

Geriatric medication safety: Drug interaction medication adherence and adverse drug reaction awareness

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Abstract

Background: Medication safety is a critical concern in the geriatric population due to age-related physiological changes, multiple comorbidities, and polypharmacy. Inappropriate medication use, poor medication adherence, drug interactions, and lack of awareness regarding adverse drug reactions (ADRs) can significantly increase the risk of medication-related problems and negatively impact health outcomes among elderly patients.

Aim: The study aimed to evaluate and enhance geriatric medication safety by examining drug interactions, medication adherence, and awareness of adverse drug reactions among the geriatric population.

Methods: A cross-sectional observational study was conducted in a selected FHC Villadom, Thrissur over a period of five months from September 2025 to January 2026. The study included geriatric participants above 65 years and data were collected using a structured and validated questionnaire based on predefined inclusion and exclusion criteria.

Results: Among the study population, (39%) were males and (61%) were females, with the majority of participants (58.7%) belonging to the 65–70 years age group. Polypharmacy was commonly observed, with (69.6%) of participants. The majority of participants experienced major drug interactions (40.9%), followed by moderate (25.7%) and minor (0.5%) interactions, while (32.8%) showed no evidence of drug interactions. Pharmacodynamic interactions were more prevalent (53.0%) than pharmacokinetic interactions (14.1%). Assessment of medication adherence revealed that (72.5%) of participants had low adherence, while (27.5%) showed medium adherence. Evaluation of ADR knowledge indicated that (67.4%) of participants had poor knowledge during the pre-test, following the distribution of educational leaflets and patient counselling, and marked improvement in ADR knowledge was observed, with only (10.1%) of participants continuing to have poor ADR knowledge in the post-study assessment.

Conclusion: The study highlights that the geriatric population is highly vulnerable to medication related problems due to polypharmacy, low medication adherence, and inadequate baseline awareness of adverse drug reactions. The findings demonstrate that educational interventions and regular follow-up play a crucial role in improving ADR awareness and promoting safer medication practices. Incorporation of pharmaceutical care services and patient-centered education into routine geriatric healthcare is essential to enhance medication safety, reduce drug-related problems, and improve overall health outcomes among elderly patients.

Keywords: Geriatrics; Polypharmacy; Medication Adherence

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1. Introduction

Geriatrics is the branch of medicine that deals with the conditions of the elderly population or aging people. The study of physical and psychological changes which are incident to old age is referred as gerontology. People above 60 years are included in elderly and as we all know that, as the age progresses one may pass through several stages of Aging which is inevitable and all of us have to experience it as we grow old (1)

Aging is a complex, intricate process that affects individuals, families, communities and societies as a whole. Studies in India highlights several key factors such as declining fertility rates, increasing life expectancy and demographic transition contributing to India's aging population. India's population is indeed ageing rapidly but India faces significant challenges in adapting to its ageing population (2).

1.1. Classification of Elderly Population

- Based on the functional and cognitive status
- Group 1 elderly (65 – 75 years)
- Group 2 elderly (76 – 85 years)
- Group 3 elderly (86 – 99 years)
- Centenarian (100+ years)
- Super-centenarian (110+ years)

1.2. Demography of Elderly

India is currently facing a demographic transition with an ageing population. This demographic shift is characterized by a growing elderly population, resulting from declining mortality and fertility rates, along with rising life expectancy. In response to significant demographic, social, and economic changes, India's growing elderly population increasingly requires access to quality medical and social care. However, existing literature highlights persistent barriers such as limited public awareness, unsupportive societal attitudes, and the lack of formal recognition of geriatrics as a distinct medical discipline which contribute to inadequate and often inaccessible care for older adults (3)

1.3. Geriatric Medicine

Geriatric Medicine (GM), the branch of healthcare dedicated to the wellbeing of older adults, shows uneven development across the globe, with several Balkan nations yet to formally recognize it as a distinct medical specialty. As a result, core concepts vital for managing elderly care are frequently unfamiliar to practitioners. Studies have identified educational gaps in GM as a major obstacle to delivering personalized care for frail older individuals within community settings. Encouragingly, healthcare professionals particularly physicians and nurses have shown enthusiasm for acquiring practical geriatric competencies. Still, even in regions where GM is well-established, there remains limited clarity among general practitioners and specialists regarding its scope and the specific role of geriatricians (4)

1.4. Medication Adherence in Elderly

Medication adherence refers to the degree to which an individual's prescription consumption aligns with the prescribed regimen from a healthcare professional. Due to the higher prevalence of multiple commodities among the elderly, this population is more susceptible to poly pharmacy, which in turn increases the likelihood of medication non-adherence compared to younger individuals. Such non-adherence can lead to sub-optimal therapeutic outcomes, a greater frequency of hospitalizations and medical consultations owing to worsening health status, elevated healthcare costs, and the potential for over treatment (5).

The World Health Organization (WHO) defines medication adherence as the degree to which an individual's behavior such as taking medication, adhering to dietary guidelines, and implementing lifestyle modifications aligns with the recommendations mutually established with a healthcare provider. This definition underscores the critical role of effective communication and active collaboration between patients and healthcare professionals. Based on this framework, non-adherence refers to the failure, whether partial or complete, to follow the agreed-upon treatment regimen. Adherence to medication, which involves the correct use of the appropriate drug at the prescribed dosage and intervals, is a fundamental determinant of therapeutic effectiveness and is particularly vital in the management of health conditions among the elderly population (6)

1.4.1. Why is Adherence to Medication is important

Medication adherence has consistently posed a challenge across patient populations. Older adults, in particular, are more susceptible to multiple chronic conditions, which often necessitate the use of multiple medications (polypharmacy). As a result, they face an elevated risk of medication non-adherence in comparison to younger individuals. This non-adherence can lead to reduced therapeutic effectiveness, increased frequency of hospital admissions and medical consultations due to the progression of disease, higher healthcare costs, and, in some instances, over-treatment (7).

1.4.2. Medication non-adherence

Medication non-adherence is a multifaceted and evolving behavioral phenomenon influenced by factors operating at intrapersonal, interpersonal, healthcare service, and systemic levels. Commonly reported reasons for non-adherence include forgetfulness often triggered by disruptions or changes in daily routines, reluctance to take medications due to concerns about adverse effects, insufficient medication supply, physical challenges or inconvenience associated with medication use, time constraints, social stigma, perceived lack of necessity or effectiveness of the medication, and the absence of symptoms. It should be noted, however, that this list is not comprehensive; many studies have relied on structured questionnaires presenting predefined options to patients, which may not fully capture the entire spectrum of factors contributing to nonadherence (8)

1.5. Polypharmacy

Polypharmacy refers to the concurrent use of multiple or excessive medications by a patient. The World Health Organization (WHO) broadly defines it as “the administration of many drugs at the same time or the administration of an excessive number of drugs. Polypharmacy is more prevalent among the geriatric population due to the presence of multiple comorbidities such as diabetes, hypertension, coronary artery disease, and cancer, along with various complications including incontinence, instability, cognitive impairment, and immobility (9)

1.5.1. Strategies to Prevent Polypharmacy

- **Enhancing Patient Knowledge:** Patient education and empowerment play a pivotal role in mitigating the risks associated with polypharmacy. It is essential that individuals are informed about the potential adverse effects of multiple medication use and the significance of adhering to prescribed treatment regimens,
- **Applying Innovative Technologies:** Technological innovations are increasingly instrumental in addressing the challenges of polypharmacy. Electronic Health Records (EHRs) and Clinical Decision Support Systems (CDSS) provide healthcare professionals with critical tools for identifying potentially inappropriate medications and recommending safer, evidence-based alternatives (10).
- **Enhancing Clinical Awareness:** Collaborative efforts among healthcare professionals are essential for promoting awareness of the clinical importance of medication reviews and the potential risks associated with inappropriate polypharmacy. Inappropriate polypharmacy may manifest as overprescribing, under prescribing, or incorrect medication use. To aid in the identification and correction of such prescribing issues, validated instruments such as the Screening 16 Tool of Older People's Prescriptions (STOPP) and the Screening Tool to Alert Doctors to Right Treatment (START) are commonly employed in geriatric care.
- **Crosspatch Reduction:** Traditional Indian medical systems such as Ayurveda, Unani, Siddha, and herbal medicine continue to be practiced, although to a lesser extent. The crosspatch defined as the concurrent use of alternative systems such as homeopathy, Ayurveda, Unani, and Siddha with allopathic medicine poses significant challenges to safe pharmacological management. It is imperative that patients disclose any history of treatment across multiple healthcare systems to their physicians (11)

1.6. Adverse Drug Reactions

According to world health organization (WHO), an ADR can be defined as any response of a drug which is noxious and unintended, that occurs at doses used in humans for the prophylaxis, diagnosis or therapy of disease; or for the modification of physiologic function purposely excludes therapeutic failures, overdoses, drug abuse, non-compliance, and medication errors (12).

Advancing age is closely linked with a greater burden of chronic conditions including diabetes, hypertension, arthritis, and cardiovascular disorders. These diseases often require sustained pharmacological management. As a result, older adults commonly receive multiple medications, which heightens their susceptibility to adverse drug reactions. Such reactions remain a major contributor to morbidity in the elderly and are associated with longer hospital admissions, higher medical expenditure, and increased mortality. Physiological alterations that accompany aging, including reduced

renal excretion, impaired hepatic metabolism, and diminished homeostatic capacity, further influence drug absorption, distribution, metabolism, and response, making this population particularly vulnerable (13)

1.6.1. ADR in Geriatric Patients

Many studies from around the world show a correlation between increasing age and adverse drug reaction (ADR) rate, at least for some medical conditions. Type A ADRs are more common in the elderly and the unpredictable type B ('bizarre' or idiosyncratic reactions) less common. However, some important and occasionally serious examples of type B toxicity (e.g. hepatotoxicity in association with the anti-biotic flucloxacillin or the antibiotic combination, co-amoxiclav) appear to be commoner in elderly than younger individuals (14).

Drugs associated with type A reactions are generally with low therapeutic index and commonly used among elderly. The lists of medicines most likely to be used in the elderly include antibiotics, anticoagulants, digoxin, diuretics, hypoglycemic agents, antineoplastic agents and non-steroidal anti-inflammatory drugs (NSAIDs) and these are responsible for 60% of ADRs leading to hospital admission and 70% of ADRs occurring in hospital. Type B ADRs are usually uncommon, but rarely may sometimes 20 cause serious toxicities. Therefore, ADRs in elderly are largely contributed by prescribing error e.g., large doses of drugs without taking into account, the effect of age and frailty on drug disposition, especially renal and hepatic clearance. The other contributing factor may be because of not considering the increased pharmacodynamic sensitivity of the elderly to several commonly used drugs, e.g., central nervous system and cardiovascular drugs (15).

1.7. Drug-Drug Interactions in Geriatrics

A drug-drug interaction (DDI) is typically defined as an unintended and clinically significant alteration in a drug's exposure or pharmacological response that arises from the concurrent administration of another drug. The risk of drug-drug interactions rise as the number of prescribed medications increases. These interactions can negatively affect patient health. Adverse outcomes may occur either through enhanced drug toxicity or through a reduction in therapeutic effectiveness, thereby compromising patient safety and treatment outcomes (16). A potential DDI occurs when two medications known to interact are prescribed together, potentially leading to qualitative or quantitative changes in drug activity. Such interactions can impact the diagnostic, preventive, or therapeutic effects of a medication, potentially resulting in reduced efficacy, treatment failure, or drug toxicity. DDIs are commonly classified based on the severity and underlying mechanisms through which the interacting drugs affect each other (17)

2. Methodology

2.1. Study Site

- FHC (Family Health Centre), Villadom, Thrissur, Kerala

2.2. Study Design

- A Cross-sectional observational study design to assess poly-pharmacy, medication adherence, drug interaction and ADR awareness in geriatrics.

2.3. Duration of Study

- 5 months (from September 2025 to January 2026)

2.4. Selection of Participants

- Randomly selected 138 geriatric patients aged 65 or older with the following criteria.

2.5. Study criteria

2.5.1. Inclusion criteria

- Individual aged 65 or older.
- Subjects who are willing to participate in the study.

2.5.2. Exclusion criteria

- Individuals younger than 65 years of age.

- Participants who unable to provide informed consent
- Critically ill or palliative care patients.

2.6. Data Collection

The study was initiated only after obtaining informed consent from all participants. The purpose and procedure of the study were clearly explained to the participants in a local language. A structured data collection form was used to record patient details, including demographic information such as age, sex, social history and allergy. Clinical details such as diagnosis, medication history polypharmacy and drug-drug interactions were documented.³⁵ Data were collected using a self-designed and validated questionnaire, which was developed after an extensive review of relevant literature and consultation with healthcare professionals. The questionnaire was designed to assess medication adherence, knowledge and awareness regarding adverse drug reactions. A baseline assessment of ADR knowledge was carried out at the time of enrolment using the validated questionnaire, based on the assessment patient counselling was provided with the help of leaflets. After a period of 1 month a follow up assessment was conducted using the same questionnaire. All collected data were entered into a data collection sheet and subjected to statistical analysis.

2.7. Sample Size Calculation

- Considering severity of drug interactions as primary outcome 22.7% and assuming 95% confidence interval and 7% margin of error.

$$n = \frac{p(1-p)(z_{1-\frac{\alpha}{2}})^2}{d^2}$$

Where,

P=Proportion value (22.7)
d=Estimated error (7%)
α=Constant value (95%)

- Minimum number of study participants required for the study was 138

2.8. Data Analysis

The statistical analysis was performed by statistical package for social sciences (SPSS) statistics 26.0 version. Chi square test was used to assess the association of polypharmacy, medication adherence and knowledge of ADR among geriatric patients.

2.9. Ethical Consideration

- The study was conducted only after obtaining approval from institutional ethics committee.
- The data would be collected only after getting duly signed patient information consent form after explaining the study procedure through patient information sheet.

3. Result And Discussion

The project entitled “Geriatric medication safety: Drug interactions, Medication adherence and Adverse drug reaction awareness” was surveyed at FHC Villadom, Thrissur and studied for a period of 5-months. A total of 138 study participants who satisfied the inclusion and exclusion criteria were included in our study.

3.1. Participants Demographics and Baseline Information

3.1.1. Gender Wise Distribution of Study Participants

- Among 138 participants, the majority (60.9%) of participants were females and 39.1% were males

3.1.2. Age Wise Distribution of Study Participants

Considering the age group of the study participants, 58.7% were within the age group of 65-70 years, followed by those aged 71-75 years, which accounted for 21%. Only one participant belongs to the age group 91-95 years.

3.1.3. Social History of Study Participants

- Out of 138 participants, 13% had a social history and 87% had no social history

3.1.4. Allergic Conditions of Study Participants.

18.1% of the total participants had allergic conditions, and 81.9% were non- allergic.

3.1.5. Diagnosis of Study Participants

Table 1 Diagnosis of Study Participants

Diagnosis	No of participants (N=138)	Percentage (%)
Diabetes	55	39.9
Hypertension	71	51.4
Dyslipidaemia	36	26.1
Stroke	6	4.3
Cardiac	45	32.6
Psychiatry	11	8.0
Cancer	4	2.9
Liver disease	4	2.9
Epilepsy	5	3.6
GERD	1	0.7
Respiratory	11	8.0
Orthopaedic	8	5.8
Thyroid	8	5.8
Alzheimer's	1	0.7
Tuberculosis	1	0.7
Skin diseases/psoriasis	3	2.2
Infections	3	2.2
Kidney disease	4	2.9
Myasthenia gravis	1	0.7
Ca/vit/iron deficiency	2	1.4
Parkinson	1	0.7
Total	138	100.0

Hypertension was the most common diagnosis among the study participants which is about 51.4% followed by diabetics 39.9% cardiac 32.6% Dyslipidemia 26.1% respectively.

3.1.6. Polypharmacy of Study Participants

Table 2 Polypharmacy of Study Participants

Polypharmacy	No of participants (N=138)	Percentage (%)
Three	12	8.7
Four	30	21.7
Five	33	23.9
Six	27	19.6
Seven	23	16.7
Eight	9	6.5
Nine	4	2.9
Total	138	100.0

Among the study participants, 23.9% take five medicines per day, and 2.9% take a total of nine medicines per day. A previous study by Gupta R *et.al.*, (2018) corroborated these results, showing that out of 64 geriatric patients, polypharmacy (5> medication/day) was found in 34 (53.13%).

3.1.7. Polypharmacy of Study Participants(combined)

Table 3 Polypharmacy of Study Participants(combined)

Polypharmacy (combined)	No of participants (N=138)	Percentage (%)
5 and more	96	69.6
Less than 5	42	30.4
Total	138	100.0

A total of 96(69.6%) participants has 5 or more medicines per day, and the remaining 30.4% have less than five medicines.

3.1.8. Drug interaction in Study Participants

Table 4 Drug interaction in Study Participants

Drug interaction	No of participants (N=138)	Percentage (%)
Major	81	58.7
Minor	1	0.72
Moderate	51	36.9
No interaction	65	47.1
Total	138	100.0

The study found that 58.7% of the total participants had at least one major interaction, 0.72% had minor interaction, 36.9% had moderate interactions, and 47.1 % had no interaction.

3.1.9. Type of interaction in Study Participants

Table 5 Type of interaction in Study Participants

Drug interaction	No of participants (N=138)	Percentage (%)
Pharmacokinetic	28	3.6
Pharmacodynamic	105	25.4
No interaction	65	47.1
Total	138	100.0

The study found that 3.6 % of the participants had pharmacokinetic drug interactions, 25.4% had pharmacodynamic drug interactions, and 47.1% had no interactions.

3.1.10. Medication Adherence in Geriatrics

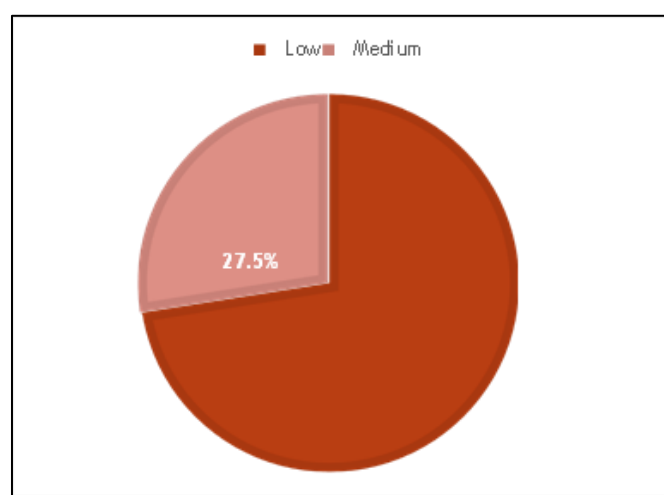


Figure 1 Medication adherence in study participants

The majority of the total population (72.5%) had low medication adherence, and 27.5% had medium medication adherence. Rayana S et al., (2025) conducted a study and reported that 63.5% had low adherence and 34.1% had medium adherence. The study disclosed that forgetfulness is among the primary reasons for non-adherence. Factors influencing medication adherence include forgetfulness, complexity of regimen, financial constraints, and physical limitations

3.1.11. ADR awareness in Study Participants

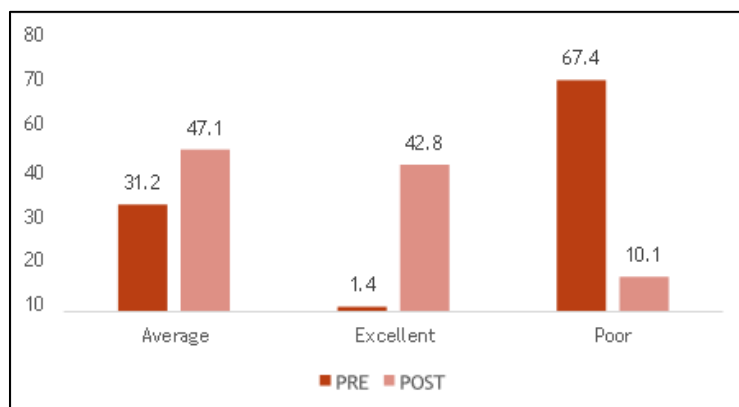


Figure 2 ADR awareness in study participants

The comparison of ADR knowledge pre- and post-test shows an improvement. In the pre-test, 67.4% had poor knowledge, and in the post-test, only 10.1% had poor knowledge. The percentage with excellent knowledge in the pre-test was 1.4%, which increased to 42.8% in the post-test.

3.1.12. Comparison between Pre and Post ADR knowledge among Study participants

Table 6 Comparison between pre and post ADR knowledge among Study Participants

		AVERA GE	EXCELL ENT	POOR	square	
POST	AVERA GE	9	0	56	39.228	0.000*
		13.8%	0.0%	86.2%		
	EXCEL LENT	34	2	23		
		57.6%	3.4%	39.0%		
	POOR	0	0	14		
		0.0%	0.0%	100.0%		

The comparison between pre- and post-intervention ADR knowledge reveals a dramatic and statistically significant improvement ($\chi^2=39.228$, $p<0.001$). Pre- test: Knowledge was heavily skewed towards "Poor" (67.4%), with only 1.4% achieving "Excellent." Post-test: The distribution shifted markedly. The "Excellent" category rose sharply to 42.8%. The "Poor" category decreased drastically to 10.1%. The shift in distribution is not due to chance. The analysis shows, for instance, that none of the participants who ended with "Poor" post-test knowledge had "Average" or "Excellent" knowledge beforehand. Conversely, most (57.6%) of those who achieved "Excellent" post-test knowledge came from the "Average" pre-test group.

4. Conclusion

The present study, "Geriatric Medication Safety: Drug Interactions, Medication Adherence, and ADR Awareness among the Geriatric Population," was conducted to evaluate medication-related safety issues among elderly patients. The study was carried out over a period of five months and included 138 geriatric participants in FHC Villadom, Thrissur with a focus on polypharmacy, medication adherence, drug-drug interactions and awareness of adverse drug reactions (ADRs).

The demographic and clinical characteristics of the study population revealed that 60.9% of the participants were males and 39.1% were females. The majority of the participants (58.7%) belonged to the age group of 65–70 years, indicating higher medication use within this age category. Assessment of polypharmacy showed that 23.9% of participants were receiving five medications per day, reflecting the presence of polypharmacy among the geriatric population. Evaluation of medication adherence demonstrated that 72.5% of participants had low medication adherence, while 27.5% exhibited medium adherence, highlighting significant adherence-related challenges. Assessment of ADR knowledge revealed that 67.4% of participants had poor ADR knowledge during the pre-test, following the distribution of educational leaflets and patient counselling, a marked improvement in ADR awareness was observed, with only 10.1% of participants continuing to have poor ADR knowledge in the post-study assessment. The study revealed that 58.7% of participants had at least one major drug-drug interaction, 36.9% experienced moderate interactions, and 0.72% had minor interactions, while 47.1% had no identified interactions. Pharmacodynamic interactions were more prevalent (25.4%) than pharmacokinetic interactions (3.6%), with 47.1% of participants showing no drug-drug interactions. These findings underscore the considerable occurrence of clinically significant drug-drug interactions within the study population. The study further identified that polypharmacy and poor medication adherence increased the risk of potential drug-drug interactions and adverse drug reactions among geriatric patients. Baseline findings emphasized limited awareness regarding the identification, prevention, and reporting of ADRs, which may contribute to medication related complications and reduced treatment effectiveness.

In conclusion, the study demonstrates that geriatric patients are highly susceptible to medication-related problems due to polypharmacy, low medication adherence, and inadequate awareness of adverse drug reactions. The findings highlight the effectiveness of educational interventions in improving ADR knowledge and promoting safer medication use. Incorporation of patient education, regular follow-up, and pharmaceutical care services is essential to enhance medication safety and improve health outcomes in the geriatric population.

Overall, this study reinforces the need for regular medication review, rational prescribing, patient education, and interdisciplinary collaboration to improve medication adherence and reduce drug-related problems in the geriatric population. Implementing such strategies can significantly enhance the quality of care and safety of elderly patients in both healthcare facilities and community settings.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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