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Research Article

Drug-related problems and clinical pharmacist interventions in prescribing for older outpatients in Vietnam

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ABSTRACT

Drug-related problems (DRPs) are a leading cause of treatment failure, hospital admissions, and mortality, particularly among older adults due to age-associated alterations in pharmacokinetics and pharmacodynamics. Vietnam is experiencing a rapidly aging population, with increasing rates of chronic diseases and polypharmacy, while its healthcare system continues to face challenges in delivering specialized geriatric care. This study aimed to evaluate the prevalence and determinants of DRPs in geriatric outpatient prescriptions and assess the impact of clinical pharmacist-led interventions on DRP reduction. A quasi-experimental study was conducted across three hospitals in Vietnam, analyzing prescriptions from patients aged ≥65 years. DRPs were identified and classified using the Pharmaceutical Care Network Europe (PCNE) criteria version 9.1. Clinical pharmacists implemented educational interventions targeting prescribers to address identified DRPs. Data were analyzed using descriptive statistics, t-tests or Mann-Whitney U tests for continuous variables, Chi-square tests for categorical variables, and multivariable logistic regression to identify factors associated with DRPs. In the pre-intervention phase, 1,651 prescriptions were reviewed; the mean patient age was 71.4 years, with 58.8% female. The proportion of prescriptions containing at least one DRP was 28.3%, with inappropriate drug indication being the most prevalent issue. Polypharmacy (≥5 medications) and a higher number of diagnoses per patient were significant predictors of DRPs. Post-intervention analysis demonstrated a statistically significant reduction in DRP prevalence. Clinical pharmacist-led interventions effectively reduced the prevalence of DRPs in geriatric outpatient settings ($p < 0.001$). These findings underscore the critical role of clinical pharmacists in optimizing medication regimens for older adults, thereby enhancing patient safety and treatment outcomes.

Keywords:
Drug-related problems; Clinical pharmacist intervention; Geriatric outpatients; Polypharmacy; Vietnam.

1. INTRODUCTION

The aging population has led to a surge in chronic non-communicable diseases among older adults, resulting in increased healthcare demand and expenditures. A study in rural Vietnam highlighted that households with elderly members, especially those with chronic conditions, faced significant financial burdens, with out-of-pocket health expenditures accounting for 86.3% of total household health spending[1]. A significant contributor to these challenges is the prevalence of drug-related problems (DRPs), defined

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by the Pharmaceutical Care Network Europe (PCNE) as "an event or circumstance involving drug therapy that actually or potentially interferes with desired health outcomes"[2]. Elderly patients are particularly susceptible to DRPs due to age-related pharmacokinetic and pharmacodynamic changes, as well as the common occurrence of polypharmacy[3,4].

Polypharmacy, often defined as the concurrent use of five or more medications, is prevalent among older adults and is associated with increased risks of adverse drug reactions, hospitalizations, and mortality[4]. According to research by Ramanath et al. (2012), medication-related problems were common in geriatric patients, with 83.4% experiencing issues due to the demand for multiple medications and extended hospital stays[5]. Another study in India indicated that DRP was identified in one out of ten prescriptions for older outpatients with adverse drug reactions being the most commonly observed issue[6]. In Vietnam, a study reported that 32.8% of outpatient prescriptions for the elderly contained at least one DRP, with polypharmacy being a significant contributing factor[7].

The healthcare system in Vietnam operates at three levels—commune (primary), provincial (secondary), and central hospitals (tertiary) - with service use varying by severity of condition[8]. Studies have shown that older adults are more likely to visit outpatient clinics than stay in hospitals. However, most of them prefer going to higher-level hospitals rather than local health centres[9,10]. This is mainly because local centres often lack trained staff and the specialised services needed to treat more complex health problems in older patients and do medication reviews after prescribing. Clinical pharmacists play a crucial role in identifying and resolving DRPs by reviewing prescriptions, monitoring drug use, and working with doctors to optimise treatment plans - especially in settings where polypharmacy is common and specialist support is limited. Evidence from various settings indicates that pharmacist-led interventions can significantly reduce the incidence of DRPs, enhance medication safety, and improve patient outcomes[11-13]. While the 2016 Vietnamese Pharmaceutical Law has laid the groundwork for clinical pharmacy services[14], the implementation remains inconsistent, with many hospitals focusing primarily on administrative tasks like medication information and pharmacovigilance rather than direct patient care[15]. Activities such as medication counselling and monitoring of adverse drug reactions are less common, especially in lower-class hospitals.

Given the high prevalence of DRPs among the elderly and the potential benefits of clinical pharmacist interventions, this study aims to assess the prevalence and determinants of DRPs in geriatric outpatient prescriptions and evaluate the effectiveness of pharmacist-led interventions in reducing these problems.

2. MATERIALS AND METHODS

2.1. Study design and setting

A quasi-experimental study with a pre- and post-intervention design was conducted to evaluate the prevalence and determinants of drug-related problems (DRPs) in elderly outpatient prescriptions, as well as the effectiveness of clinical pharmacist-led interventions. The study was carried out across three general public hospitals in Ben Tre province, Vietnam. These hospitals were selected to represent the northern, central, and southern regions of the province, respectively. All three institutions utilize computerized prescribing systems, facilitating standardized data collection and analysis.

2.2. Study population

The study population comprised first-time prescriptions for outpatients aged 60 years and older, issued by physicians in the outpatient departments of the participating hospitals between June 2020 and May 2022. All full-time physicians in the outpatient department who agreed to participate in the study.

Exclusion criteria included prescriptions from pediatric, obstetrics, intensive care, and oriental medicine departments; prescriptions containing herbal or traditional remedies; follow-up prescriptions; and prescriptions with incomplete information. Physicians who did not provide outpatient care from the start of the study and those without a fixed outpatient clinic schedule.

2.3. Sample size determination

Based on prior literature indicating a 10% prevalence of DRPs among elderly outpatients[6], a sample size calculation was performed using a single population proportion formula, with a 2% margin of error and a 95% confidence level. This yielded a minimum required sample size of 865 prescriptions.

A systematic random sampling was applied in both the pre- and post-intervention periods. The sampling frame in each period consisted of all outpatient prescriptions generated during the 3-month data-collection window, ordered chronologically.

- Target sample size: n.
- Let N be the total number of outpatient prescriptions for older patients in the period (Duplicate prescriptions belonging to the same patient were excluded).
- Sampling interval: k = N / n (rounded to the nearest integer).
- Choose a random start r uniformly from [1, k]
- Select prescriptions with sequence numbers: r, r+k, r+2k,
  Continue until n prescriptions are selected

Table 1. Timelines for conducting research at hospitals

	1st Hospital	2nd Hospital	3rd Hospital
Sampling before intervention	01/4/2020-30/6/2020	01/4/2020-30/6/2020	01/4/2020-30/6/2020
Intervention period	01/4/2022-07/4/2022	08/04/2022-15/4/2022	16/4/2022-24/4/2022
Repeated intervention period	08/4/2022-07/5/2022	16/4/2022-16/5/2022	25/4/2022-25/5/2022
Sampling after intervention	08/4/2022-07/5/2022	16/4/2022-15/5/2022	25/4/2022-25/5/2022
Number of physicians	27	17	21

All physicians who met the inclusion criteria during the study period were invited and they were the same individuals in both phases.

Specific timelines and the number of physicians who participated for each hospital are detailed in Table 1.

2.4 Data Collection

Two clinical pharmacists were trained over a one-day session covering study protocols, data collection, and DRP identification criteria. Training occurred two weeks prior to data collection. During the pre-intervention phase, data were collected retrospectively from the hospital's electronic prescription system. Post-intervention data were collected prospectively. The principal investigator and supervisors verified the completeness and accuracy of the collected data.

DRPs were identified by referencing PCNE classification system version 9.1, and determined DRPs in the following order of priority: (1) summary of product characteristics, (2) the Vietnamese National Drug Formulary (2018)[16], (3) Ministry of Health guidelines. Significant drug-drug interactions were evaluated using the Drugs.com[17] interaction checker, focusing on interactions with substantial clinical relevance. DRPs include:

(1) DRPs for drug indications: contraindication, no indication for the drug, no drug treatment despite existing indication.

(2) DRPs for dosage: dosage too high and too low

(3) DRPs for frequency of use: high and low frequency of use.

(4) DRPs for the time of taking drugs: the time of taking medications per day (morning, afternoon, evening) and time of taking drugs compared with meals (before, during, and after meals).

(5) Drug-drug interaction

Potential determinants of DRPs analyzed included patient gender (male or female), number of diagnoses (≤2 or >2), and number of prescribed medications (<5 or ≥5), aligning with established risk factors for DRPs in elderly populations.

2.5 Intervention strategies

Based on the findings from the pre-intervention phase, a multi-faceted intervention was implemented:

- Educational Sessions: Clinical pharmacists conducted over one-hour sessions for all outpatient physicians, excluding medical students and residents. Sessions covered DRP definitions, prevalence data, case studies, and strategies for identifying and preventing DRPs. Physicians unable to attend received individual consultations.
- Informational Leaflets: Leaflets detailing common DRPs, specific drug issues, and prescribing errors were distributed to physicians' desks. Content was validated by clinical pharmacists and study supervisors and presented during hospital meetings.
- Direct Clinical Engagement: Post-educational sessions, clinical pharmacists participated in outpatient clinics for two 90-minute sessions daily over three days at each hospital. They provided real-time consultations on prescriptions, discussed DRPs, and suggested modifications, with approval from hospital boards and physicians.

2.6 Outcome measures

Primary outcomes included:

- Prevalence of DRPs in elderly outpatient prescriptions
- Identification of determinants associated with DRPs
- Effectiveness of clinical pharmacist interventions in reducing DRPs

Outcome collectors: Drug-related problems were abstracted from outpatient prescriptions and coded by trained clinical pharmacists who were not involved in delivering the intervention. The same data-collection team worked in both phases. To minimize detection bias, records were de-identified, and phase-masked; files were presented in random order so collectors could not infer the study phase.

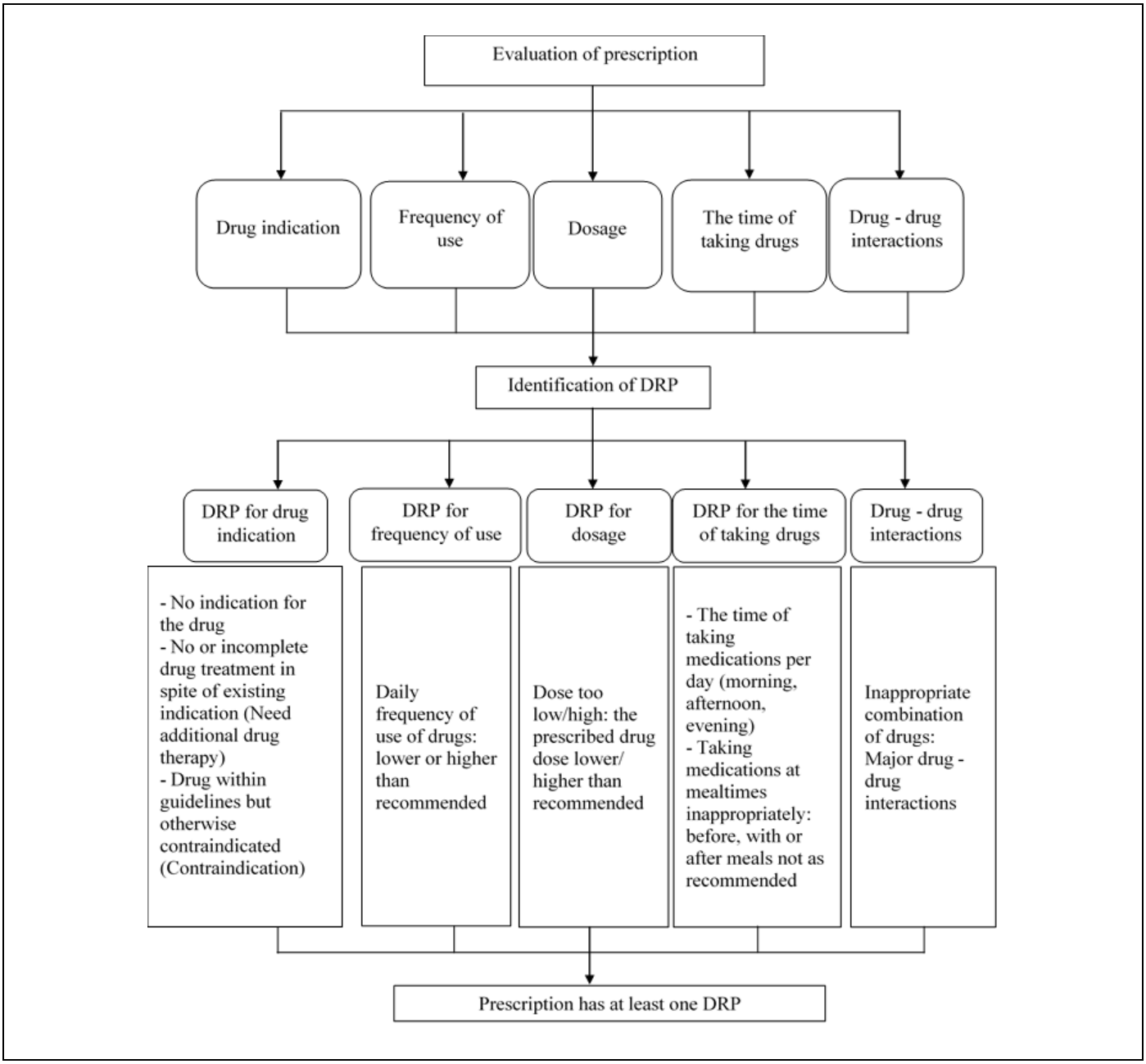

Figure 1. Flowchart of Prescription Evaluation Process

2.7 Statistical analysis

Data were analyzed using Microsoft Excel 2013 and SPSS version 23.0. Descriptive statistics summarized categorical variables as frequencies and percentages, and continuous variables as means with standard deviations or medians with interquartile ranges. Comparisons between groups utilized t-tests or Mann–Whitney U tests for continuous variables and Chi-square tests for categorical variables. Multivariable logistic regression models calculated odds ratios (ORs) with 95% confidence intervals (CIs) to identify factors associated with DRPs. A p-value of <0.05 was considered statistically significant. All variables were first assessed in univariate logistic regression to examine their association with the occurrence of DRPs. Variables with a p-value < 0.20 in univariate analysis were considered for inclusion in the multivariable logistic regression model. In addition, variables considered clinically important based on prior literature[7,18] were included in the model regardless of their univariate p-value. The final multivariable model was built using the Enter method.

3. RESULTS

3.1 Characteristics of the study population

A total of 1,651 prescriptions were analyzed in the pre-intervention phase and 1,538 in the post-intervention phase. The demographic and clinical characteristics of the

Table 2. Characteristics of the study population pre- and post-intervention

Characteristics		Pre-intervention		Post-intervention		p[a]
		No. (n=1651)	%	No. (n=1538)	%	
Gender	Female	971	58.8	903	58.7	0.954
	Male	680	41.2	635	41.3	
Age	Mean ± SD	71.4 ± 7.9		71.5 ± 7.7		0.839[b]
Number of diagnoses	≤2	533	32.3	457	29.7	0.117
	>2	1118	67.7	1081	70.3	
Number of drugs prescribed	<5	854	51.7	850	55.3	0.045*
	≥5	797	48.3	688	44.7	

[a]: Chi-square test, [b]: t-test *: statistically significant ($p < 0.05$)

study population are presented in Table 2. There were no statistically significant differences between the two groups regarding gender distribution, mean age, or the number of diagnoses ($p > 0.05$). However, a significant difference was observed in the number of drugs prescribed, with a higher proportion of patients receiving fewer than five medications in the post-intervention phase ($p = 0.045$).

3.2 Impact of clinical pharmacist interventions on drug-related problems (DRPs)

The implementation of clinical pharmacist-led interventions resulted in a significant reduction in the proportion of prescriptions containing at least one DRP, decreasing from 28.3% in the pre-intervention phase to 10.5% post-intervention, representing a 17.8% reduction ($p < 0.001$). Detailed comparisons of DRP types before and after the intervention are presented in Table 3. Notable reductions were observed for DRPs related to drug indication (16.9% to 7.1%, 9.8% reduction). Most DRP categories showed a reduction, except for instances of drug doses being too low, which did not show a statistically significant change ($p = 0.688$).

3.3 Common medications associated with DRPs

Analysis identified specific drug classes frequently associated with DRPs, notably selective calcium channel blockers, proton pump inhibitors (PPIs), and cough suppressants. Table 4 lists the medications with the highest rates of DRPs in the pre-intervention phase.

3.4 Determinants of DRPs in prescribing

Multivariable logistic regression analysis identified several factors significantly associated with the occurrence of DRPs, as detailed in Table 5. Prescriptions issued pre-intervention had a significantly higher risk of containing DRPs compared to those issued post-intervention (OR = 3.351; 95% CI: 2.751–4.083; $p < 0.001$). Female patients were more likely to experience DRPs than male patients (OR = 1.292; 95% CI: 1.071–1.559; $p = 0.007$). Patients prescribed five or more medications had a higher likelihood of DRPs (OR = 2.204; 95% CI: 1.824–2.664; $p < 0.001$). Interestingly, patients with more than two diagnoses had a lower risk of DRPs (OR = 0.592; 95% CI: 0.487–0.721; $p < 0.001$).

4. DISCUSSION

4.1 Drug-related problems in pre- and post-interventions

This study identified a significant prevalence of DRPs among elderly outpatients in Vietnam, with 28.3% of prescriptions exhibiting at least one DRP prior to the pharmacist-led intervention. This finding aligns with previous research indicating that DRPs are a common concern in geriatric populations due to factors such as polypharmacy and age-related physiological changes[19-21].

The most frequent DRPs identified were inappropriate drug indications, accounting for 16.9% of cases before the intervention. This is consistent with findings from Nguyen et al. (2022) at one hospital in Vietnam, where inappropriate prescribing was observed in 53.5% of cases, and with Hailu et al. (2020), who reported that such drug selection causes are common (54.1%) and often lead to adverse drug events[18,19].

The implementation of pharmacist-led interventions resulted in a substantial reduction in DRPs, decreasing from 28.3% to 10.5% post-intervention. Notably, the intervention completely eliminated contraindicated prescriptions and issues related to frequency of use, and reduced problems with drug indications by 9.8%. These outcomes underscore the effectiveness of pharmacist involvement in reviewing and optimizing medication regimens for elderly patients. Similar interventions have demonstrated significant improvements in medication safety and appropriateness in older populations[22]. Our findings are consistent with those of Nguyen et al. (2022), who also conducted a before–after intervention study in Vietnam to assess the impact of clinical pharmacist–led interventions on DRPs in outpatient prescribing. In their study, the proportion of prescriptions with at least one DRP decreased significantly from 88.8% to 74.9% after the intervention ($p<0.001$) with

Table 3. Comparison of drug-related problems pre- and post-intervention

Drug-related problem	Pre-intervention		Post-intervention		Change (%)	p[a]
	No. (n=1651)	%	No. (n=1538)	%		
At least one DRP	468	28.3	162	10.5	↓17.8	<0.001*
DRP classification						
Drug indication	279	16.9	109	7.1	↓9.8	<0.001*
Contraindication	23	1.4	0	0.0	↓1.4	<0.001*
No indication for the drug	127	7.7	31	2.0	↓5.7	<0.001*
No drug treatment despite existing indication	129	7.8	78	5.1	↓2.7	0.002*
Dose selection	69	4.2	31	2.0	↓2.2	0.001*
Drug dose too high	42	2.5	3	0.2	↓2.3	<0.001*
Drug dose too low	27	1.6	28	1.8	↑0.2	0.688
Frequency of use	72	4.4	0	0.0	↓4.4	<0.001*
High frequency of use	46	2.8	0	0.0	↓2.8	<0.001*
Low frequency of use	26	1.6	0	0.0	↓1.6	<0.001*
Time of taking medications per day	47	2.8	11	0.7	↓2.1	<0.001*
Taking medications compared with meals	156	9.4	0	0.0	↓9.4	<0.001*
Major drug-drug interaction	57	3.5	23	1.5	↓2.0	<0.001*

[a]: Chi-square test, *: statistically significant ($p < 0.05$)

Table 4. Common medications associated with DRPs pre-intervention

Class of drugs	Drug	Number of DRPs per total number of prescriptions with this drug	%
Calcium channel blockers	Amlodipine	68/498	13.6%
Proton pump inhibitors (PPIs)	Esomeprazole, Omeprazole, Pantoprazole	64/561	11.4%
Cough medicines: cough suppressants	Codein	8/72	11.1%
Oral diabetes medication (biguanides group)	Metformin	35/376	9.3%
Non-steroidal anti-inflammatory drugs (NSAIDs): oxicams	Meloxicam	10/109	9.1%
Non-steroidal anti-inflammatory drugs (NSAIDs): Acetic acid derivatives	Diclofenac	14/158	8.8%
Cephalosporin	Cefuroxime Cefadroxil	4/67	5.9%
Treats nerve pain	Pregabalin	3/64	4.7%
Oral diabetes medication (Sulfonylureas group)	Gliclazide	6/232	2.5%
Potassium-sparing diuretics	Spironolactone	3/25	1.2%

Table 5. Determinants of drug-related problems among geriatric patients

Characteristics	OR[(a)]	95%CI	p	OR[(b)]	95%CI	p
Pharmacist intervention[(c)]						
No (pre-intervention)	3.351	2.751-4.083	<0.001*			
Yes (post-intervention)	1					
Gender						
Male	1	1.071-1.559	0.007*	1	1.009-1.444	0.040*
Female	1.292			1.207		
Number of drugs prescribed						
<5	1	1.824-2.664	<0.001*	1	1.641-2.539	<0.001*
≥5	2.204			2.041		
Number of diagnoses						
≤2	1	0.487-0.721	<0.001*	1	0.551-0.863	0.001*
>2	0.592			0.689		

OR: odds ratio, 95% CI: 95% confidence interval, *: statistically significant ($p < 0.05$)
[(a)] OR from multivariable logistic regression
[(b)] OR from univariate logistic regression
[(c)] the reference group was the post-intervention (pharmacist intervention) group

marked improvements in DRPs related to drug indication, dosage, and frequency of use[18].

Moreover, the complete elimination of mealtime errors suggests that some DRPs—particularly those related to administration timing - can be effectively and rapidly addressed through targeted education and clear reminders. These issues are often due to knowledge gaps rather than complex clinical decision-making, making them more responsive to pharmacist-led educational interventions.

However, the lack of reduction in "dose too low" cases in our results may reflect physicians' clinical caution, particularly in elderly patients who are more susceptible to adverse effects, as well as variability or ambiguity in dosing guidelines for certain conditions. In some instances, lower doses were intentionally prescribed to balance efficacy with safety, which may explain why this DRP type did not decrease post-intervention.

In our study, the observed reduction in DRPs following the intervention is likely attributable to changes in prescriber behavior facilitated by multiple pharmacists' intervention components. Clinical pharmacy briefing sessions increased physician awareness of DRPs and provided practical, guideline-based recommendations. Printed and electronic DRP information sheets served as accessible reminders at the point of care, while direct case-specific interactions between pharmacists and physicians reinforced appropriate prescribing practices. In cases of disagreement, follow-up discussions promoted consensus and strengthened interprofessional collaboration. This mechanism were applied consistently across all participating sites and may have contributed to the sustained improvement in prescribing quality.

4.2 Determinants of drug-related problems

The study identified several factors associated with an increased risk of DRPs. Polypharmacy, defined as the use of five or more medications, was significantly associated with a higher likelihood of DRPs, corroborating findings from previous research that links polypharmacy with increased medication-related complications in the elderly. Pfister et al. (2017) noted that prescribing multiple medications increases the likelihood of DRPs[23]. Similarly, a study by Hailu et al. (2020) and Nguyen et al. (2022) revealed that patients with polypharmacy were significantly relevant to DRP occurring[18,19].

Gender differences were also observed, with female patients exhibiting a higher incidence of DRPs compared to male patients. A similar trend was noted in another study in Vietnam, female patients were more likely than males to experience DRPs[18]. This disparity may be attributed to differences in pharmacokinetics and pharmacodynamics between genders, as well as variations in health-seeking behaviors and medication use patterns. Further research is needed to clarify and identify the main underlying causes.

Interestingly, patients with more than two diagnoses had a lower risk of DRPs. Our result contradicts Hailu et al.'s study (2020), which showed that patients with one or more comorbidities had more DRPs[19]. This finding may reflect increased clinical attention and monitoring in patients with multiple comorbidities, leading to more cautious prescribing practices.

4.3 Comparison with other studies

Compared with Trinh et al. (2024)[7], which was conducted in a single G2 hospital in Vietnam and primarily relied on periodic educational sessions and dissemination of prescribing guidelines, our study involved a larger sample size and evaluated more prescriptions, covering three hospital sites instead of one. In addition to reporting sessions and information sheets, our intervention incorporated direct reminders, case-specific discussions, and repeated follow-up, which may explain the greater reduction in DRPs observed. Differences in intervention intensity, duration, and multi-site implementation likely contributed to the more pronounced effect.

In contrast, the study of Dong et al. (2022)[15] focused on a nationwide survey of inpatient hospital settings with an emphasis on describing the extent of clinical pharmacy activities. Our study was intervention-based and assessed the impact of pharmacist-led prescription review on drug-related problems in outpatient settings. While their study reported limited implementation of patient-specific services due to workforce constraints, our intervention directly engaged prescribers, leading to a substantial reduction in DRPs. These contrasting contexts suggest that targeted, structured interventions may yield measurable clinical benefits even where broader clinical pharmacy service implementation is still developing.

In addition, our findings align with evidence from Asia showing pharmacist-led interventions effectively reduce DRPs. In Indonesia, DRPs in type 2 diabetes outpatients fell from 263 to 205 after pharmacist counseling[24], while in Thailand's cardiovascular ICUs, 97.4% of 790 pharmacist interventions were accepted[25]. Globally, studies from Saudi Arabia and multinational reviews report high acceptance (70–95.5%) and significant DRP reductions with interventions led by pharmacists[26,27]. Compared with other countries, DRP prevalence in our

outpatient clinics was lower than many inpatient or specialty care reports in Asia, where nearly all patients may experience at least one DRP. Implementation feasibility in Vietnam differs due to more limited pharmacist resources and high patient volumes in public hospitals. Nevertheless, our multi-component approach - regular briefings, targeted DRP information sheets, and real-time feedback - achieved physician engagement and substantial DRP reductions, suggesting that structured pharmacist-led interventions can be successfully adapted to resource-constrained outpatient settings.

These findings suggest that integrating pharmacist-led medication review into routine outpatient geriatric care could be an effective and scalable strategy under Vietnam's current pharmaceutical legislation, especially if supported by structured clinical pharmacy training.

4.4 Strengths and limitations

The results of this study highlight the critical role of clinical pharmacists in mitigating DRPs among elderly outpatients. Integrating pharmacists into multidisciplinary healthcare teams can enhance medication safety, optimize therapeutic outcomes, and reduce healthcare costs associated with adverse drug events. Given the aging population and the increasing prevalence of chronic diseases, implementing pharmacist-led interventions in outpatient settings is a practical and cost-effective strategy to improve medication management in older adults.

This study has several limitations. First, the retrospective design of the pre-intervention phase may have introduced information bias. Second, we did not evaluate patient adherence or secondary outcomes such as clinical or economic effects. Information on prescribing physician characteristics (e.g., age, department, specialization, years of experience) was also unavailable, limiting our ability to assess their influence on prescribing patterns and DRP occurrence. Inter-rater reliability between pharmacists was not formally measured, and multicollinearity between covariates - such as number of drugs and number of diagnoses—was not assessed, which may affect the precision of regression results. Future studies should address these gaps to better understand factors associated with DRPs. Lastly, the potential influence of external factors, such as the COVID-19 pandemic, on prescribing practices was not evaluated. Future research should explore the long-term impact of such interventions on clinical outcomes, patient satisfaction, and healthcare utilization. Additionally, studies assessing the scalability and adaptability of pharmacist-led programs in diverse healthcare settings are warranted.

5. CONCLUSIONS

In conclusion, our study reveals that drug-related problems, especially inappropriate drug indications, are still frequent in prescriptions for older outpatients in Vietnam. After implementing pharmacist-led interventions, the proportion of prescriptions with DRPs fell sharply from 28.3% to 10.5%. The findings highlight the value of having clinical pharmacists work closely with physicians to improve prescribing quality, particularly for patients taking multiple medications or with complex health conditions. In Vietnam and similar low- and middle-income settings, integrating pharmacists into routine outpatient geriatric services could be an effective step toward safer, more appropriate medication use.

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Author contributions

T.Nguyen: Validation, Supervision, Writing review and editing, and Project administration. D.B.T.Le: Conceptualization, Methodology, Software, Formal analysis, Resources, Data curation, and Project administration. . S.T.Pham: Validation and Supervision. D.N.Lam: Formal analysis and Writing original draft preparation. Q.N.T.Le: Software, Formal analysis, Resources, and Data curation. T.T.C.Le : Methodology, Resources, and Data curation. T.T.N.Nguyen: Methodology, Resources, and Data curation. P.M.Nguyen: Validation and Supervision. T.T.Nguyen: Validation T.V.Ngo: Validation and Supervision. N.T.N.Duong: Validation and Supervision. N.V.Le: Validation and Supervision.

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Conflict of interest

None to declare.

Ethics approval

The study protocol received ethical approval from the Ethics Committee in Biomedical Research of Can Tho

University of Medicine and Pharmacy (Approval No. 22/PCT-HĐĐĐ in 2020). Patient confidentiality was maintained throughout the study.

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