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Analysis of the Relationship Between MedRiPh (Medication Risk in Pharmacotherapy) Scores and the Incidence of Drug-Related Problems (DRPs) in Geriatric Patients with Comorbidities at Community Health Center X, Surabaya

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ABSTRACT

Drug-Related Problems (DRPs) remain a significant issue in geriatric pharmacotherapy, particularly among older adults with multiple chronic conditions and complex medication regimens. The MedRiPh (Medication Risk in Pharmacotherapy) scoring model has been introduced to identify patients at higher risk of medication related harm, yet its usefulness in Indonesian primary care has not been well evaluated. This cross-sectional study was conducted from October to December 2024 involving 100 geriatric patients aged ≥60 years selected using purposive sampling. MedRiPh scores were calculated using validated criteria, and DRPs were identified based on the Pharmaceutical Care Network Europe (PCNE) version 9.1 system. Statistical analysis included the Shapiro Wilk test, Spearman correlation, and linear regression. A total of 412 DRPs were recorded, with drug interactions, dosing errors, and duplicate therapies being the most common. A strong correlation was found between MedRiPh scores and DRPs ($r = 0.82$, $p < 0.001$). These results indicate that MedRiPh may be useful for improving medication safety in geriatric primary care.

Keywords: *Medriph Score, Drug-Related Problems, Geriatrics, Polypharmacy, Predictive Tool, Primary Healthcare, Medication Safety*

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INTRODUCTION

Population aging represents one of the most profound demographic transformations of the 21st century and poses major challenges for healthcare systems worldwide. The World Health Organization (WHO) projects that by 2050, approximately one in six individuals globally will be aged 60 years or older, with older adults becoming the fastest-growing population segment. This shift is accompanied by a rising burden of chronic diseases, functional impairment, frailty, and reduced physiological reserve, all of which increase healthcare complexity and service utilization. As a result, pharmacotherapy plays a central role in disease management, symptom control, and maintenance of quality of life among older adults. However, the increasing dependence on medications also exposes this population to a heightened risk of medication-related harm due to age-related physiological changes and complex treatment regimens.

Drug-related problems (DRPs) have emerged as a major threat to patient safety and therapeutic effectiveness in geriatric care. A DRP is defined as any event or circumstance involving drug therapy that actually or potentially interferes with desired health outcomes. DRPs encompass a wide range of issues, including inappropriate prescribing, adverse drug reactions (ADRs), medication non-adherence, under-treatment, overuse, therapeutic duplication, and clinically significant drug–drug or drug–disease interactions (Hanlon et al., 1997). Epidemiological studies indicate that between 30% and 60% of older adults experience at least one DRP during treatment, and up to half of these events are considered preventable through improved prescribing practices and systematic medication review (Hailu et al., 2019; Ruiz-Ramos et al., 2024).

Beyond their clinical consequences, DRPs impose a substantial economic burden on healthcare systems. Preventable medication-related morbidity and mortality have been estimated to cost billions of dollars annually due to increased emergency department visits, hospital admissions, prolonged length of stay, and long-term disability (Watanabe et al., 2018). Older adults are particularly vulnerable to these outcomes, as DRPs frequently lead to loss of functional independence, institutionalization, and increased mortality risk (Parameswaran Nair et al., 2016; Ratigan et al., 2021).

A major determinant of DRPs in older populations is multimorbidity, defined as the coexistence of two or more chronic conditions. Multimorbidity is highly prevalent among older adults and often necessitates complex therapeutic regimens involving multiple medications. This situation frequently results in polypharmacy, commonly defined as the concurrent use of five or more medications. A robust body of evidence demonstrates that polypharmacy is strongly associated with increased risk of medication errors, reduced adherence, pharmacokinetic and pharmacodynamic interactions, and preventable adverse drug events (Lavan & Gallagher, 2016; Schneider et al., 2021). Severe polypharmacy (≥10–15 medications) further exacerbates these risks and has been linked to cognitive impairment, falls, prescribing cascades, therapeutic duplication, and increased monitoring burden, particularly in frail older adults (Van Dam et al., 2022).

Age-related physiological changes further compound medication-related risks in older adults. Declining renal and hepatic function, altered body composition, reduced protein binding,

and changes in receptor sensitivity can significantly alter drug absorption, distribution, metabolism, and excretion. These changes increase susceptibility to drug accumulation, toxicity, and adverse drug reactions, even when medications are prescribed at standard doses (Lavan & Gallagher, 2016). Consequently, traditional prescribing approaches based solely on disease-specific guidelines may be insufficient for ensuring medication safety in older patients with multimorbidity and polypharmacy.

To address these challenges, various structured tools and models have been developed to identify patients at high risk for DRPs and adverse medication-related outcomes. Traditional explicit criteria, such as the Beers Criteria and STOPP/START tools, focus primarily on identifying potentially inappropriate medications. While valuable, these tools do not quantify cumulative medication risk or account for the complex interplay between multiple drugs, comorbidities, and patient-specific factors. More recently, medication risk scoring models have been introduced to overcome these limitations by providing a comprehensive and quantitative assessment of medication-related risk.

Examples of such models include the MedWise Risk Score, the DICER score, and the Medication Risk in Pharmacotherapy (MedRiPh) model. These tools integrate multiple risk domains, including medication count, comorbidity burden, drug–drug interaction intensity, use of high-risk medication classes (e.g., anticoagulants, opioids, anticholinergics), age, and organ function. Strong evidence supports the predictive validity of these models. Bankes et al. (2020) demonstrated that higher medication risk scores were significantly associated with increased incidence of adverse drug events among older adults enrolled in integrated care programs. Similarly, Michaud et al. (2021) and Ratigan et al. (2021) reported that incremental increases in medication risk scores were associated with higher rates of emergency department visits, hospitalization, and mortality. A systematic review by Jung-Poppe et al. (2022) further confirmed that validated medication risk scoring tools consistently outperform clinician judgment alone in predicting preventable medication harm.

Despite growing international evidence, the implementation of medication risk scoring tools remains uneven, particularly in low- and middle-income countries. In high-income settings, these tools are increasingly integrated into electronic health records and pharmacist-led medication review programs. In contrast, structured pharmacotherapy risk assessment is not yet routinely implemented in many developing countries, including Indonesia. Indonesia is experiencing rapid growth of its geriatric population, and community health centers (Puskesmas) serve as the primary setting for long-term management of chronic diseases such as hypertension, diabetes mellitus, dyslipidemia, cardiovascular disease, and chronic respiratory conditions. Geriatric patients attending Puskesmas commonly receive long-term multidrug therapy; however, systematic medication risk stratification is rarely performed, and pharmacist involvement in structured medication review varies substantially across regions.

Local studies in Indonesia have reported increasing rates of polypharmacy and medication therapy problems among older adults in primary care. Nevertheless, most existing research has

focused on describing DRP prevalence rather than evaluating predictive tools capable of identifying patients at highest risk. Evidence-based medication risk stratification models such as MedRiPh have not been widely tested in Indonesian primary care settings, leaving uncertainty regarding their feasibility, applicability, and predictive performance in this context. To date, no published study has specifically examined the association between MedRiPh score and DRP incidence among geriatric patients with multimorbidity in community healthcare environments.

Given these gaps, evaluating the relationship between MedRiPh score and DRP incidence in primary care is essential to support early detection and prevention of medication-related harm in Indonesia's aging population. Establishing whether MedRiPh scores correlate with DRP occurrence may inform clinical prioritization, optimize pharmacist-led intervention strategies, improve allocation of healthcare resources, and support evidence-based policy development related to geriatric medication safety.

Therefore, this study aimed to analyze the association between MedRiPh (Medication Risk in Pharmacotherapy) scores and the incidence of drug-related problems among geriatric patients with comorbidities receiving care at Community Health Center X in Surabaya. The findings of this study are expected to provide empirical support for integrating structured medication risk assessment into routine primary healthcare practice and strengthening the role of clinical pharmacy services in improving medication safety for older adults.

METHODS

This study employed an analytical observational design with a cross-sectional approach to examine the relationship between Medication Risk in Pharmacotherapy (MedRiPh) scores and the incidence of Drug-Related Problems (DRPs) among geriatric patients receiving pharmacotherapy in a primary healthcare setting. A cross-sectional design was selected because it allows for simultaneous assessment of medication risk and DRP occurrence in real-world clinical practice, which is appropriate for evaluating associations and screening tool performance in community-based populations (Parameswaran Nair et al., 2016; Jung-Poppe et al., 2022).

The study was conducted at Community Health Center X in Surabaya, Indonesia, between October and December 2024. This setting was chosen due to its role as a frontline provider of long-term chronic disease management for older adults, where polypharmacy and multimorbidity are highly prevalent.

The study population consisted of geriatric patients aged 60 years and older who were actively receiving pharmacotherapy. Inclusion criteria were: (1) age ≥60 years, (2) receiving at least two prescribed medications to reflect exposure to polypharmacy risk, (3) availability of complete medical and prescription records, and (4) willingness to participate, demonstrated by written informed consent. Patients were excluded if they were in terminal or palliative conditions, had severe cognitive impairment that could compromise the validity of interview data, or had incomplete medical documentation.

A purposive sampling technique was applied to ensure inclusion of patients with sufficient medication complexity for meaningful MedRiPh and DRP assessment. The minimum sample size was calculated using a correlation-based sample size formula for clinical research, assuming a moderate effect size, a 95% confidence level, and 80% statistical power. This calculation yielded a minimum requirement of 100 participants, which was deemed adequate for correlation and regression analyses examining medication risk scores and DRP counts (Lavan & Gallagher, 2016).

Data were collected through a combination of electronic medical record review, structured prescription assessment, and semi-structured patient interviews. Demographic variables included age, sex, and educational level. Clinical variables comprised diagnosed comorbidities, number of chronic conditions, and relevant laboratory indicators when available. Medication-related data included the number of prescribed medications, therapeutic classes, dosing regimens, duration of use, and presence of high-risk medications such as anticoagulants, antidiabetics, cardiovascular agents, opioids, and anticholinergic drugs.

Patient interviews were conducted to clarify medication-taking behavior, adherence, and potential symptoms suggestive of adverse drug reactions, complementing information obtained from medical records.

Medication-related risk was quantified using the MedRiPh (Medication Risk in Pharmacotherapy) scoring model. MedRiPh was selected over other tools such as Beers Criteria, STOPP/START, and proprietary medication risk scores (e.g., MedWise Risk Score) for several reasons. Unlike explicit criteria-based tools that primarily identify potentially inappropriate medications, MedRiPh provides a composite, quantitative assessment of cumulative medication risk by integrating multiple clinically relevant domains, including medication count, comorbidity burden, disease complexity, and exposure to high-risk pharmacological classes (Bankes et al., 2020; Jung-Poppe et al., 2022).

Furthermore, while advanced tools such as the MedWise Risk Score and DICER score have demonstrated strong predictive validity, their routine use often requires integration with electronic health record systems or proprietary algorithms, which may limit feasibility in primary care settings in low- and middle-income countries (Michaud et al., 2021; Ruiz-Ramos et al., 2024). MedRiPh offers a more pragmatic and transparent framework that can be applied manually by pharmacists and clinicians, making it particularly suitable for Indonesian community health centers where informatics infrastructure and clinical pharmacy resources vary widely.

MedRiPh scores were calculated following the most recent validated scoring guidelines, incorporating the number of medications, presence of multimorbidity, disease severity indicators, and other established medication-related risk factors. Higher scores reflected greater cumulative medication risk.

DRPs were identified and classified using the Pharmaceutical Care Network Europe (PCNE) classification system version 9.1. This standardized framework was selected due to its comprehensive coverage and widespread international use in geriatric pharmacotherapy research. DRPs were categorized into domains including inappropriate drug selection, dosing errors,

therapeutic duplication, untreated indications, clinically significant drug–drug interactions, adverse drug reactions, and medication non-adherence (Hailu et al., 2019; Ruiz-Ramos et al., 2024).

To ensure consistency and reliability of DRP identification, data extraction and classification were performed independently by two trained reviewers. Inter-rater reliability was assessed using Cohen's Kappa statistic, with a value of ≥0.80 considered indicative of excellent agreement.

Statistical analysis was conducted using the latest version of SPSS software. Descriptive statistics were used to summarize demographic, clinical, medication-related, MedRiPh score, and DRP data. Continuous variables were assessed for normality using the Shapiro–Wilk test. Depending on data distribution, the association between MedRiPh scores and the number of DRPs was analyzed using Pearson's correlation test (for normally distributed data) or Spearman's rank correlation test (for non-normally distributed data).

To further evaluate the predictive value of MedRiPh scores, a simple linear regression analysis was performed, with DRP count as the dependent variable and MedRiPh score as the independent variable. Results were reported as regression coefficients, confidence intervals, and p-values. Statistical significance was defined as $p < 0.05$.

Ethical approval for this study was obtained from the Institutional Health Research Ethics Committee prior to data collection. All procedures were conducted in accordance with the Declaration of Helsinki. Participants were informed about the study objectives, procedures, potential risks, and benefits, and confidentiality was strictly maintained. Participation was voluntary, and patients retained the right to withdraw from the study at any time without affecting their access to healthcare services.

RESULTS

A total of 100 geriatric patients met the eligibility criteria and were included in the final analysis after exclusion of incomplete or inconsistent medical records. The study population consisted of 56 females (56.0%) and 44 males (44.0%), with a mean age of 71.4 ± 6.2 years (range: 60–89 years). Hypertension was the most prevalent chronic condition (68.0%), followed by type 2 diabetes mellitus (45.0%), cardiovascular diseases including coronary heart disease (22.0%), chronic kidney disease (18.0%), osteoarthritis (16.0%), and dyslipidemia (12.0%).

Medication profile analysis showed a high prevalence of polypharmacy. Participants were prescribed between 3 and 17 medications, with a mean of 6.9 ± 2.8 medications per patient, confirming substantial exposure to medication-related risk within the study cohort.

1. Distribution of MedRiPh Scores and DRP Incidence

Medication risk stratification using the MedRiPh scoring system demonstrated a clear gradient in drug-related problem (DRP) occurrence across predefined risk categories. DRPs were counted per event, and each patient could contribute more than one DRP.

Table 1. Distribution of MedRiPh Score Categories and Mean DRP Rates (n=100)

MedRiPh Risk Category	Score Range	n (%)	Mean DRPs ± SD	95% CI
Low Risk	5–8	18	1.3 ± 0.5	0.98–1.62
Moderate Risk	10–14	43	3.0 ± 1.1	2.71–3.29
High Risk	≥15	39	5.2 ± 1.8	4.79–5.61

Patients classified as high risk (≥15 points) accounted for 39.0% of the cohort and exhibited the highest mean DRP count per patient (5.2 ± 1.8). In contrast, the low-risk group demonstrated a substantially lower DRP burden (1.3 ± 0.5). This stepwise increase indicated a strong dose–response relationship between cumulative medication risk and DRP occurrence.

2. Statistical Correlation Analysis

ormality testing using the Shapiro–Wilk test indicated that MedRiPh scores and DRP counts were not normally distributed ($p < 0.001$). Therefore, Spearman's rank correlation was applied. A strong positive correlation was observed between MedRiPh scores and DRP counts (Spearman's $r = 0.82$, $p < 0.001$), indicating that higher medication risk scores were significantly associated with increased DRP incidence.

To further evaluate the predictive strength of MedRiPh, a simple linear regression analysis was conducted. The model demonstrated a statistically significant association ($p < 0.001$) and explained a substantial proportion of variance in DRP occurrence ($R^2 = 0.67$). The regression equation was:

$$DRP\ Count\ =\ 0.41\ \times\ (MedRiPh\ Score)\ -\ 1.02$$

This finding indicated that for each one-point increase in MedRiPh score, the number of DRPs increased by approximately 0.41 events per patient, underscoring the tool's strong predictive capacity.

3. Visualization of the MedRiPh–DRP Relationship

Figure 1 illustrates the relationship between MedRiPh scores and DRP counts using a scatter plot with a fitted regression line. The upward distribution pattern demonstrated a consistent increase in DRP frequency with rising MedRiPh scores. Clustering along the regression line supported the robustness of the model and visually reinforced the statistical findings.

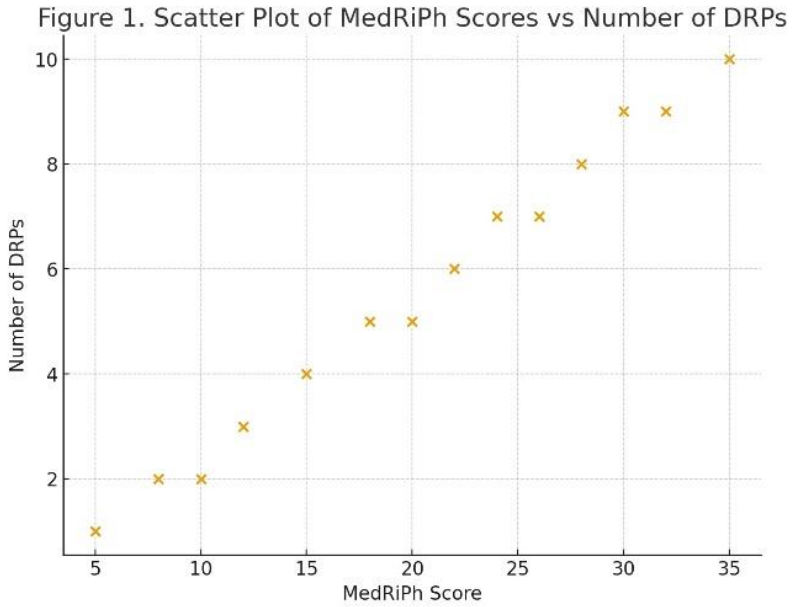

Figure 1. Scatter Plot Illustrating the Relationship Between MedRiPh Scores and DRP Counts

The visual trend aligned with the regression model (R^2 = 0.67), indicating that MedRiPh scores substantially contributed to explaining DRP variability and supporting their use as a screening instrument in primary care settings.

4. Classification and Frequency of Drug-Related Problems

A total of 412 DRPs were identified and classified according to the Pharmaceutical Care Network Europe (PCNE) classification system version 9.1. DRPs were categorized strictly according to PCNE definitions.

Table 2. Frequency Distribution of Drug-Related Problems by PCNE v9.1 Category (n = 412)

PCNE DRP Category	Frequency (n)	Percentage (%)
Potential drug–drug interactions	132	32.0%
Inappropriate dose (over/underdosing)	99	24.0%
Duplicate therapy	70	17.0%
Untreated indication	58	14.0%
Non-adherence	33	8.0%
Inadequate monitoring or follow-up	20	5.0%

Treatment safety problems, primarily driven by potential drug–drug interactions, constituted the most frequent DRP category (32.0%), reflecting high medication complexity and limited routine medication review. Dose selection and treatment effectiveness issues together accounted for 41.0% of all DRPs, indicating substantial opportunities for pharmacist-led intervention.

DISCUSSION

The findings of this study demonstrate a strong and statistically significant association between MedRiPh scores and the number of drug-related problems (DRPs) among geriatric patients receiving pharmacotherapy in primary healthcare settings. The high Spearman correlation coefficient ($r = 0.82$; $p < 0.001$) indicates that increasing medication risk, as measured by MedRiPh, closely reflects the actual burden of medication-related problems experienced by older adults. This relationship is clinically meaningful, as it suggests that MedRiPh is capable of capturing cumulative pharmacotherapeutic risks rather than merely describing medication complexity. The progressive increase in DRP counts across low-, moderate-, and high-risk MedRiPh categories further supports a dose–response relationship, in which higher risk scores correspond to a substantially greater likelihood of encountering drug-related problems during routine care.

The observed relationship can be explained by the interaction between polypharmacy, multimorbidity, and age-related physiological changes that affect drug handling in older adults. Declines in renal and hepatic function, changes in body composition, and altered pharmacodynamic responses increase vulnerability to drug–drug interactions, inappropriate dosing, and adverse drug reactions. When these physiological changes coexist with complex medication regimens involving multiple therapeutic classes or drugs with narrow therapeutic indices, the probability of DRPs increases substantially. MedRiPh incorporates several of these risk determinants, including the number of medications, chronic disease burden, and long-term therapy exposure, which explains its strong correlation with DRP occurrence in this study.

These findings are consistent with previous research showing that higher medication risk scores are associated with increased adverse drug events and medication-related complications in older populations. Studies conducted by Bankes et al. and Ratigan et al. reported that incremental increases in medication risk scores were linked to higher rates of adverse outcomes, including emergency department visits and hospitalizations. However, the present study contributes novel evidence by demonstrating the applicability and predictive strength of MedRiPh in a primary healthcare setting, particularly within a resource-limited context. Unlike many earlier studies that relied on proprietary or electronically integrated tools, this research highlights that a structured, non-proprietary risk scoring system such as MedRiPh can provide substantial predictive value when applied systematically in community-based care.

Regression analysis further supports the clinical relevance of MedRiPh, showing that the score explained approximately 67% of the variance in DRP occurrence. This finding indicates that MedRiPh is a strong predictor of medication-related problems and may serve as an effective initial screening tool for identifying high-risk geriatric patients. Clinically, this suggests that increases in MedRiPh scores are associated with a meaningful rise in DRP burden, reinforcing the cumulative nature of medication risk. Nevertheless, the remaining unexplained variance indicates that DRPs are influenced by additional factors not captured in the MedRiPh framework, such as health literacy, socioeconomic status, caregiver support, medication affordability, continuity of care, and the quality of communication between healthcare providers and patients.

The pattern of DRPs identified using the PCNE version 9.1 classification system revealed that drug–drug interactions were the most frequent category, followed by dosing errors and duplicate therapies. This distribution reflects the high prevalence of polypharmacy and the absence of systematic medication review processes in many primary care settings. The presence of untreated indications and medication non-adherence further suggests gaps in therapeutic monitoring and patient education. These findings indicate that DRPs are not solely pharmacological issues but also reflect organizational and communication-related challenges within primary healthcare services.

From a clinical perspective, the results of this study underscore the potential role of MedRiPh as a practical risk stratification tool in primary care. Routine implementation of MedRiPh could enable healthcare providers to prioritize pharmacist-led medication reviews for patients at the highest risk, thereby improving efficiency and patient safety. The findings also support expanding the involvement of clinical pharmacists in primary healthcare teams, as previous studies have shown that pharmacist interventions can reduce DRP prevalence, improve medication adherence, and optimize therapeutic outcomes. In the context of an aging population and increasing chronic disease burden, structured medication risk assessment combined with targeted pharmaceutical care may represent a feasible and scalable strategy to enhance geriatric pharmacotherapy.

Despite its strengths, this study has several limitations. The cross-sectional design limits causal interpretation and does not allow assessment of changes in MedRiPh scores or DRP incidence over time. The use of purposive sampling and a single study site may limit generalizability to other primary healthcare settings. Additionally, several patient-related factors that may influence DRP occurrence, including cognitive function, socioeconomic conditions, and family support, were not quantitatively assessed and may have contributed to residual confounding. Future studies employing longitudinal and multicenter designs are needed to validate these findings and to explore the integration of patient-centered variables into medication risk assessment models.

CONCLUSIONS

This study confirms that MedRiPh scores are strongly associated with the occurrence of drug-related problems (DRPs) among geriatric patients in primary healthcare settings. Higher MedRiPh scores were consistently linked to a greater burden of DRPs, indicating that medication complexity and multimorbidity substantially increase the risk of pharmacotherapy-related harm in older adults. The regression analysis further demonstrated that MedRiPh possesses substantial predictive capacity, explaining a large proportion of the variability in DRP occurrence, thereby supporting its utility as a practical medication risk stratification tool.

The predominance of drug–drug interactions, inappropriate dosing, and duplicate therapies highlights persistent gaps in medication review, prescribing oversight, and therapeutic monitoring within primary care. These findings emphasize the need for systematic approaches to medication safety and reinforce the value of integrating MedRiPh into routine clinical workflows. When combined with pharmacist-led medication review and interdisciplinary collaboration, MedRiPh

may facilitate earlier identification of high-risk patients, optimize pharmacotherapy, and reduce preventable medication-related complications.

Several limitations should be acknowledged. The cross-sectional design precludes causal inference, and the single-setting, purposive sampling approach may limit generalizability. Additionally, patient-related factors such as health literacy, socioeconomic conditions, and caregiver support were not fully explored and may have influenced DRP occurrence.

Future research should employ longitudinal and interventional designs to evaluate the effectiveness of MedRiPh-guided clinical interventions on patient outcomes, healthcare utilization, and medication safety. Expanding validation across diverse primary care settings and incorporating patient-centered variables may further enhance the applicability and impact of MedRiPh in geriatric pharmacotherapy management.

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