

Optimizing Outpatient Medication Management: The Impact of Clinical Pharmacists on Identifying and Addressing Drug-Related Problems

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Abstract:

Medication Therapy Management Services (MTMS) are effective strategies to reduce Drug-Related Problems (DRPs) and associated healthcare costs. Given the high prevalence of DRPs in outpatient settings and the lack of an effective process to detect such problems in Iran, we decided to evaluate the type and number of DRPs identified by clinical pharmacists in a university-affiliated Pharmacotherapy Clinic in Khuzestan province, South of Iran. In this cross-sectional study, 150 eligible outpatients were included. At a university-affiliated pharmacotherapy clinic, pharmacy students took patients' histories and referred them to clinical pharmacists for DRP evaluation and detection. Appropriate interventions were then implemented in collaboration with patients and their healthcare providers to resolve the problems. Approximately 3.56 DRPs per patient were identified during a nine-month study period. The most prevalent DRPs were lack of education or information (32.40% [174/537]), undertreated indications (17.31% [93/537]), and patient compliance (15.27% [82/537]). Clinical pharmacists detected 537 DRPs, implemented 525 interventions, and performed 0.977 interventions per DRP. The provision of information (57.52% [302/525]) and change of therapy (21.71% [114/525]) were the most frequent types of clinical pharmacist interventions. This study revealed deficiencies and limitations in our healthcare services, resulting in a significant prevalence of DRPs. Implementing pharmaceutical care practice models, such as Pharmacotherapy Clinics, where clinical pharmacists integrate their experience and knowledge in a patient-centered manner, is the most effective method for preventing and managing these issues.

Keywords: Pharmaceutical Services, Medication Therapy Management, Disease Management, Medication Adherence, Medication Error, Iran

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1. Introduction

In recent years, improvements in the quality of medical and health services have increased life expectancy and the number of older adults with co-morbidities [1, 2].

Polypharmacy, a consequence of the predominance of chronic diseases among older adults, is the routine use of at least five drugs and is common among older and younger high-risk populations, increasing the risk of undesirable healthcare outcomes [3-5]. In individuals

with polypharmacy, the incidence of adverse drug reactions and drug-drug interactions is augmented, which increases the risk of DRPs [6]. DRPs can lead to extended hospital stays, increased hospitalization expenditures, and higher mortality [7-9]; although some problems, such as idiosyncratic reactions, are unavoidable, the majority can be prevented.

Several studies have demonstrated that MTMS can decrease DRPs and related healthcare expenses [10-14]. In this practice model, clinical pharmacists assess medication therapy during face-to-face visits, focusing on prescribed drugs, supplements, non-prescription medications, and herbal remedies, and communicate with authorized physicians to resolve or prevent DRPs [15].

In the context of the prevalence of DRPs in outpatient settings globally [16] and presumably in Iran, a comprehensive assessment approach is essential to effectively and expeditiously address this health issue. Clinical pharmacists in Iran provide these services at pharmacotherapy clinics, the first practice models established for providing pharmaceutical care services in outpatient settings.

This study aims to assess the types and numbers of DRPs identified by clinical pharmacists at a pharmacotherapy clinic in Iran.

2. Materials & Methods

2.1 Study Design

In this descriptive-cross-sectional study, 150 patients were enrolled from September 2016 to June 2017. Inclusion criteria were as follows: outpatient adults (age ≥ 18 years old) with more than one chronic disease state and chronic consumption of 4 or more medications.

2.2 Study subjects and data gathering

Community pharmacists identified eligible patients and referred them to the Pharmacotherapy Clinic at Imam Sajjad outpatient pharmacy affiliated with Ahvaz Jundishapur University of Medical Sciences (AJUMS), where patients received pharmaceutical care services at no cost. Initially, a 5th-year pharmacy student (Pharm.D. program), under a clinical pharmacist's supervision, thoroughly reviewed the patient's medical history and treatment plan. The clinical pharmacist had two years of experience practicing at the 13-Aban Pharmacotherapy Clinic affiliated with Tehran University of Medical Sciences (TUMS). Pharmacy students received 1-month training on history taking and communication skills with patients at the mentioned site. Clinical pharmacists then reviewed therapeutic regimens to detect DRPs, followed by appropriate interventions to resolve them. All information was collected using a research-made checklist from face-to-face interviews with patients and their medical records by a trained pharmacists' team.

2.3 Questionnaire

The data collection instrument was designed as a research form based on the Pharmaceutical Society of Australia (PSA) recommendations. Documentation elements and data collection instruments adopted from the MTMS model included: Patient demographics, Subjective and Objective Observations, Assessment, Plan, Collaboration, Personal Medication Record (PMR), and Medication Action Plan (MAP) [13]. All data were documented in the patient's electronic health records; The Anatomical Therapeutic Chemical (ATC) Classification was used to classify patients' medication.

2.4 Drug-Related Problem Classification System

Due to the absence of a comprehensive system for detection and documentation of DRPs and the need for conformity for use in Iranian pharmacy practice, the authors decided to design and validate a documentation system for this purpose. As described by *Williams et al.*, the DOCUMENT Classification system was used as the reference, to create our customized DRP classification [10], which was then tested for content, face, construct, and criterion validity. This proposed validated system categorized DRPs into seven categories and 45 sub-categories (compared to eight categories and 35 sub-categories in the DOCUMENT Classification system) [18].

2.5 Clinical Pharmacist Interventions

Clinical pharmacist recommendations were grouped into five categories: change of therapy, referral required, provision of information, monitoring, and others. Following the detection of DRPs, a letter was written to the practitioner, addressing the problem and necessary recommendations. Follow-up of the referral letters to physicians was separate from this study.

2.6 Ethics Approval

MTMS were provided free of charge. Data were collected anonymously under the general regulations for protecting patient data and privacy. The requirement for informed consent from participants was waived because of the routine care services of the MTM. The Ethics Committee and review board of Ahvaz Jundishapur University of Medical Sciences (AJUMS) approved the study protocol (IR.AJUMS.REC.1395.785).

2.7 Sampling method and sample size estimation

The sample size was estimated using Cochran's formula with the following assumptions [17].

$P_{prescribing\ errors} = 0.06$, $d = 0.04$, $\alpha = 0.05$. Finally, about 150 patients were recruited using a convenience sampling method.

2.8 Statistical analysis

Continuous variables were reported using mean, standard deviation (mean \pm SD), and minimum and maximum range. Categorical variables were reported as frequency and percentage. All statistical analyses were performed using SPSS software version 22.

3. Results & Discussion

In our study, we examined 150 patients, consisting of 77 males (51.33%) and 73 females (48.67%), with an age range of 18 to 90 years old and a mean age of 49.56 ± 19.99 years. Over a period of nine months, clinical pharmacists identified 537 DRPs in these patients and made 525 interventions, averaging 0.977 interventions per DRP. The number of DRPs per patient ranged from 1 to 11, averaging of 3.56 ± 1.98 . Clinical pharmacist interventions ranged from 1 to 8 per patient, averaging of 3.25 ± 1.57 .

Table 1 presents the detected DRPs based on main categories, and Table 2 presents them based on sub-categories. The most prevalent DRPs were lack of education or information (32.40% [174/537]), undertreated indication (17.31% [93/537]), and patient compliance (15.27% [82/537]). Over or under-use problems had the lowest prevalence (5.40% [29/537]) among DRP categories. In the drug selection category, precaution apparent and contraindication (2.04% [11/537]) were the most prevalent DRPs, while incorrect strength (0.18% [1/537]) was the least prevalent. Unclear dose instruction was more prevalent (2.04% [11/537]) than other DRPs in the over or under-use category. Notably, non-compliance due to safety or efficacy concerns (7.63% [41/537]) was more prevalent than others in the compliance category. Untreated conditions (7.82% [42/537]) and the need for laboratory monitoring (5.02% [27/537]) had higher rates of DRPs in the untreated and monitoring categories, respectively. The most prevalent DRP among all categories was consumer request for drug information (13.59% [73/537]) (Table 1 and 2).

Our results demonstrated that the most prevalent clinical pharmacist interventions were implantation of a new drug regimen (14.48% [76/537]), referral to the prescriber (13.14% [69/537]), complication of monitor learning (12.19% [64/537]), and enhancing patient knowledge (10.10% [53/537]) (Table 3 and 4).

Using the ATC code, drug classes most associated with DRPs fell into five categories, as shown in Table 6, with cardiovascular drugs as the most prevalent cause of DRPs (Table 5). This cross-sectional study focused on 150 patients with polypharmacy and at least one chronic disease. During the nine-month study period, we identified approximately 3.56 DRPs per patient. These findings align with other studies evaluating the role of

pharmacists in providing MTMS, which reported DRPs ranging from 0.8 to 4.2 per patient [11, 12, 14].

In the MTMS program study by *Doucette WR et al.* involving ambulatory Iowa Medicaid recipients, the incidence of DRPs was as high as 5.9 per patient [16]; This high prevalence can be attributed to the higher number of medications used by each patient (mean (SD) of 9.3 (4.6) medications) and the high prevalence of comorbidities among patients (mean (SD) of 6.1 (3.1) medical conditions). However, comparing results is inconclusive due to inconsistencies among studies regarding the use of a comprehensive universal DRP classification system.

Similar to other studies, the most common drug classes associated with DRPs were cardiovascular, anti-diabetic agents, antibiotics, analgesics, and CNS medications [18, 19].

In this study, the incidence of "education or information"-

Table 1: Types and number of drug-related problems by category.

Drug-related problems	Frequency (Percent)
Drug selection (D)	76 (14.15%)
Over or under use (O)	29 (5.40%)
Compliance (C)	82 (15.27%)
Undertreated (U)	93 (17.31%)
Monitoring (M)	39 (7.26%)
Education or information (E)	174 (32.40%)
Toxicity (T)	44 (8.19%)
Total drug-related problems	537 (100%)

related problems was greater than in other studies [20-22]. This difference may be due to the undervaluing or underestimation of the importance of patient education and effective counseling services within the Iranian healthcare system, resulting in patients' inadequate information about their illnesses and medications. The lack of an effective mechanism for care coordination and interprofessional collaboration in our healthcare system may also contribute to confusion about therapeutic regimens among patients and providers, leading to a higher incidence of DRPs. As previously shown in other studies, this ultimately reduces patient compliance and optimal therapeutic outcomes [23]. Furthermore, our study identified a higher prevalence of antibiotic-related problems, which may be attributed to the arbitrary use of antibiotics by patients and irrational prescribing by clinicians [24]. This finding underscores the need for more stringent antibiotic stewardship programs to promote rational antibiotic use and reduce the risk of

Table 2: Types and numbers of drug-related problems by sub-category.

Category	Sub-category	Code	Frequency (Percent)
Drug selection	Duplication	D1	3 (0.55%)
	Drug interaction	D2	10 (1.86%)
	Wrong drug	D3	10 (1.86%)
	Incorrect strength	D4	1 (0.18%)
	Inappropriate dosage form	D5	2 (0.37%)
	Precaution apparent and contraindication	D6	11 (2.04%)
	No indication apparent	D7	2 (0.37%)
	Using expired drugs	D8	10 (1.86%)
	Lack of efficacy or more effective drugs	D9	27 (5.02%)
Over or under use	Too high dose prescription	O1	9 (1.67%)
	Too low dose prescription	O2	6 (1.11%)
	Unclear dose instruction	O3	11 (2.04%)
	Dose adjustment	O4	3 (0.55%)
Compliance	Under used by consumer	C1	5 (0.93%)
	Over used by consumer	C2	1 (0.18%)
	Erratic use of medication	C3	8 (1.48%)
	Drug misuse	C4	1 (0.18%)
	Non-compliance due to safety or efficacy concern	C6	41 (7.63%)
	Failure to learn drug administration	C7	15 (2.79%)
	Forgetting to take medication	C8	1 (0.18%)
	Drug shortage	C9	8 (1.48%)
	The high cost of medicine ratio patient outcome	C10	2 (0.37%)
Undertreated	Undertreated condition	U1	32 (5.95%)
	Untreated condition	U2	42 (7.82%)
	Preventive therapy required	U3	19 (3.53%)
Monitoring	Laboratory monitoring	M1	27 (5.02%)
	Non-laboratory monitoring	M2	12 (2.23%)
Education or information	Consumer requests for drug information	E1	73 (13.59%)
	Consumer requests for disease management advice	E2	45 (8.38%)
	Lack of patient knowledge about disease and medication	E3	49 (9.12%)
	Medical devices training and education problem	E4	7 (1.30%)
Toxicity	Toxicity due to dose	T1	8 (1.49%)
	Toxicity due to interaction	T2	4 (0.74%)
	Adverse Drug Reaction (ADR)	T3	16 (2.97%)
	Side effect of start or sudden increase of the dose	T4	2 (0.37%)
	Inadequate drug safety for patient	T5	4 (0.74%)
	Risk of toxicity due to long term use of medication	T6	6 (1.11%)
	Wrong time medication administration	T7	4 (0.74%)

Table 3: Clinical pharmacist interventions by category.

Drug-related problems	Frequency (Percent)
Change of therapy	114 (21.71%)
Referral required	69 (13.14%)
Provision of information	302 (57.52%)
Monitoring	40 (7.61%)
Total interventions	525 (100%)

Table 5: Drug class associated with DRPs.

Drug Class	ATC code	Frequency (Percent)
Cardiovascular	C	49 (35.77%)
Anti-diabetic agents	A10	27 (19.70%)
Antibiotics	J01	11 (8.03%)
Analgesics	M01	16 (11.68%)
CNS	N	8 (5.84%)
Others*	-	26 (18.98%)
Total		137 (100%)

*Such as hormone replacement medications and supplements

antibiotic resistance. In our study, most diabetic patients experienced difficulty with insulin injection techniques, leading to poor blood glucose control. This finding agrees with previous studies that identified difficulty with insulin use as a common DRP in diabetic patients [25].

Providing information and changing the therapeutic regimen were the most common interventions rendered by clinical pharmacists in this study. After detecting DRPs, a letter was written to the practitioner, describing the problem and recommending necessary interventions. The high prevalence of educational interventions demonstrated that most patients did not receive adequate instruction on drug use and its possible side effects.

Implementing electronic health records (EHRs) and clinical decision support systems (CDSS) in healthcare can help to identify potential DRPs, facilitate communication among healthcare professionals, and provide evidence-based recommendations for patient care [26].

Clinical pharmacists played a crucial role in detecting and managing DRPs in this study, with the most common interventions being providing information and changes to

Table 4: Clinical pharmacist interventions by sub-category.

Category	Sub-category	Code	Frequency (Percent)
Change of therapy	Increase in drug dose	R1	34 (6.48%)
	Decrease in drug dose	R2	19 (3.62%)
	Change in prescribed drug	R3	14 (2.67%)
	Change in drug formulation	R4	2 (0.38%)
	Change in drug brand	R5	4 (0.76%)
	Change in dose frequency/schedule	R6	15 (2.86%)
	No drug intake until further notice	R7	18 (3.43%)
	Change in duration of treatment	R8	2 (0.38%)
	Over the counter drug administration	R0	6 (1.14%)
	Referral required	Refer to prescriber	R9
Provision of information	Implementation of new drug regimen	R12	76 (14.48%)
	Efficacy of monitor learning	R13	28 (5.33%)
	Complications of monitor learning	R14	64 (12.19%)
	Drug administration learning	R15	33 (6.29%)
	Enhancing patient adherence	R16	48 (9.14%)
	Enhancing patient knowledge	R17	53 (10.10%)
Monitoring	Laboratory monitoring	R18	31 (5.90%)
	Non-laboratory test monitoring	R19	9 (1.71%)

the therapeutic regimen. Integrating clinical pharmacists into ambulatory care settings can improve patient outcomes by effectively detecting and managing DRPs, as they possess the unique expertise required for collaborative medication management.

Our study has some limitations that should be acknowledged:

- 1) The sample size of 150 patients may need to be larger to generalize the results to a broader population.
- 2) The study did not include a control group, making it challenging to determine the impact of the interventions.
- 3) The study did not assess the long-term outcomes of the interventions implemented by clinical pharmacists, which could have strengthened the study's findings.

Future studies with larger and more diverse patient populations could provide a more comprehensive understanding of DRPs and the role of clinical pharmacists in addressing them. Based on our findings, future research could explore the impact of specific pharmacist interventions on patient outcomes, such as medication adherence, hospitalizations, and quality of life. Additionally, investigating the effectiveness of different educational strategies in reducing DRPs, such as personalized counseling, group education sessions, or

digital tools, could help identify best practices for patient education and medication management.

As practical recommendations healthcare providers can take several steps to address DRPs and improve patient care. These include:

- 1) Enhancing patient education by providing clear and concise information about medications, their side effects, and proper administration techniques.
- 2) Fostering interprofessional collaboration among healthcare providers, such as physicians, nurses, and pharmacists, to ensure a coordinated approach to medication management.
- 3) Implementing antibiotic stewardship programs to promote rational antibiotic use and reduce the risk of antibiotic resistance.

4. Conclusion

In conclusion, our study highlights the need for a more patient-centered approach in healthcare services, focusing on patient education, medication management, and interprofessional collaboration. Implementing pharmaceutical care practice models, such as Pharmacotherapy Clinics, can help address the high prevalence of DRPs and improve patient outcomes by leveraging the expertise of clinical pharmacists in a collaborative, patient-centered manner.

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