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Assessment of Drug-Related Problems Detected by Clinical Pharmacists in a Thai Academic Healthcare Institution

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Abstract

Medication-related complications remain a major concern in healthcare because drug-related problems (DRPs) may reduce treatment effectiveness, compromise patient safety, and contribute to unwanted clinical outcomes. Clinical pharmacists are increasingly involved in healthcare teams to detect medication-related issues and recommend appropriate solutions. This study investigated the frequency, classification, severity, and management outcomes of DRPs identified through clinical pharmacist activities.A retrospective review was conducted at Ramathibodi Hospital, a tertiary academic hospital in Thailand. Patient information was retrieved from the institutional DRP monitoring database and electronic medical records. Descriptive statistical analysis was conducted using Statistical Package for Social Sciences (SPSS) version 18.0. Of 2837 hospitalised patients reviewed, 580 (20.44%) had one or more DRPs. A total of 1255 medication-related issues were evaluated according to the Cipolle-Strand-Morley classification system (2012). The leading DRP category was the absence of necessary drug therapy (27.09%), followed by inadequate dosing (26.93%) and excessive dosing (22.31%). Anti-infective medications were the drug class most frequently linked with DRPs (23.71%), whereas omeprazole was the most commonly involved individual medication (2.70%). Based on severity evaluation, the majority of DRPs resulted in no patient harm (95.46%). Clinical pharmacists' recommendations were accepted by physicians in almost all cases (99.12%). Medication-related issues most frequently involved the initiation of required therapies and optimisation of medication doses, particularly for antimicrobial treatments. Ward-based clinical pharmacy services demonstrated a valuable role in detecting, correcting, and preventing DRPs among hospitalised patients.

Keywords: Drug-related problems, Hospitalised patients, Clinical pharmacists, Thailand

Introduction

Medication use involves multiple processes, and errors or inappropriate decisions at any stage may lead to drug-related problems (DRPs). A DRP is defined as an occurrence associated with pharmacotherapy that either has already affected or may potentially affect the achievement of appropriate health outcomes [1]. These problems are recognised internationally as important healthcare challenges because they may increase patient risks and place additional financial pressure on healthcare systems. DRPs may occur during prescribing, documentation, dispensing, administration, or monitoring, although many can be avoided through effective pharmaceutical care interventions [2, 3].

The risk of DRPs is particularly high among hospitalised patients due to frequent medication adjustments and complex treatment plans. Previous research has shown that internal medicine wards, especially those within academic hospitals, experience a higher incidence of DRPs due to the complexity of patient conditions and therapies [2, 4, 5]. Factors associated with increased DRP

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occurrence include older age, polypharmacy, multiple chronic diseases, and extended hospitalisation periods [4-9]. Studies conducted among Thai hospital populations have reported that DRPs occur in approximately 23%–74% of patients admitted to general medical wards or medical intensive care units [10-14].

Pharmaceutical care services provide an important method for improving medication safety by identifying and managing DRPs. Within multidisciplinary healthcare teams, clinical pharmacists contribute specialised knowledge to evaluate medication regimens, optimise therapy, and support better patient outcomes. In Thailand, clinical pharmacy practice does not require formal credentialing; however, pharmacists working in clinical settings generally provide patient-focused services that require advanced understanding of pharmacotherapy and practical experience across different hospital departments.

Evidence from previous studies indicates that clinical pharmacists contribute significantly to acute care management by identifying medication-related issues, improving therapy decisions, and reducing healthcare costs [15-21]. Assessing the characteristics of DRPs can support improvements in clinical pharmacy programs and healthcare delivery. Although pharmacist interventions have been studied in several countries, their contribution within Thailand remains insufficiently described. Therefore, this study aimed to investigate DRP patterns among hospitalised patients and to evaluate the characteristics and outcomes of interventions performed by clinical pharmacists at a Thai tertiary university hospital.

Materials and Methods

Study setting and population

This study used a retrospective descriptive design and was conducted at Ramathibodi Hospital, a tertiary university hospital in Thailand. Patients admitted to medical wards or the intermediate care unit from July 2019 to June 2020 were considered eligible when they had received at least one medication during hospitalisation. Patients without prescribed medications were excluded.

Data extraction and analysis were performed between August 2021 and February 2022. DRPs were grouped according to the seven categories established by the [22]: unnecessary therapy, additional therapy required, ineffective therapy, dosage below the required level, dosage above the appropriate level, adverse drug reaction (ADR), and medication non-compliance [22].

Approval for the study was granted by the Human Research Ethics Committee, Faculty of Medicine Ramathibodi Hospital, Mahidol University (COA.MURA2021/685). The research procedures complied with international ethical frameworks, including the Declaration of Helsinki, the Belmont Report, the CIOMS Guidelines, and the International Conference on Harmonization Good Clinical Practice (ICH-GCP). Because existing retrospective data were analysed, informed consent was not necessary.

Clinical pharmacist activities

Clinical pharmacists were assigned to hospital wards during the week, providing approximately 6 hours of daily clinical support. Their activities included participation in medical rounds, medication review, and pharmaceutical care interventions. Additional monitoring was provided during weekends when patient conditions required closer observation.

Junior pharmacists received structured preparation from senior pharmacists with advanced clinical qualifications, including board-certified pharmacotherapy specialists and pharmacists with postgraduate clinical pharmacy education. Training focused on developing specialised knowledge and skills relevant to patient populations managed within each ward. Before beginning independent clinical responsibilities, pharmacists completed a minimum three-month training period and were assessed by experienced pharmacists. Each ward typically had one to two clinical pharmacists involved in patient care.

Data sources and evaluation

Information regarding DRPs was obtained from the hospital's electronic medical records and the internal DRP documentation system completed by clinical pharmacists. Medication reviews were performed routinely to identify potential and actual medication-related problems.

When a DRP was detected, pharmacists communicated recommendations directly with physicians. The seriousness of DRPs was assessed using the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) classification. Intervention outcomes were recorded as accepted, partially accepted, or not accepted.

Statistical analysis

Data analysis was performed using SPSS version 18.0. The characteristics of DRPs, medications involved, severity levels, and pharmacist interventions were summarised using descriptive statistics. Categorical data were expressed as numbers and percentages, while numerical variables were presented as mean with standard deviation or median with interquartile range.

Results and Discussion

A total of 2837 patients were included during the study period. Clinical pharmacists identified DRPs among 580 patients, corresponding to 20.44% of the study population. Most patients with DRPs were older adults, with a median age of 65 years (interquartile range 29 years). Female patients represented the majority of cases (54.31%). The highest proportion of DRPs occurred among patients admitted to the female medical ward (47.93%). Additional patient characteristics are provided in **Table 1**.

Table 1. Baseline profile of individuals with identified drug-related problems (total patients = 580)

Category	Distribution among patients, n (%)
Gender distribution	
Men	265 (45.69%)
Women	315 (54.31%)
Age group	
Patients aged below 65 years	283 (48.79%)
Patients aged 65 years and above	297 (51.21%)
Location of admission	
Medical unit for male patients	200 (34.48%)
Medical unit for female patients	278 (47.93%)
Intermediate care setting	102 (17.59%)

Characteristics of drug-related problems

In total, 1255 DRPs were detected across 580 patients, yielding a mean of 2.16 DRPs per affected individual. The three most frequent types were the requirement for additional drug therapy (27.09%), subtherapeutic dosage (26.93%), and supratherapeutic dosage (22.31%). The full breakdown of DRPs according to the [22] is displayed in **Table 2**.

With respect to the phase of care where the issues arose, the majority occurred while patients were hospitalized (51.55%). During this inpatient period, problems involving a dosage that was too low or too high were the most prevalent (52.70%; 341/647). In contrast, the need for additional drug therapy was identified most often at the time of discharge relative to other phases (52.65%; 179/340). A summary of DRPs distributed across the different stages of care is provided in **Table 2**.

Table 2. Distribution of drug-related problems (DRPs) by type and phase of care

Type of drug-related problem	Total frequency n (%)	At admission	During hospitalization	At discharge
Drug-induced adverse reactions	14 (1.12)	1	9	4
Requirement for additional pharmacotherapy	340 (27.09)	74	87	179
Excessive dosing	280 (22.31)	18	171	91
Subtherapeutic dosing	338 (26.93)	18	170	150
Unwarranted medication use	155 (12.35)	4	133	18
Lack of therapeutic effectiveness	101 (8.05)	4	72	25
Poor medication adherence	27 (2.15)	20	5	2

Drug classes associated with drug-related problems

A total of 1,295 medications contributed to the DRPs observed in the study. These agents were classified using

the AHFS Pharmacologic Therapeutic Classification. The three leading therapeutic categories responsible for DRPs were anti-infective agents, accounting for 307 instances (23.71%), followed by electrolytic, caloric, and water balance preparations with 179 instances (13.82%), and cardiovascular medications with 171 instances (13.20%). Detailed frequencies of the various drug groups involved are displayed in **Table 3**.

Among individual agents, omeprazole was the most frequently implicated drug (2.7%; 35 out of 1,295 cases) and was mainly connected to the need for supplementary therapy. Ganciclovir was often linked to situations requiring dosage increases (dosage too low), while cefepime was commonly associated with excessive dosing (dosage too high). The leading 10 drugs responsible for DRPs are summarized in **Table 4.**

Table 3. Distribution of drug classes associated with drug-related problems (DRPs)

Therapeutic category	Number of cases (%)
Anti-infective medications	307 (23.71)
Fluids, electrolytes, and caloric agents	179 (13.82)
Cardiovascular therapy agents	171 (13.20)
Endocrine therapies and hormone-related drugs	103 (7.95)
Drugs for gastrointestinal disorders	92 (7.10)
Hematologic and anticoagulant agents	85 (6.56)
Central nervous system medications	83 (6.41)
Miscellaneous treatment categories	82 (6.33)
Vitamin preparations	61 (4.71)
Respiratory system drugs	35 (2.70)
Autonomic nervous system agents	30 (2.32)
Ophthalmic, otic, nasal, and throat preparations	23 (1.78)
Dermatological and mucosal agents	21 (1.62)
Anticancer medications	8 (0.62)
Total	**1295 (100)**

Table 4. Most frequently implicated drugs in drug-related problems (n = 1295)

Rank	Drug(s)	Frequency (%)
1	Omeprazole	35 (2.70)
2	Co-trimoxazole	34 (2.63)
3	Ganciclovir; Atorvastatin	29 (2.24)
4	Acyclovir	28 (2.16)
5	Tacrolimus; Prednisolone	27 (2.08)
6	Calcium carbonate	25 (1.93)
7	Lamivudine; Potassium chloride	24 (1.85)
8	Cefepime; Furosemide; Vitamin D	22 (1.70)
9	Sodium bicarbonate	21 (1.62)
10	Vitamin B complex	19 (1.47)

Severity classification of drug-related problems (DRPs)

Most identified DRPs were classified as non-harmful events (severity levels B and C), accounting for 95.46% of all cases. Events categorized as potentially harmful (Category D) accounted for 3.75%, while those associated with actual patient harm (Category E) were rare, comprising only 0.80%. Among DRPs with potential risk (D), over one-third (34.04%; 16 out of 47

cases) were linked to excessive drug dosing. In contrast, nearly all harmful outcomes (Category E) were associated with medication non-adherence before admission (9 cases). The overall distribution of severity levels is summarized in **Table 5,** while specific details of Category E cases are presented in **Table 6.**

Table 5. Distribution of DRP severity based on the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) classification

Severity category	Frequency (%)	Description
B	952 (75.86)	DRP occurred but did not reach the patient
C	246 (19.60)	DRP reached the patient but did not result in harm
D	47 (3.75)	DRP reached the patient and required monitoring or intervention to prevent harm
E	10 (0.80)	DRP may have contributed to or resulted in temporary harm requiring intervention
Total	**1255**	

Table 6. Detailed description of DRPs associated with temporary harm (Category E)

Category	Clinical details	Medications involved
E	Long-term discontinuation of therapy by the patient, potentially contributing to hospital admission due to dyspnea and uncontrolled hypertension	Aspirin, doxazosin, enalapril, hydralazine, lercanidipine, doxofylline, tiotropium
E	Administration of an inappropriately high dose without renal adjustment, resulting in neurotoxic effects	Cefepime
E	Incorrect understanding of medication use by the patient	Valproic acid
E	Injection-related fear leading to non-adherence and subsequent hyperglycemia	Insulin

Clinical pharmacists' interventions for resolving DRPs

Interventions performed by clinical pharmacists were implemented following the identification of DRPs (**Table 7**). Each issue was directly communicated and discussed with physicians for resolution. Overall acceptance of pharmacist recommendations was very high at 99.12%, while 0.48% were partially accepted and a minimal proportion was not accepted. These findings indicate that clinical pharmacist involvement in medical wards is effective in addressing and resolving DRPs.

Table 7. Summary of clinical pharmacist interventions and their acceptance outcomes

Intervention type	Frequency (%)	Not accepted	Partially accepted	Accepted
Drug recommendation	340 (27.09)	1	2	337
Dose modification	618 (49.24)	3	1	614
Discontinuation of therapy	156 (12.43)	0	1	155
Switching of medication	103 (8.21)	1	1	101
Change in administration route or schedule	11 (0.88)	0	0	11
Information provision	27 (2.15)	0	1	26
Total	**1255 (100)**	**5**	**6**	**1244**

This research examined drug-related problems (DRPs) detected by clinical pharmacists among hospitalized patients in a tertiary teaching hospital in Thailand. We observed that 580 patients (20.44% of the sample) experienced at least one DRP. This rate is lower compared to findings in critically ill populations. For instance, studies by [13] and [16] indicated that approximately 70% of patients in medical intensive care units (ICUs) had at least one DRP. Individuals in ICU settings often face heightened risks due to polypharmacy stemming from multiple underlying conditions and impaired organ function, which can lead to issues such as

inappropriate dose adjustments, adverse drug reactions, and drug–drug interactions [15, 23, 24]. Additionally, among patients with identified DRPs, the average number per patient was 2.2. This aligns with multiple prior investigations reporting an average of 1–2 DRPs per patient [4, 6, 7, 13, 16, 25-27]. The figure is modestly higher than those reported by [26] and [27]. (1.2), which focused on DRPs within specialized neurology and stroke units. Such differences may stem from the availability of more specialized care and expertise in those focused units compared to general medical wards. Overall, the frequency and average number of DRPs can differ substantially depending on the healthcare environment, patient demographics, and the DRP classification approach employed.

The Pharmaceutical Care Network Europe (PCNE) classification system utilized in various other studies differs from the framework applied here. The PCNE offers a highly detailed structure with primary domains and sub-domains that address problems, their causes and potential interventions, enabling the detection and categorization of a greater number of DRPs. In contrast, this study employed the classification proposed by [22]. The predominant issues identified were the need for additional drug therapy and dosage too low (each accounting for roughly 27%), followed by dosage too high (22.31%). While DRP categories may vary across research, problems related to drug and dose selection frequently emerged as key contributors, consistent with several reports [4, 7, 28]. Our results also correspond with Thai-based investigations. [10] noted that improper dose regimens (32.94%) and untreated indications (10%) were among the most common DRPs. [26] identified untreated indications as the leading issue (22.6%) in stroke unit inpatients. [11] similarly found untreated symptoms or indications (30.7%) to be the primary concern in general medical wards. By comparison, a Thai ICU study by [13] reported dosage too high as the most prevalent DRP (27.7%) in critically ill patients at a tertiary university hospital. This variation likely arises from greater disease severity, renal impairment, and complex medication regimens prone to interactions in ICU environments. In contrast, research in southwestern Ethiopian medical wards highlighted unnecessary drug therapy as the main problem (27.79%) [6]. Thus, the nature of DRPs can be influenced by the classification method, patient characteristics, illness severity, and local healthcare provisions.

With respect to the stage of care, the majority of DRPs (52%) occurred during the hospital stay and were primarily related to inappropriate dosing (either overdose or underdose). At hospital discharge, the absence of drug treatment for existing diseases or conditions was particularly common (52.65%). During medication reconciliation, clinical pharmacists identified most of these as prescribing errors (82.12%). This echoes the findings of [11], who reported frequent medication omissions at discharge. Another study observed that dosage too low and the need for additional drug therapy were prominent in post-discharge pharmacist follow-up [29]. Consequently, a thorough review of discharge medications is a critical step in addressing DRPs and reducing the likelihood of hospital readmissions.

In terms of severity, using the NCC-MERP system, the vast majority of DRPs were rated as causing ‘no harm’ (categories B–C, 95.46%), which is comparable to other research. Studies in a Thai tertiary academic hospital [13] and in China [30] similarly reported high rates of no-harm DRPs at 78.2% and 86.9%, respectively. Additional investigations in Chinese tertiary teaching hospitals found that most DRPs fell into the no-harm or potential-harm categories (B–D), ranging from 75% to 89% [27, 31, 32]. These outcomes suggest that clinical pharmacists are effective at identifying and resolving DRPs before patient harm occurs. Nevertheless, one instance in our study that resulted in harm requiring intervention (Category E) involved failure to adjust dosage based on renal function, leading to an adverse event from excessive dosing during hospitalization. Other harmful cases often involved cardiovascular medications linked to non-adherence, which contributed to hospital admission. Primarily, DRPs causing harm were associated with non-adherence due to misunderstandings about medication use, lack of concern regarding therapy, or difficulties with proper self-administration. Hence, pharmacist-led counseling plays a vital role in enhancing medication adherence before patient discharge.

Anti-infective agents were the drug class most commonly implicated in DRPs (23.71%), aligning with numerous previous studies [5, 7, 11, 13, 14, 30, 33, 34]. Dose-related issues accounted for the majority of problems in this group. Antimicrobials also represented the leading drug category for pharmacist interventions in tertiary hospitals in Oman (30%) [17] and Abu Dhabi (31%). This contrasts with other research identifying proton pump inhibitors [13] or analgesics [35] as the top classes. [4] frequently noted warfarin and prednisolone. In our

study, omeprazole was the single most common drug associated with DRPs, similar to findings from the University of Gondar, where it accounted for 17.6% of cases [36].

The acceptance rate for clinical pharmacists' recommendations was notably high at 99.12%, with nearly all interventions accepted by physicians and leading to modifications in drug therapy. This is consistent with reports from internal medicine wards in teaching hospitals, where acceptance rates exceeded 90%—for example, 96.8% in a Swiss university hospital [21], 97.8% in a Brazilian teaching hospital [35], and 93.2% in an Italian hospital [34]. These findings highlight strong interdisciplinary collaboration and recognition of ward-based clinical pharmacy services. Dose adjustment emerged as the most frequent intervention (49.24%), followed by suggestions to add drug therapy (27.09%). This pattern matches results from [17] at a tertiary university hospital in Oman and from [16], in which dose modifications accounted for 56.79% of interventions in a Turkish university hospital ICU.

The strengths of this study underscore the valuable contribution of clinical pharmacists in detecting DRPs and averting harm among hospitalized patients, while also offering insights to support the development of ward-based pharmacy services in comparable environments. Limitations include its retrospective, descriptive design and reliance on data from routine clinical pharmacist documentation, which may be less comprehensive than prospective data collection. Additionally, the single-center setting in an academic institution may limit generalizability. Future research should involve multiple sites and explore factors associated with DRPs in Thailand to help optimize pharmacy services.

Conclusion

The predominant DRPs identified involved the need for additional drug therapy and dosage adjustments, particularly for antimicrobial agents. The majority of clinical pharmacists' interventions successfully prevented patient harm. Clinical pharmacy services should emphasize medication counseling at discharge, discharge medication reconciliation, and antimicrobial stewardship programs. Additional prospective studies are required to understand the effects of ward-based pharmacy services better.

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