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Original Research

Reducing outpatient drug-related problems through pharmacist-led interventions: A multi-center interventional study in provincial hospitals in Vietnam

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Abstract

Background: Drug-related problems (DRPs) significantly affect patient safety, clinical outcomes, and healthcare efficiency. Pharmacist-led interventions have demonstrated potential in improving prescribing practices, yet limited data exist on their effectiveness in outpatient settings in Vietnam. This study evaluated the impact of structured pharmacist interventions on reducing DRPs in outpatient prescriptions at multiple healthcare facilities in a province in Vietnam. **Methods:** A pre-post interventional study was conducted at three hospitals in a province in Vietnam. Pharmacists systematically reviewed outpatient prescriptions identified DRPs using version v9.1 of the Pharmaceutical Care Network Europe (PCNE) classification and selected criteria from Vietnam's Ministry of Health classification, and provided structured interventions, including quarterly seminars, hospital DRP bulletins, and personalized physician-specific DRP information sheets. Multivariate logistic regression assessed factors associated with DRP. **Results:** In total, 4,070 prescriptions pre-intervention and 4,051 prescriptions post-intervention were analyzed. Pharmacist-led interventions significantly reduced the proportion of prescriptions with at least one DRP from 21.7% (pre-intervention) to 9.1% (post-intervention; p<0.001). Significant reductions were observed across multiple DRP categories, including inappropriate drug indications, contraindicated medications, unnecessary drug prescriptions, incorrect dosing, improper timing of administration, and clinically significant drug-drug interactions (p<0.001). Factors independently associated with higher DRP risk included patient age ≥60 years (OR=1.554; p<0.001) and prescriptions containing five or more medications (OR=2.435; p<0.001). Proton pump inhibitors, gastrointestinal motility regulators, and non-steroidal anti-inflammatory drugs (NSAIDs) were most frequently implicated in DRPs. **Conclusions:** Pharmacist-led interventions effectively reduced DRPs in outpatient prescriptions at provincial hospitals in Vietnam. Older patients and those receiving polypharmacy were at higher risk, highlighting the need for targeted pharmaceutical care. This intervention model is practical, scalable, and well-suited for integration into electronic prescribing systems, significantly enhancing medication safety and prescribing quality.

Keywords: Drug-related problems, pharmacist intervention, outpatient prescribing, clinical pharmacy, Vietnam

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INTRODUCTION

Drug-related problems (DRPs) continue to represent a significant global healthcare challenge, negatively impacting patient safety, clinical outcomes, and healthcare expenditures[1,2,3]. DRPs encompass multiple prescribing issues, including inappropriate medication selection, incorrect dosing, potential drug interactions, and deviations from established clinical guidelines[4,5]. These problems substantially compromise medication effectiveness and patient safety, underscoring the urgent need for structured interventions to enhance prescribing quality and medication management[6,7]. Recent international studies emphasize that DRPs remain prevalent across healthcare settings, particularly in outpatient care, highlighting significant gaps in current medication management

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practices globally[8,9].

Internationally, DRPs persist at high levels across diverse patient populations. For instance, recent research in France indicated that 77.4% of patients had at least one identified DRP in their prescriptions[10]. Similarly, a study conducted in Indonesia revealed DRPs in approximately 57.0% of outpatient prescriptions, predominantly involving inappropriate medication use[11]. Such issues lead to reduced patient quality of life, increased morbidity, and elevated mortality rates, emphasizing the essential role pharmacists play in proactively identifying, preventing, and managing DRPs to optimize therapeutic outcomes[12,13].

In Vietnam, DRPs are frequently reported in outpatient settings, commonly characterized by excessive antibiotic prescribing, incorrect dosage regimens, and inadequate prescribing documentation[14,15,16]. These issues arise from multiple factors, including increased healthcare demands, widespread polypharmacy, limited clinician access to current prescribing guidelines, and underdeveloped structured mechanisms for effective DRP management, particularly at the provincial outpatient level[17,18,19].

Pharmacists have a pivotal role in addressing DRPs through comprehensive interventions spanning the medication-use continuum, from prescription review to patient counseling and education[20,21]. Robust international evidence consistently supports pharmacist-led interventions in significantly reducing DRP incidence, improving medication adherence, and enhancing clinical outcomes[22,23,24]. Recent global studies have further reinforced this evidence, demonstrating notable improvements in medication safety and patient outcomes across varied healthcare contexts, including community pharmacies and outpatient clinics[25,26,27]. However, evidence remains limited regarding pharmacist interventions specifically targeting outpatient prescribing practices in provincial hospitals in Vietnam.

This study addresses this critical knowledge gap by evaluating the impact of structured pharmacist-led interventions on prescribing quality in outpatient departments of provincial hospitals in Vietnam. The primary objectives are to systematically identify and classify common DRPs, implement targeted pharmacist interventions, and evaluate their effectiveness in reducing DRP prevalence and enhancing prescribing quality. The results of this study aim to strengthen clinical pharmacy practices and substantially contribute to medication safety initiatives both nationally and internationally.

METHODS

Study design

This was a pre-post multi-center interventional study designed to evaluate the impact of pharmacist-led interventions on outpatient prescribing practices by comparing outcomes before and after the intervention.

Study population and setting

The study included outpatient prescriptions collected from three hospitals in a province in Vietnam: one provincial general hospital and two district-level general hospitals. Prescriptions were collected in two phases: pre-intervention (April 1–June 30, 2020) and post-intervention (April 1–May 31, 2022).

Participating physicians comprised 27 from the provincial general hospital, 17 from one district hospital, and 21 from the other district hospital, all actively working in outpatient departments during the study periods.

Inclusion criteria

- Outpatient prescriptions from the hospitals' outpatient departments.
- Adult patients aged ≥18 years.
- Physicians are actively involved in outpatient treatment during the study periods.

Exclusion criteria

- Repeated prescriptions for the same patient with identical diagnoses within one month.
- Prescriptions for pregnant patients.
- Prescriptions from physicians are absent due to leave or training during data collection periods.

Study timeline

The study was conducted from June 2020 to May 2022, structured as follows:

- **Pre-intervention data collection:** April 1–June 30, 2020 (all hospitals).
- **Main interventions:** April 1–7, 2022 (provincial hospital), April 8–15, 2022 (first district hospital), April 16–24, 2022 (second district hospital).
- **Reinforcement interventions:** Following the main interventions, from April 8–May 7, 2022 (provincial hospital), April 16–May 16, 2022 (first district hospital), and April 25–May 25, 2022 (second district hospital).
- **Post-intervention data collection:** Conducted immediately after each hospital's respective main intervention.

Sample size calculation

The sample size aimed to detect changes in the proportion of prescriptions containing at least one DRP. Using an expected DRP prevalence (p = 0.89 from previous research by Nguyen Anh Nhut[8]), a confidence interval of 95% (Z = 1.96), and an allowable error margin of 1%, the calculated minimum sample size per phase was approximately 3,761 prescriptions. Accounting for a potential 5% data loss, at least 4,000 prescriptions per study phase were targeted, resulting in a total of at least 8,000 prescriptions.

Sampling technique

Systematic random sampling was used to select prescriptions from each hospital during both pre- and post-intervention periods.

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Study procedures

Pre-intervention phase

- **Data collection:** Patient demographic data (age, gender, insurance), diagnosis, clinic details, and comprehensive medication data (generic/brand names, dosage form, strength, frequency, timing relative to meals, total medications prescribed) were recorded.
- **DRP identification:** Clinical pharmacists identified DRPs by referencing standard resources, including drug manufacturer leaflets, the Vietnam National Drug Formulary, hospital-specific protocols, and guidelines issued by the Vietnamese Ministry of Health.
- **Expert validation:** Identified DRPs were reviewed by a nine-member expert panel. DRPs receiving consensus from ≥5/9 panelists were accepted; those without clear consensus underwent further discussion for resolution[3].

DRP categories

DRPs were systematically classified according to Vietnam Ministry of Health guidelines (Decision No. 3547/QĐ-BYT) and Pharmaceutical Care Network Europe (PCNE) Classification v9.1, including[1]:

- Indication issues (e.g., unnecessary medication, contraindications).
- Dosage errors (excessive or inadequate daily doses).
- Frequency errors (excessively frequent or infrequent medication administration).
- Timing errors (incorrect administration relative to meals or daily schedule).
- Clinically significant drug interactions (identified via Drugs.com).

Intervention phase

Pharmacist-led interventions, developed based on pre-intervention findings, included[5,6]:

- Short educational seminars (10–15 minutes), highlighting identified DRPs and corrective actions.
- Informational flyers placed in physicians' work areas summarizing key DRP cases and best practices.
- Direct pharmacist-to-physician discussions providing immediate feedback on prescribing issues.

Post-intervention phase

Post-intervention prescriptions underwent identical DRP analysis and categorization as in the pre-intervention phase. Outcomes evaluated included changes in the overall proportion of prescriptions containing DRPs and individual DRP types.

Statistical analysis

Data were analyzed using IBM SPSS Statistics v23.0. Descriptive statistics were used for continuous (mean) and categorical (% frequencies) variables. Chi-square tests compared DRP proportions before and after interventions. Independent t-tests and Mann-Whitney U tests assessed differences in continuous data across study phases. Logistic regression analyses identified factors influencing DRP occurrence. Statistical significance was set at $p<0.05$.

Ethical considerations

Ethical approval was obtained from the Ethics Committee of Can Tho University of Medicine and Pharmacy. Data confidentiality was ensured, with anonymized patient and physician information maintained throughout the study. Results were used solely for academic research purposes.

RESULTS

Characteristics of study samples

A total of 4,070 prescriptions were collected in the pre-intervention phase, and pharmacist interventions were subsequently conducted with prescribing physicians. Post-intervention evaluation included 4,051 prescriptions. Characteristics of prescriptions before and after the intervention are summarized in Table 1.

Significant differences were found in patient age groups ($p = 0.016$) and the number of diseases per prescription ($p = 0.040$). No significant differences were observed in gender distribution or the number of drugs per prescription.

Overall Effectiveness of Pharmacist Interventions on DRP

The effectiveness of pharmacist interventions on the overall incidence of drug-related problems (DRPs) is summarized in Table 2.

Table 1. Comparison of prescription characteristics before and after intervention

Characteristics	Pre-intervention (n=4,070)	Post-intervention (n=4,051)	p-value
Gender, n (%)			0.374
Female	2,273 (55.8)	2,302 (56.8)	
Male	1,797 (44.2)	1,749 (43.2)	
Patient age group, n (%)			0.016
< 60 years	2,419 (59.4)	2,513 (62.0)	
≥ 60 years	1,651 (40.6)	1,538 (38.0)	
Mean age (SD) years	56.8 (15.2)	56.4 (15.1)	–
Number of diseases per prescription, n (%)			0.04
≤ 2 diseases	1,575 (38.7)	1,478 (36.5)	
> 2 diseases	2,495 (61.3)	2,573 (63.5)	
Mean diseases (SD)	3.3 (1.9)	3.3 (1.9)	–
Number of drugs per prescription, n (%)			0.124
< 5 drugs	2,448 (60.1)	2,504 (61.8)	
≥ 5 drugs	1,622 (39.9)	1,547 (38.2)	
Mean drugs (SD)	4.1 (1.9)	4.0 (1.9)	–

Chi-square tests were used to compare proportions between groups.

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The proportion of prescriptions containing at least one DRP significantly decreased after pharmacist interventions (from 21.7% to 9.1%, $p < 0.001$).

Effectiveness of Pharmacist Interventions on Specific DRP Types

The effectiveness of pharmacist interventions on specific DRP categories is detailed in Table 3.

Overall, pharmacist-led interventions effectively improved prescribing practices, notably regarding appropriateness of drug indication, dosage accuracy, timing, and management of drug interactions.

Factors Associated with Drug-Related Problems (DRPs)

Multivariate logistic regression was conducted to identify independent predictors of DRPs. Results are presented in Table 4.

Patients aged ≥60 years (OR = 1.554; 95% CI: 1.370-1.762; $p < 0.001$) and prescriptions containing ≥5 medications (OR = 2.435; 95% CI: 2.133-2.780; $p < 0.001$) were significantly associated with an increased risk of DRPs. Prescriptions with more than two diagnosed diseases were associated with a reduced risk of DRPs (OR = 0.718; 95% CI: 0.615-0.807; $p < 0.001$). Gender was not significantly associated with DRP occurrence ($p = 0.102$).

Medication Groups Frequently Associated with DRPs

Medication groups frequently involved in DRPs identified during the study period are listed in Table 5.

Disease Conditions Frequently Associated with DRPs

Disease conditions commonly associated with DRPs in this study are summarized in Table 6.

Diseases most frequently associated with DRPs were intervertebral disc disorders, chronic sinusitis, and gastro-esophageal reflux disease (GERD).

Intervertebral disc disorders, chronic sinusitis, and gastro-esophageal reflux disease (GERD) were most associated with DRP.

DISCUSSION

This study demonstrated that structured pharmacist-led interventions significantly reduced drug-related problems (DRPs) in outpatient prescriptions at provincial hospitals in Vietnam. Specifically, the intervention decreased prescriptions containing at least one DRP from 21.7% pre-intervention to 9.1% post-intervention ($p < 0.001$). These findings align closely with recent global research, underscoring pharmacists' critical role in improving medication safety, prescribing quality, and patient outcomes[22,27].

Detailed analysis revealed substantial reductions across various DRP categories, including inappropriate drug indications, contraindicated medications, unnecessary prescriptions, incorrect dosing, inappropriate timing, and drug-drug interactions. These outcomes reflect international evidence that highlights pharmacist interventions as effective

Table 2. Overall effectiveness of pharmacist interventions on DRP

DRP presence	Pre-intervention (n=4,070) (%)	Post-intervention (n=4,051) (%)	p-value
Prescriptions with ≥1 DRP	21.7	9.1	<0.001

Chi-square test was used to compare proportions.

Table 3. Effectiveness of pharmacist interventions on specific types of DRP

Specific DRP Type	Pre-intervention (%)	Post-intervention (%)	p-value
Inappropriate drug indication	11.7	6.4	<0.001
Contraindicated drug prescribed	0.7	0.1	<0.001
Unnecessary drug prescription	6.6	2.8	<0.001
Missing drug indication	4.8	3.5	0.003
Inappropriate drug dosage	2.4	0.9	<0.001
Excessive daily dosage	1.6	0.1	<0.001
Insufficient daily dosage	1	0.8	0.49
Incorrect dosing frequency	2.5	0.3	<0.001
Excessive dosing frequency per day	1.7	0.3	<0.001
Insufficient dosing frequency per day	0.8	0.1	<0.001
Incorrect timing of drug administration per day	2.6	0.8	<0.001
Incorrect timing relative to meals	5.5	0	<0.001
Serious drug-drug interactions	3.1	1.4	<0.001

Chi-square tests indicated significant reductions across most DRP categories ($p < 0.001$), except for insufficient daily dosage ($p = 0.490$). The reduction in missing drug indications was statistically significant but less pronounced ($p = 0.003$).

Table 4. Multivariate logistic regression analysis of factors associated with DRP

Factor	Prescriptions without DRP n (%)	Prescriptions with DRP n (%)	Adjusted OR (95% CI)	p-value
Intervention				
Pre-intervention (n=4070)	3186 (78.3%)	884 (21.7%)	1 (reference)	-
Post-intervention (n=4051)	3683 (90.9%)	368 (9.1%)	0.362 (0.317-0.414)	<0.001
Gender				
Male (n=3546)	3018 (85.1%)	528 (14.9%)	1 (reference)	-
Female (n=4575)	3849 (84.1%)	726 (15.9%)	1.111 (0.979-1.261)	0.102
Age group				
<60 years (n=4932)	4308 (87.3%)	624 (12.7%)	1 (reference)	-
≥60 years (n=3189)	2559 (80.3%)	630 (19.7%)	1.554 (1.370-1.762)	<0.001
Number of medications				
<5 medications (n=4952)	4402 (88.9%)	550 (11.1%)	1 (reference)	-
≥5 medications (n=3169)	2465 (77.8%)	704 (22.2%)	2.435 (2.133-2.780)	<0.001
Number of diagnosed diseases				
≤2 diseases (n=3053)	2572 (84.3%)	481 (15.7%)	1 (reference)	-
>2 diseases (n=5068)	4295 (84.8%)	773 (15.2%)	0.718 (0.615-0.807)	<0.001

Table 5. Medication groups frequently associated with DRP

No.	Medication group	Specific medications	DRP count / Total prescriptions (%)
1	Proton pump inhibitors (PPI)	Esomeprazole, Omeprazole, Pantoprazole	246 / 2965 (8.3%)
2	Gastrointestinal motility regulators	Domperidone	40 / 486 (8.2%)
3	Non-steroidal anti-inflammatory drugs	Meloxicam	7 / 126 (5.5%)
4	Non-steroidal anti-inflammatory drugs	Diclofenac	34 / 655 (5.2%)
5	Quinolone antibiotics	Levofloxacin	4 / 92 (4.3%)
6	Neuropathic pain and antiepileptic drugs	Pregabalin	15 / 384 (3.9%)
7	Cough suppressants	Codeine	2 / 55 (3.6%)
8	Potassium-sparing diuretics	Spironolactone	1 / 70 (1.4%)
9	Single vitamin preparations	Calcium lactate	3 / 230 (1.3%)
10	Lactic acid-producing bacteria	Lactobacillus acidophilus	1 / 132 (0.75%)

Proton pump inhibitors (PPI) and gastrointestinal motility regulators were most involved in DRP.

Table 6. Disease conditions frequently associated with DRP

No.	Disease condition	ICD-10	DRP count / Total prescriptions (%)
1	Other intervertebral disc disorders	M51	93 / 458 (20.3%)
2	Intervertebral disc disorders with spinal cord involvement	G99.2	41 / 232 (17.7%)
3	Chronic sinusitis	J32	22 / 178 (12.4%)
4	Gastro-esophageal reflux disease (GERD)	K21	359 / 2965 (12.1%)
5	Other chronic obstructive pulmonary diseases	J44	7 / 92 (7.7%)
6	Polyarthrosis	M15	28 / 711 (4.0%)
7	Conjunctivitis	H10	3 / 89 (3.4%)
8	Essential (primary) hypertension	I10	4 / 667 (0.6%)
9	Non-insulin-dependent diabetes mellitus	E11	3 / 498 (0.6%)
10	Other allergic rhinitis	J30.3	5 / 165 (0.3%)

strategies to address common prescribing errors, enhance medication adherence, and improve clinical outcomes[10,11,25,27]. However, the intervention demonstrated limited effectiveness in addressing insufficient daily dosing, suggesting the need for further targeted education and system-level enhancements to prescribing practices.

Significant predictors of DRP occurrence identified in this study included older patient age (≥60 years) and polypharmacy (≥5 medications). These factors align with previous research emphasizing elderly patients' increased vulnerability due to pharmacokinetic alterations, complex medication regimens, and multiple comorbidities[3,9,13]. Conversely, prescriptions involving more than two diagnosed conditions were associated with a lower DRP risk, potentially reflecting heightened clinical vigilance and careful prescribing behaviors in more complex clinical scenarios.

Medication groups frequently associated with DRPs included proton pump inhibitors, gastrointestinal motility regulators, and non-steroidal anti-inflammatory drugs (NSAIDs). This finding aligns with international concerns about inappropriate prescribing practices and the overuse of these medication classes, further highlighting the importance of pharmacist oversight in rationalizing medication use[8,10,12]. Chronic conditions most commonly associated with DRPs, such as intervertebral disc disorders, chronic sinusitis, and gastroesophageal reflux disease (GERD), underscore the necessity for cautious medication prescribing in chronic disease management[12,16,18].

From a practical standpoint, these findings offer significant implications, especially in the context of Vietnam's ongoing administrative restructuring, which is consolidating administrative units from 63 provinces to approximately 34. This consolidation is anticipated to increase patient volume and workload pressures in provincial healthcare facilities, thereby elevating the risk of medication errors and DRPs. Implementing structured pharmacist-led interventions, as demonstrated in this study, can effectively address these challenges by providing standardized, scalable solutions to improve prescribing safety, medication efficacy, and patient outcomes amidst increased healthcare demands[14,17,19].

Moreover, in line with Vietnam's national digital transformation strategy outlined in Resolution No. 52-NQ/TW and Decision No. 749/QĐ-TTg, integrating pharmacist-generated DRP data into electronic prescribing platforms could substantially enhance the sustainability and effectiveness of clinical pharmacy services. Clinical pharmacists' systematic identification, classification, and validation of DRPs provide essential data for national electronic health databases. Integrating these validated datasets into electronic prescribing systems and clinical decision support tools could significantly enhance prescribing accuracy, patient safety, and quality improvement nationwide[24,28]. Leveraging national-level DRP data could facilitate proactive identification of high-risk medications, potential drug interactions, and prescribing errors, ultimately improving therapeutic outcomes through big data analytics and artificial intelligence applications.

Structured pharmacist-led interventions effectively reduce DRPs, significantly improving outpatient prescribing quality in provincial hospitals. Given Vietnam's administrative restructuring and national digital transformation goals, these interventions represent a critical strategy for sustainably enhancing medication safety, clinical pharmacy practice, and healthcare quality across Vietnam's evolving healthcare landscape. Future research should explore randomized controlled trials, long-term clinical outcomes, and comprehensive economic analyses to further validate and expand these findings nationally and internationally.

CONCLUSIONS

Pharmacist-led interventions significantly reduced drug-related problems (DRPs) in outpatient prescriptions, emphasizing pharmacists' essential role in enhancing medication safety and prescribing quality. Older age (≥60 years) and polypharmacy (≥5 medications) were key predictors of DRP, highlighting the need for targeted interventions in these groups. The structured intervention model is practical and scalable nationwide, especially considering Vietnam's administrative restructuring and digital transformation goals. Future research should extend the intervention to diverse healthcare settings, evaluate long-term outcomes, and integrate pharmacist-validated DRP data into electronic prescribing systems to support optimal medication management nationwide.

CONFLICTS OF INTEREST

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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