

# การระบุความคลาดเคลื่อนในการสั่งยาโดยเภสัชกรคลินิกบนหอผู้ป่วยอายุรกรรม ณ โรงเรียนแพทย์ ประเทศไทย Identification of Prescription Errors by Clinical Pharmacists in Internal Medicine Wards of An Academic Hospital, Thailand

นิพนธ์ต้นฉบับ

Original Article

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วารสารไทยเภสัชศาสตร์และวิทยาการสุขภาพ 2566;18(4):339-344.

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Thai Pharmaceutical and Health Science Journal 2023;18(4):339-344.

## บทคัดย่อ

**วัตถุประสงค์:** เพื่อระบุความถี่ ชนิด และความรุนแรงของความคลาดเคลื่อนในการสั่งยาในหอผู้ป่วยอายุรกรรม **วิธีการศึกษา:** การศึกษาย้อนหลังเชิงพรรณนาในผู้ป่วยที่รับการรักษา ณ หอผู้ป่วยอายุรกรรมชายและหอผู้ป่วยอายุรกรรมหญิง ณ โรงเรียนแพทย์ จังหวัดเชียงใหม่ ประเทศไทย ระหว่างวันที่ 1 มิถุนายน ถึง 31 ตุลาคม พ.ศ. 2562 เก็บข้อมูลจากบันทึกการบริบาลเภสัชกรรมโดยเภสัชกรคลินิก วิเคราะห์ชนิดและความรุนแรงของการเกิดความคลาดเคลื่อนในการสั่งยา นำเสนอเป็นความถี่และร้อยละ **ผลการศึกษา:** พบว่าผู้ป่วยที่ได้รับการบริบาลเภสัชกรรมเพื่อจัดการความคลาดเคลื่อนในการสั่งยาร้อยละ 12.4 (149 คนจาก 1,202 คน) เมื่อพิจารณาชนิดความคลาดเคลื่อนในการสั่งยาทั้งหมด 237 ครั้ง พบว่าชนิดที่พบบ่อยที่สุดคือ ไม่สั่งยาเดิมที่ผู้ป่วยสมควรได้รับจำนวน 75 ครั้ง (ร้อยละ 31.6) และความคลาดเคลื่อนในการเลือกขนาดยาหรืออัตราบริหาร 74 ครั้ง (ร้อยละ 31.2) ประเภทที่พบความคลาดเคลื่อนมากที่สุดคือ กลุ่มยาปฏิชีวนะ (ร้อยละ 24.5 หรือ 58 ครั้งจาก 237 ครั้ง) พบว่าร้อยละ 57 หรือ 136 ครั้งจาก 237 ครั้งมีความรุนแรงจัดอยู่ในกลุ่มที่ไม่เกิดอันตรายต่อผู้ป่วย **สรุป:** ความคลาดเคลื่อนในการสั่งยาที่ตรวจพบโดยเภสัชกรคลินิกสามารถพบได้ในหอผู้ป่วยอายุรกรรม ชนิดความคลาดเคลื่อนที่พบบ่อยที่สุดคือ การไม่สั่งยาเดิมที่ผู้ป่วยสมควรได้รับและความคลาดเคลื่อนในการเลือกขนาดยา ความรุนแรงของความคลาดเคลื่อนในการสั่งยาที่พบเป็นส่วนใหญ่ในการศึกษานี้คือ ไม่เกิดอันตรายต่อผู้ป่วย

**คำสำคัญ:** ความคลาดเคลื่อนทางยา, ความคลาดเคลื่อนในการสั่งยา, เภสัชกรคลินิก

### Editorial note

Manuscript received in original form: January 11, 2023;

Revision notified: January 23, 2023;

Revision completed: February 10, 2023;

Accepted in final form: February 12, 2023;

Published online: December 31, 2023.

## Abstract

**Objective:** To determine frequencies, types and severities of prescription errors in internal medicine wards. **Methods:** This retrospective descriptive study was conducted in male and female internal medicine wards at an academic hospital in Chiangmai, Thailand, between June 1<sup>st</sup> and October 31<sup>st</sup>, 2019. Recorded pharmaceutical care services by ward-based clinical pharmacists were collected to determine the type and severity of prescription errors. Types and severities of prescription errors were determined and presented as frequencies and percentage. **Results:** There were 12.4% of patients (149 out of 1,202) requiring pharmacists' intervention for prescription errors. Of 237 pharmacists' interventions, the most frequent medication errors were 75 omission errors (31.6%) and 74 dosing errors (31.2%). The most common type of medication involving pharmacists' interventions was antimicrobial agents (24.5%, 58 out of 237 interventions). 57% or 136 out of 237 interventions were categorized as causing no harm to the patients. **Conclusion:** Prescription errors identified by ward-based clinical pharmacists commonly occurred in internal medicine wards. The omission errors and dosing errors were mostly detected. The majority of errors in this study were categorized as causing no harm to the patients.

**Keywords:** medication error, prescription error, clinical pharmacist

Journal website: <http://ejournals.swu.ac.th/index.php/pharm/index>

## Introduction

Medication error is a preventable event that unintentionally occurs and increases patient harm.<sup>1</sup> Consequences of medication error range from risk of harm to life-threatening events and death from adverse effects. The adverse effect and ineffective treatment also increase medical costs and damage patients' quality of life. Several medications are initially administered for acute illness during hospital admission. Some home medicines are contra-indicated or increase the risk of adverse effects during acute conditions

such as acute kidney injury, acute liver failure, hypotensive status, and respiratory failure. Furthermore, polypharmacy in the elderly might cause adverse events through drug interactions and drug duplication. Therefore, prescription screening is an essential process to prevent medication errors at the first step of the drug distribution chain.<sup>2</sup>

The incidence of prescribing errors found in the process of prescription screening varied from 7% to 34.5% in Southeast Asia.<sup>3</sup> The interventions to prevent and reduce

prescription errors were necessary. The American Society of Health-System Pharmacists has provided practical recommendation to enhance patient's safety throughout the hospitalization process.<sup>4,5</sup> It emphasizes the importance of obtaining an accurate medication history and performing medication reconciliation upon admission. Pharmacists are advised to participate in ordering, transcribing, and reviewing physician's orders. Prescriptions must be both complete and clear, ensuring the appropriateness of individualized medications for each patient. Furthermore, incorporating computerized alert systems into clinical practice and pharmacists' participation in the multidisciplinary team were encouraged to reduce medication errors.<sup>4,6</sup>

In our settings, the hospital system has been changed from traditional paper prescription to a combination of paper orders and computerized physician order entry (CPOE) system to promote medical safety and effectiveness. Ward-based clinical pharmacists routinely practice at internal medicine wards. Pharmacists have the responsibility to double-check prescriptions in real-time with the most recent patients' clinical status to prevent prescribing and transcribing errors. However, not all hospital pharmacists are specialized in pharmacotherapy and confident at joining the multidisciplinary team. Experienced ward-based pharmacists should provide educational initiatives and training for effective communication. The objective of this study was to determine frequencies, types and severities of prescription errors averted by clinical pharmacists in internal medicine wards at an academic university hospital.

## Methods

We conducted a retrospective descriptive study in an academic hospital in Chiangmai, Thailand. In our setting, ward-based clinical pharmacists provided pharmaceutical care services at a female and a male medicine ward from Monday to Friday. Daily routine tasks consisted of medication reconciliation, daily drug use evaluation by prescription screening, drug information provision, interdisciplinary round attendance, and patient counseling.<sup>4-6</sup> All interventions were voluntarily recorded via an electronic reporting system and patient's daily record form (paper-based system).

The population of this study was the adult patients hospitalized in internal medicine wards at an academic hospital. The study sample consisted of patients admitted to

these wards between June 1<sup>st</sup> and October 31<sup>st</sup>, 2019 (five months). To be eligible the patients had to receive at least one medication, be hospitalized more than 48 hours, and have one recorded ward-based clinical pharmacist's intervention. The exclusion criteria were patients with records of pharmacist's interventions on medication errors other than prescribing ones, or patients with inadequate information on pharmacist interventions including unclear patient situations resulting in medical problems or irrelevant problem and medication resolution.

Prescription errors in our study was defined as any pharmacists' records addressing issues in written prescriptions from the doctor's order form. Types of prescription errors were modified from previous studies<sup>6,7</sup>; while severities were classified based on the National Coordination Council for Medication Error Reporting and Prevention (NCC MERP) index.<sup>8</sup> Severity levels of A to I based on NCC MERP index were further re-classified into three categories as (1) no harm (A - C); (2) monitoring required (D), and (3) harmful (E - I).

Data collection was done using two forms. The hardcopy data collection form was used to extract and record demographic and clinical characteristics of the patient including age, gender, comorbidities, primary diagnosis and length of hospitalization, and pharmaceutical services provided. The digital data collection form was used to collect types of medication errors, severity of the errors, and major classes of medications involving the errors. To verify the accuracy of clinical pharmacist's records, the investigators (NC and NS) reviewed all the pharmacist's records of patients' demographic and interventions compared with medical charts retrospectively. The unclear pharmacists' records or uncertain recorded interventions were confirmed by clinical pharmacists who had responsibility at the internal medicine wards. The two additional investigators with expertise in internal medicine (ST and MN) separately extracted the interventions of prescribing errors, classified type of error and re-assessed the severity of error. The third investigator (SS) resolved the disagreements or inconclusions in term of type and severity of prescription errors if any.

### Participant ethical protection

This study was approved by the research ethics committee, Faculty of Medicine, Chiang Mai University (approval number: 039/2563). No information that could be

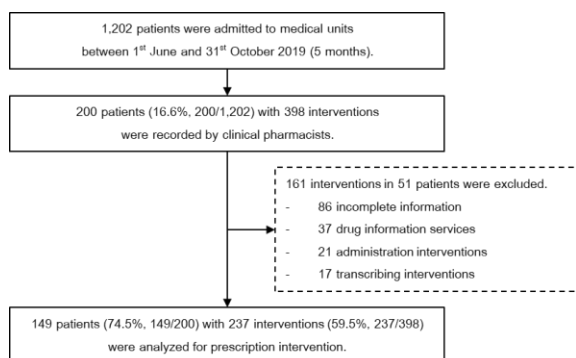
used to identify the patients were not obtained. Results were presented as a summary not individual patient information.

### Data analysis

We presented the distribution of prescribing errors and severity as frequencies and proportions. The continuous variables are displayed as mean and standard deviation or median and interquartile ranges (IQR). All data were analyzed using Statistical Package for Social Science (SPSS®) statistical software version 17.0.

## Results

During the five-month study period, a total of 398 pharmacist interventions were documented, corresponding to 200 patients. Of these interventions, 237 documents, involving 149 patients, were attributed to prescription errors. As a results, 149 individuals among the 1,202 hospitalized patients (12.4%) required pharmacist intervention due to prescription-related issues (Figure 1). The median prescription error was one incident per patients (interquartile range = 1 – 2 errors per patients). More than half of prescription errors (140/237 or 59%) happened during pharmacist on-service time, and 70% (or 167 of 237) were intervened within 24 hours.



**Figure 1** Study profile.

Of the 149 patients receiving pharmacist intervention, the majority were elderly (61.1%) and one-fifth (20.8%) older than 80 years (Table 1). The majority of patients had comorbidities (89.9%, 134/149). Primary diagnoses of infectious disease (41.6%), renal and electrolyte disorders (26.2%), and cardiovascular disease (22.1%) were the most common reasons for admission to medical wards. Median length of hospital stay was more than a week (median = 8.8 days).

**Table 1** Demographic and clinical characteristics (N = 149).

Characteristics	N (%)
Female gender	76 (51.0)
Age (years), mean (SD)	62.9 (19.2)
> 60	91 (61.1)
> 80	31 (20.8)
Comorbidities, n (%)	134 (89.9)
Hypertension	72 (48.3)
Diabetes	42 (28.2)
Malignancy	41 (27.5)
Dyslipidemia	40 (26.8)
Cardiovascular disorder	25 (16.8)
Chronic kidney disease	25 (16.8)
No comorbidity	15 (10.1)
Primary diagnosis, n (%)	
Infectious disease	62 (41.6)
Renal and electrolyte disorder	39 (26.2)
Cardiovascular disorder	33 (22.1)
Malignancy	19 (12.8)
Length of hospital stay, days, median (Q1 - Q3)	8.8 (5.0 - 8.8)

Of the 237 intervened prescription errors in 147 patients, the most frequent errors were omission errors and dosing errors (31.6% and 31.2%, respectively) (Table 2). A high as 69% of omission errors (52/75) were related to omitting the patient's medication before admission.

**Table 2** Types of intervened prescription errors (N = 237)\*.

Types of errors	N	%
Omission error	75	31.6
Dosing error	74	31.2
Wrong drug	24	10.1
Duplication error	17	7.2
Drug interaction	14	5.9
Frequency error	12	5.1
Incorrect duration of treatment	9	2.8
Pharmaceutical form error	7	3.0
Intravenous administration error	3	1.3
Allergy information error	1	0.4
Monitoring error	1	0.4

\* Number of intervened prescription errors from 149 patients.

Of the 237 intervened prescription errors, the majority were with the severity of "no harm" (57.4%) followed by "monitoring required" (39.7%). Only 7 events (2.9%) were categorized as harmful (NCC MERP category E) (Table 3).

**Table 3** Severity of intervened prescription errors categorized by NCC MERP<sup>6</sup> (N = 237)\*.

Modified category	NCC MERP category	N	%
No harm	A	9	3.8
	B	72	30.4
	C	55	23.2
Monitoring required	D	94	39.7
Harm	E	7	2.9

\* Number of intervened prescription errors from 149 patients.

The top three medications related to prescription errors were antimicrobial agents, cardiovascular drugs, and gastrointestinal drugs (Table 4).

**Table 4** Medication groups related with prescription errors (N = 237)\*.

Medical groups	N	%
Antimicrobial agents <sup>a</sup>	58	24.5
Cardiovascular drugs <sup>b</sup>	29	12.2
Gastrointestinal drugs	23	9.7
Anti-hyperglycemic agents	19	8.0
Central nervous system drugs <sup>c</sup>	18	7.6
Electrolyte, vitamin, and minerals	18	7.6
Analgesic agents <sup>d</sup>	16	6.7
Antithrombotic agents <sup>e</sup>	15	6.3
HMG-CoA reductase inhibitors	9	3.8
Inhalation and ophthalmic agents <sup>f</sup>	9	3.8
Systemic corticosteroids	6	2.5
Antigout agents	6	2.5
Miscellaneous <sup>g</sup>	11	4.6

\* Number of intervened prescription errors from 149 patients.

<sup>a</sup> antibacterials (n=46), antifungals (n = 7), antivirals (n=3), antituberculosis (n = 2)

<sup>b</sup> antihypertensive agents (n = 26), diuretics (n = 2), digoxin (n = 1)

<sup>c</sup> antiepileptic agents (n = 7), antipsychotics (n = 5), antiparkinsons (n = 3), anxiolytics (n = 2), antidepressants (n = 1)

<sup>d</sup> opioids (n = 14), non-opioids (n = 2)

<sup>e</sup> anticoagulants (n = 11), antiplatelets (n = 4)

<sup>f</sup> inhalation (n = 8), ophthalmic (n = 1)

<sup>g</sup> genitourinary (n = 3), levothyroxine (n = 3), antineoplastic agents (n = 2), immunomodulatory agent (n = 2), GCSF (n = 1)

## Discussions and Conclusion

There are many pharmacists' activities involving patient care in internal medicine wards. Our findings indicated that prescription screening took the most part of activity and 12.4% (149/1202) of hospitalized patients required intervention involving prescribing errors. The major issues for errors were omission of patients' usual medication and dose adjustment. Most medication groups that pharmacist involved in admission intervention were antimicrobial agents and cardiovascular drugs. Most prescription errors posed no harm to patient due to early detection and management within 24 hours of error's occurrence.

The prevalence of prescription errors varied widely ranging from 2% to 94% in community settings<sup>9</sup> and 107 to 218 errors per 100 hospital admissions.<sup>10</sup> Such discrepancy was due to differences in definitions, methods of data collection and study settings.<sup>11</sup> While our study presented the frequency of patients receiving interventions for prescription errors, other studies<sup>9,10</sup> often present prevalence data based on the count of prescriptions or medication orders. This difference in approach necessitates careful consideration in the interpretation of our results. Nevertheless, despite the methodological variance, our findings revealed the nature of prescription errors and illustrated the important role of ward-based pharmacists to

detecting and solving the errors that enhance medication safety.

Our findings showed that the most frequent type of prescription errors were omission errors and dosing errors which are similar with those of Franklin and colleagues.<sup>12</sup> More than half of interventions (69%) involved the re-initiation of the patients' medication before hospital discharge. This was because hospitalized patients usually had acute illnesses which could lead to discontinuing regular medications for their chronic illnesses. For example, renal and electrolyte disorders could jeopardize various concurrent drugs, such as antihypertensive and antihyperglycemic drugs; hence, the discontinuation. When the acute illnesses were cured, their regular medications might be missed before hospital discharge. The result from Abdel-Qader and co-workers also supported that omission error were frequently found in discharge state.<sup>13</sup> In our settings, all pharmacist's interventions involving omission error were discussed with prescribers for re-initiation when no contra-indication or risk of adverse effects before hospital discharge. Thus, the reconciliation process is still important to avoid missing medications for comorbidities and ensure continuity of care. Furthermore, the first primary reason for admission in our settings was infectious diseases. Antimicrobial agents usually require drug use evaluation on indication and dosing regimen. Antibiotic dosage adjustments, particularly for beta-lactams, are needed for older patients with compromised renal function because of advancing age. Dose adjustment for chronic renal failure is performed to avoid drug toxicity and achieve cost saving. Additionally, dose increment after recovery of renal function is necessary to guarantee drug efficacy. The pharmacist takes an important part of antimicrobial stewardship program for rational antimicrobial selection as empirical therapy and de-escalated therapy with the effective dosing regimen.<sup>14</sup>

Clinical severity of prescription error in our study was reported as no harm to patients (i.e., NCC MERP category A to C). The early detection and solving of the error within 24 hours could prevent the serious consequence of medication errors. Most harmful events were related to dosing error (5 out of 7 events with NCC MERP category E), such as underdose and overdose of subcutaneous insulin. Even though hyperglycemia in inpatients was not a life-threatening condition, the prolonged hyperglycemia increased a risk of a hyperglycemic crisis and impaired immune function that might

lead to secondary infection and delay the hospital length of stay.<sup>15</sup> One dose error resulted from a reconciliation error that overdosed on a hypertensive medication and caused bradycardia.

Our findings indicated that major responsibilities of ward-based clinical pharmacists for prevention of prescription errors should focus on medication reconciliation at admission and before discharge, dose adjustment, and proper drug combination. To further prevent and reduce prescription error, incorporating CPOE system and computerized alert systems into clinical practice was recommended and implemented in our settings.<sup>6</sup> Electronic medication reconciliation, concurrent medication list during admission, and crucial laboratory values, particularly the bacterial profile and renal function test, should all be included in the system. The alert system for fatal drug interactions and drug class duplication could prevent improper drug combination. Additionally, ward-based clinical pharmacists should educate hospital pharmacists on antimicrobial agents, the most common class of medication found in prescription error, to optimize dose and proper choice for empirical therapy or de-escalated therapy.

Our study showed some limitations. First, our study was restricted to the retrospective, non-controlled design. Clinical pharmacists routinely recorded the interventions without using standardized form, leading to an incomplete data record. Therefore, we confirmed each intervention by retrospective patient's chart review. The classification of intervention and severity was based on literature and experts' opinions who specialized in pharmaceutical services and internal medicine. Second, the frequency of intervention was susceptible to under-reporting due to the voluntary reporting system, heavy workload, or unwillingness to report unaccepted interventions. There should be more focus on documenting pharmacist's intervention should be focused and preventing data entry error.<sup>16</sup> Refusal of pharmacist intervention is crucial for pharmacists to gain more knowledge and communication skills with medical staff. Furthermore, clinically trained researcher could also be a key person to collect, record, and analyze the data continuously. Third, our findings were presented as pharmacists' perspective on medication. We are always aware of the importance of physician's perspective. The unaccepted intervention might have individualized reason. The judgment of potential impact on patients should be performed in future study. Last, this study was conducted only in an academic hospital where complicated, rare illnesses are found. Findings

might not be highly representing other levels of healthcare settings. However, the complicated diseases and medication use could offer a deep understanding of the prescription errors.

In conclusion, prescribing error in our settings was 12.4% of all 1,202 hospitalized patients inspected. The main prescribing errors were omission errors and dosing errors. Antimicrobial agents were the principal drug group involving prescribing errors. The majority of errors in this study were categorized as causing no harm to the patients. To implement the pharmacist's intervention for the prevention of prescribing errors, the continuity of medications for chronic diseases during admission and before discharge, as well as dose adjustment of antimicrobial agents, were essential issues for hospital pharmacists to re-check on CPOE system.

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