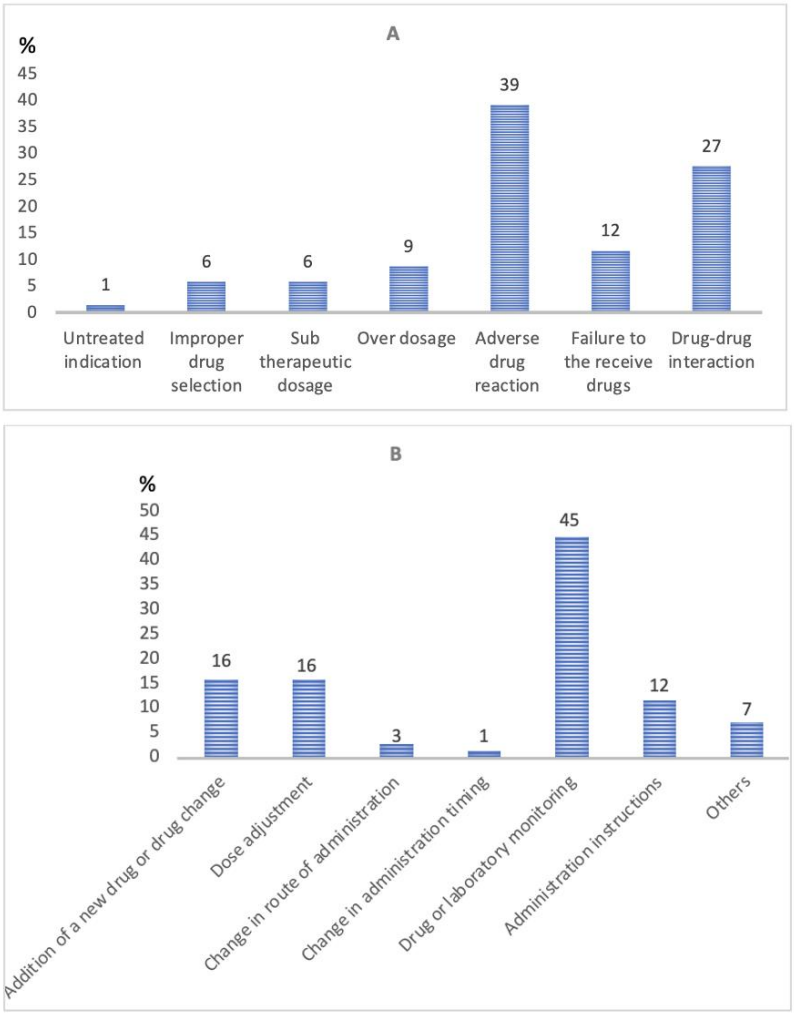

Figure 2. A. Distribution of drug-related problems categorized by hepler and strand, B. distribution of types of interventions

As shown in Table 2, the evaluation of the relationship between demographic characteristics and interventions revealed that significantly more interventions were performed in the pediatric population (1.4±0.49 vs. 1±0.16, $p < 0.001$). Additionally, another important finding was that the number of comorbidities was significantly higher in patients with acute kidney injury ($p < 0.001$).

Table 2. Relationship between demographic characteristics and interventions

	Gender			**Acute kidney injury**			**Patient population**		
	Male mean (SD)	**Female** mean (SD)	***p* value**	**Yes** mean (SD)	**No** mean (SD)	***p* value**	**Pediatric** mean (SD)	**Adult** mean (SD)	***p* value**
Number of interventions	1.211 (0.413)	1.097 (0.301)	0.205	1.250 (0.442)	1.111 (0.318)	0.182	1.357 (0.488)	1.024 (0.156)	<0.001
Number of comorbidities	2.053 (1.3744)	1.935 (1.1523)	0.707	2.708 (1.197)	1.622 (1.154)	<0.001	1.571 (0.836)	2.293 (1.436)	0.020

SD: Standard deviation, CI: Confidence interval, bold values indicate statistical significance

Clinical pharmacy services (CPS) in hospitals have been significantly, becoming integral to patient-centered care and safety [21]. Today, key activities include medication therapy management

(MTM), where pharmacists assess and optimize patients' medication regimens to enhance therapeutic outcomes and minimize ADRs [22]. Additionally, pharmacists play a crucial role in antimicrobial stewardship programs, collaborating with healthcare teams to ensure appropriate antibiotic use and reduce resistance. Medication reconciliation during transitions of care is another vital service, helping to prevent medication errors during hospital admissions and discharges [23-24]. This study aimed to evaluate patients consulted by clinical pharmacists over 11 months retrospectively and to evaluate the relationship between the mean value of interventions performed on the patient and gender, the presence of acute kidney injury, and the patient population.

The main DRPs identified in our study were ADRs (42%) and drug-drug interactions (26.1%). The main reason for the high rates of these two DRPs may be those patients in the pediatric bone marrow unit, the anesthesia and intensive care unit, which request the most consultations to our unit, use a greater variety of medications compared to other services. Patients undergoing hematopoietic stem cell transplantation are treated with complex medical regimens that combine chemotherapeutic, immunosuppressive, and anti-infective agents, which have the potential to cause multiple drug-drug interactions in various combinations [25]. Hasan et al. reported that ADRs rate was 29.9% in an anesthesiology and reanimation ICU. In a study conducted in an education and research hospital in a 2023 study conducted at an educational and research hospital in Türkiye, the most prevalent causes of DRPs were identified as potential drug-drug interactions (55.8%), errors in dose timing instructions (9.5%), and the inappropriate use of medications according to clinical guidelines (8.2%) [26]. In a study conducted by Fan et al., DRPs were examined specifically in patients who did not use anti-infective drugs and the most common reason for consultation was found to be adverse reactions (27%), similar to our study [27].

DRPs are any occurrence or situation related to medication therapy that can either actually or potentially compromise a patient's ability to attain the best possible clinical outcome [20]. When clinical pharmacist interventions are classified according to the Hepler-Strand classification system, the most frequently interventions included drug/laboratory monitoring, the addition of a new drug/drug modification, and dose adjustment, respectively. Among the interventions made within the scope of Bektay et al.'s study, the dose adjustments of the prescribed drugs were noted as a frequent intervention by the clinical pharmacist [28]. The reason for this difference between the two studies is that therapeutic drug monitoring (TDM), which is frequently discussed and important for the treatment management of antibiotics in our hospital, cannot be provided. Since TDM cannot be provided, it is not possible to dose adjustment, drug discontinuation and other similar interventions. Therefore, we recommended that patient-specific evaluations be made and prioritized monitoring of drug levels or laboratory parameters as a primary priority.

Various factors may affect the frequency and nature of DRPs including modifiable variables such as the duration of hospitalization and polypharmacy, as well as non-modifiable factors like patient age, primary diagnosis, and the presence of comorbid conditions. Similar to our study, the study conducted by Blix et al. found that gender was not associated with an increase in the number of DRPs and interventions [29]. The number of comorbidities and the number of interventions in DRPs did not show any statistically significant difference according to demographic characteristics and gender, as in other studies in the literature [30-32].

The number of DRP interventions in patients with AKI did not show statistical significance compared to patients without AKI. Similar findings were found in a study conducted with 151 patients in the medical intensive care unit of a hospital in Türkiye in 2022 [31].

The number of comorbidities in patients with AKI is statistically higher than in patients without AKI. In a retrospective study conducted in China in 2023, the incidence of four different types of comorbidities, including diabetes, hypertension, chronic renal disease, and chronic heart failure, was compared in patients with and without AKI. It was observed that the incidence of these four main comorbidities was higher in patients with AKI ($p < 0.05$) [33].

A retrospective study published in 2024 evaluated all recommendations made by clinical pharmacists across a hospital in Saudi Arabia. A total of 5310 recommendations were made to 1494 patients, and 4.4% of these recommendations were for pediatric patients. When the number of interventions made to adult and pediatric patients in the relevant study was compared, the total number

of interventions was in favor of adult patients, as adult patients were more prevalent in the study population. Unlike our study, the average number of interventions made per adult and pediatric patients was not statistically evaluated [34]. In an epidemiological study conducted in Scotland in 2007, the number of comorbidities between the ages of 0-24 was reported as 0.16. In the age range of 25-84, this number was stated as 0.50-2.60 [35]. Multimorbidity, or multiple diseases, is defined as the occurrence of two or more chronic diseases in a person at the same time. Multimorbidity increases with age in our country. According to a cohort study conducted with 17714 patients in our country in 2021, the prevalence of multimorbidity under the age of 35 was below 2%, while it reached 20% in the age group of 45-54, 32% in the age group of 55-64, and 46% in the age group of 65 and over [36].

In conclusion, the results of this study highlight the successful implementation and clinical relevance of the CPCS within a tertiary-level hospital in Türkiye. The system, led by CPS trained through the CPSEP, facilitated structured drug-related consultations across various clinical settings, particularly inpatient wards and intensive care units. The majority of consultations addressed adverse drug reactions, drug interactions, and inappropriate prescribing practices, emphasizing the vital role of CPS in identifying and resolving DRPs. Moreover, the data presents a high acceptance rate of CPCS by healthcare providers, as evidenced by its consistent use in daily clinical workflows and its integration into patient documentation through e-records. The range and nature of recommendations-especially those focused on monitoring and dose optimization-reflect the advanced clinical judgment exercised by CPS in complex patient cases. This preliminary evaluation provides a basis for recognizing and confirming the impact of CPS in Türkiye's hospitals. This study provides valuable insights into the types of clinical challenges addressed through CPCS and presents the system's potential to enhance medication safety and therapeutic outcomes. Future research needs to assess patient outcomes, long-term cost-effectiveness, and interdisciplinary collaboration to further substantiate the value of this evolving clinical pharmacy model. Overall, this study affirms the CPCS as a promising advancement in the optimization of pharmacotherapy and healthcare quality in Türkiye.

The strengths of our study include being one of the first studies in Türkiye to present findings on the consultation system with clinical pharmacists, which has recently been implemented in hospitals in a novel manner. The main weaknesses of this study are its limited duration and the relatively small number of participants. Additionally, clinical pharmacist's recommendations was not evaluated within the scope of this study. To enhance the integration of clinical pharmacist practices and their interventions, further research involving a more extended study period and a larger patient population is warranted.

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CONFLICT OF INTEREST

The authors declare that there is no real, potential, or perceived conflict of interest for this article.

ETHICS COMMITTEE APPROVAL

This study received ethical approval from the Marmara Clinical Research Ethics Committee (approval no: 09.2025-25-0018). All procedures adhered to the ethical standards of the University of Siena and the principles of the 1964 Declaration of Helsinki and its subsequent amendments.

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