

Medication Use Patterns, Polypharmacy, and Potentially Inappropriate Medications among Institutionalized Older Adults in East Coast Malaysia: A Cross-sectional Study

Azlini Ismail¹, Basma Ezzat Mustafa¹, Farah Natashah Mohd², Muhd Firdaus Che Musa³, Nazih Shaban Mustafa², Khairani Idah Mokhtar¹, Yunita Dewi Ardini³, Omar Abdul Jabbar Abdul Qader⁴

¹Department of Fundamental Dental and Medical Sciences, Kulliyah of Dentistry, International Islamic University Malaysia, Kuantan, Pahang, Malaysia

²Department of Oral Maxillofacial Surgery and Oral Diagnosis, Kulliyah of Dentistry, International Islamic University Malaysia, Kuantan, Pahang, Malaysia

³Department of Paediatric Dentistry and Dental Public Health, Kulliyah of Dentistry, International Islamic University Malaysia, Kuantan, Pahang, Malaysia

⁴Department of Oral and Maxillofacial Pathology, Faculty of Dentistry, Al Mashreq University, Baghdad, Iraq

Received: 30-10-2025.
Revised: 16-11-2025.
Accepted: 24-11-2025.
Published: 29-01-2026.

ABSTRACT

Objective: Older adults need comprehensive healthcare with particular attention to medication management to prevent drug-related problems while ensuring optimal therapeutic outcomes. This study aims to assess the pattern of medication use, prevalence of polypharmacy, and the use of potentially inappropriate medications (PIMs) based on the 2023 American Geriatrics Society Updated Beers Criteria[®]. **Methods:** This cross-sectional study gathered demographic and medication use data from older adults ($n = 73$) at an institutional care facility in East Coast Malaysia, who met the inclusion criterion of taking at least one medication. Patterns of medication use, prevalence of polypharmacy, and PIM use were examined descriptively, while their associations with demographic characteristics were analyzed using IBM SPSS[®] Version 26 software. **Findings:** The mean age of this population was 72 ± 9.07 years, with the majority being Malays (83.6%), males (50.7%), Muslims (86.3%), single (53.4%), bedbound (75.3%), and they were dependent on caretakers for their daily activities (75.3%). Polypharmacy occurred in approximately one-fifth of the population (21.9%). The most commonly prescribed medications were lipid-modifying agents and antihypertensives, followed by antiplatelet agents, anti-diabetic agents, and Vitamin B and iron supplements. Identified PIMs include prazosin, colchicine, lorazepam, and chlorpromazine, each prescribed to a minority of residents. **Conclusion:** The prevalence of polypharmacy in this study was moderate, reflecting the need for continued attention to medication management among institutionalized older adults. Despite the low prevalence of PIM, regular monitoring remains essential to minimize adverse drug reactions and improve the quality of care for this population.

KEYWORDS: Beers criteria, medication use, older adults, pattern, polypharmacy, potentially inappropriate medication

INTRODUCTION

The World Health Organization defines older adults as those aged 60 and above, representing about 15% of the global population.^[1,2] By 2050, this number was projected to reach 2.1 billion due to increased life expectancy and declining birth rates.^[3] As people age, their disease burden rises, often necessitating multiple medications to manage several comorbidities.^[4,5] The use of five or more concurrent medications, termed

polypharmacy, was linked to an elevated risk of adverse reactions, morbidity, and mortality.^[6]

The prevalence of polypharmacy among older adults in Malaysia ranged from 45.9% to 80.6% across

Address for correspondence:

Dr. Azlini Ismail,
E-mail: dr_azlini@iiu.edu.my

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 License (CC BY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Ismail A, Mustafa BE, Mohd FN, Musa MF, Mustafa NS, Mokhtar KI, *et al.* Medication use patterns, polypharmacy, and potentially inappropriate medications among institutionalized older adults in East Coast Malaysia: A cross-sectional study. J Res Pharm Pract 2026;15:26-32.

Access this article online

Quick Response Code:



Website: <https://journals.lww.com/jrpp>

DOI: 10.4103/jrpp.jrpp_83_25

different populations.^[7-9] For example, the prevalence of polypharmacy among the hospitalized older adults in Hospital Kuala Lumpur was 39.2%^[10] and 48.3% in 17 private aged care homes in Klang Valley.^[8] Another study at the University Malaya Medical Centre reported a prevalence of 45.9%, with age, Indian ethnicity, male gender, and multiple comorbidities as contributing factors.^[9] A recent review paper by Chang *et al.* estimated the pooled prevalence of 49.5% among older adults in Malaysia.^[11] Prescribing for older adults with polypharmacy was challenging due to age-related pharmacokinetics and pharmacodynamics changes, which alter drug handling and response.^[12] For example, reduced hepatic clearance of medications such as propranolol and lidocaine was observed in older adults, primarily due to decreased liver blood flow and diminished metabolic capacity.^[5]

Besides polypharmacy, another concern in older adults is the use of medications that pose higher risks than benefits, especially when safer alternatives exist. Such agents were classified as potentially inappropriate medications (PIMs).^[13] Several tools have been developed to identify PIM, including the Screening Tool of Older Persons' Potentially Inappropriate Prescriptions and the Screening Tool to Alert to Right Treatment criteria, and the PRISCUS List. Among these, the Beers criteria, developed by the American Geriatrics Society, represented the first expert consensus on PIM for older adults and remained widely used for guiding safer prescribing for this population.^[4,14] The use of PIM among older adults has increased globally over the past 20 years, with a pooled prevalence of 36.7%.^[4] In Malaysia, nearly one-third of older adults in nursing homes have been reported to use at least one PIM.^[15] Chang *et al.* estimated a pooled prevalence of 28.9% nationwide.^[11] Among older adults with COVID-19 admitted to Malaysian tertiary hospitals, 151 PIMs were identified based on the Beers 2023 criteria.^[6]

Although several studies in Malaysia have examined polypharmacy and PIM use in hospital and urban nursing home settings, data from government-managed institutions remained limited. Understanding prescribing patterns in this setting is essential to improving medication safety and informing policy. Rumah Ehsan Dungun, an older adults' care institution on the East Coast of Malaysia, managed by the Malaysian Department of Social Welfare, provides an important context for such evaluation. This study, therefore, aims to evaluate medication use patterns among older adults of this institution, focusing on the extent of polypharmacy and the prevalence of PIM use.

METHODS

This cross-sectional study was conducted from September 2019 to January 2020. Approval for this research was obtained under the I DO CARE flagship project for Kulliyyah of Dentistry, International Islamic University Malaysia (IIUM), from the Department of Social Welfare, Malaysia, with reference letter JKMM 100/12/5/2: 2018/107. Ethical approval was granted by the IIUM Research Ethical Committee (IREC) with approval number IREC 2019-166. The study population comprised all older adults at Rumah Ehsan Dungun, Dungun, Terengganu, Malaysia, with the following inclusion criteria: (1) aged 60 and above; (2) taking one or more medications during data collection. Exclusion criteria included older adults whose personal folders had incomplete information. To determine the prevalence of polypharmacy and PIM use, all eligible older adults fulfilling the inclusion criteria were included ($n = 73$). Data on age, gender, bedbound status, and dependency on caretakers were obtained from the institution's list, while data on medication use were collected by an investigator from the older adults' folders, medication charts, and interviews with the staff nurse in the ward. Each resident was assigned a unique anonymous code to protect their confidentiality.

Statistical analyses were performed using Statistical Package for Social Sciences (SPSS®) Version 26 (Chicago, IL, USA). A descriptive analysis was used to describe the demographic characteristics of the older adults, such as age, gender, dependency on caretakers, and bedbound status. For the analysis on the pattern of medication use, the prescribed medications were recorded and further analyzed in terms of types of medications based on the anatomical therapeutic chemical (ATC) classification system, which is maintained by the WHO. Each older adult's number of concurrent medications was used to determine the status of polypharmacy (five or more concurrent medications).^[6] The prescribed medications were checked with the AGS Updated Beers Criteria® (2023) list to identify any PIM use among the older adults.^[16] Categorical variables were presented as frequencies and percentages, while means and standard deviations were calculated for numerical variables. The association between the older adults' demographic profiles and the polypharmacy status and the PIM status was tested using the Chi-square (χ^2) test of independence. A $P < 0.05$ was considered statistically significant.

RESULTS

Table 1 presents the demographic profiles of older adults in this institution. The mean age of the older adults was

72 ± 9.07 years. Most of them were Malays (83.6%), males (50.7%), Muslims (86.3%), single (53.4%), bedbound (75.3%), and dependent on caretakers for their daily activities (75.3%). Table 1 also indicates that older adults were mostly on lipid-modifying agents (72.6%) and antihypertensive drugs (64.4%). Other common medications included antiplatelet agents (37.0%), antidiabetic agents (21.9%), nerve supplements (19.2%), and iron supplements (16.4%). In addition, Table 1 shows the pattern of medication use among older adults. Majority of the respondents (23.3%) were prescribed two concurrent medications. The highest number of concurrent medications was eight. Polypharmacy was

observed in about one-fifth (21.9 %) of the older adults in this institution. Other than polypharmacy, Table 1 also indicates the use of PIMs as listed in the American Geriatric Society 2023 Updated Beers Criteria®. PIMs were used by only a minority of residents (5.5%).

Figure 1 provides further details about the specific medications used within each category. It was found that the only lipid-modifying agent prescribed was simvastatin (ATC Code: C10AA01), which accounted for 100%. For antihypertensive drugs, majority of the older adults were prescribed amlodipine (ATC Code: C08CA), accounting for 56%, followed by perindopril (ATC Code: C09AA) at 28%. Other prescriptions include hydrochlorothiazide (ATC Code: C03AA), metoprolol (ATC Code: C07A), bisoprolol (ATC Code: C07A), prazosin (ATC Code: C02CA), and furosemide (ATC Code: C03CA), which altogether comprise the remaining 16%. Among older adults

Table 1: Demographic characteristics of residents, polypharmacy status, and potentially inappropriate medications use

Category	n (%)
Age	
60–69	34 (46.6)
70–79	24 (24.0)
80–89	12 (16.4)
≥90	3 (4.1)
Gender	
Male	37 (50.7)
Female	36 (49.3)
Dependency on caregivers (yes or no)	
Yes	55 (75.3)
No	18 (24.7)
Bedbound status (yes or no)	
Yes	55 (75.3)
No	18 (24.7)
Types of medication use	
Lipid-modifying agents	53 (72.6)
Antihypertensives	47 (64.4)
Antiplatelet agents	27 (37.0)
Anti-diabetic agents	16 (21.9)
Nerve supplements	14 (19.2)
Iron supplements	12 (16.4)
Number of concurrent medications (n)	
1	14 (19.2)
2	17 (23.3)
3	10 (13.7)
4	16 (21.9)
5	8 (11.0)
6	4 (5.5)
7	3 (4.1)
8	1 (1.4)
Polypharmacy* status (yes or no)	
Yes	16 (21.9)
No	57 (78.1)
Potentially inappropriate medication use (yes or no)	
Yes	4 (5.5)
No	95 (94.5)

*The use of five or more concurrent medications

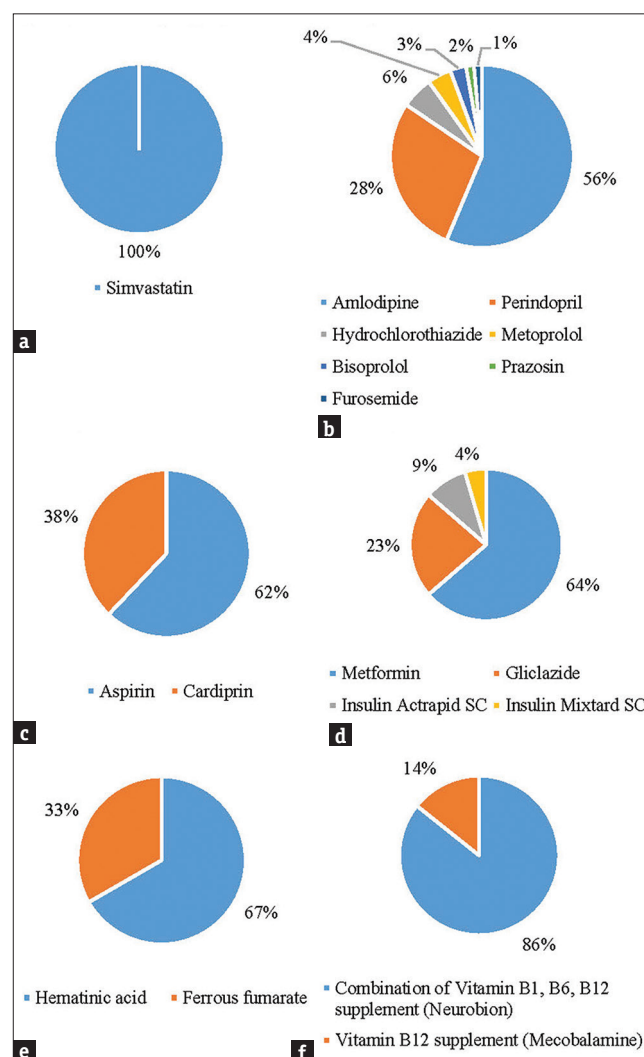


Figure 1: Types of medications. (a) Lipid-modifying agent. (b) Anti-hypertensive drug, (c) Antiplatelet agents. (d) Anti-diabetic agents. (e) Iron supplements. (f) Nerve supplements

receiving antiplatelet agents, aspirin (ATC Code: B01AC) accounted for 62%, while cardiprin (aspirin with glycine; ATC Code: B01AC) comprised 38% of prescriptions. The two most frequently prescribed anti-diabetic agents were metformin (ATC Code: A10BA), totaling 64%, and gliclazide (ATC Code: A10BB) at 23%. The remaining 13% were on insulin injections, utilizing either Insulin Actrapid (ATC Code: A10AB) at 9% or Insulin Mixtard (ATC Code: A10AD01) at 4%. Residents on iron supplements received either hematinic acid (67%) or ferrous fumarate (33%), while those on nerve supplements were given a combination of Vitamins B1, B6, and B12 (86%) or Vitamin B12 supplements (14%). Regarding PIM use according to the AGS 2023 Updated Beers Criteria®, only one out of 73 older adults received colchicine (M04AC01), lorazepam (N05BA06), prazosin (C02CA), or chlorpromazine (N05AA01), each representing merely 1.4% of the study population. Based on the analysis, as shown in Table 2, the older adults' demographic profiles had no significant association with the polypharmacy status or the use of PIM in this study population.

DISCUSSION

The nationwide National Health and Morbidity Survey 2018 data reported that 40.6% of older adults in Malaysia presented with multimorbidity, involving diseases such as hypertension, type 2 diabetes mellitus, dyslipidemia, and cancer.^[17] Multimorbidity often leads to increased use of medications. In this study, older adults in this institution were prescribed lipid-modifying agents and antihypertensives, followed by antiplatelet and antidiabetic agents. These patterns reflect common

chronic disease management, consistent with earlier findings in Malaysia and Southeast Asia.^[8,11]

Simvastatin was the only lipid-modifying agent prescribed, consistent with Hasan *et al.*,^[8] who reported statins as the most commonly used medication (46%). Statins are β -Hydroxy β -methylglutaryl-Coenzyme A reductase inhibitors that lower cholesterol, particularly low-density lipoprotein cholesterol, and reduce cardiovascular risk.^[18] Simvastatin is preferred due to its established safety profile, efficacy, and cost-effectiveness, making it suitable for resource-limited settings, particularly in low-and middle-income countries.^[11,17]

The second most prescribed medications were antihypertensives, mainly the calcium channel blocker (CCB) amlodipine and the angiotensin-converting enzyme (ACE) inhibitor perindopril. This pattern was consistent with the findings of Hasan *et al.*, who also reported CCBs and ACE inhibitors as commonly prescribed medications among older adults.^[8] Amlodipine was effective for blood pressure control and offered vascular protection, although it was associated with peripheral edema and gingival hypertrophy, requiring monitoring in this age group.^[19,20] Perindopril was prescribed for its ability to lower blood pressure, improve vascular function, and reduce cardiovascular risk, making it a preferred ACE inhibitor in this population.^[21-23]

Meanwhile, our study also found that aspirin and cardiprin were the two most commonly prescribed antiplatelet agents. Aspirin, or acetylsalicylic acid, is widely used to prevent cardiovascular events by inhibiting platelet aggregation through cyclooxygenase-1

Table 2: Association between demographic profiles and the polypharmacy status and the use of potentially inappropriate medications

Category	Polypharmacy status (%)		χ^2	P	Use of PIM (%)		χ^2	P
	Yes	No			Yes	No		
Age								
60–69	8 (50.0)	26 (45.6)	0.49	0.921	3 (75.0)	31 (44.9)	1.684	0.641
70–79	5 (31.3)	19 (33.3)			1 (25.0)	23 (33.3)		
80–89	2 (12.5)	10 (17.5)			0	12 (17.4)		
≥90	1 (6.2)	2 (3.5)			0	3 (4.3)		
Gender								
Male	10 (62.5)	27 (47.4)	1.114	0.285	2 (50.0)	35 (50.7)	0.001	0.978
Female	6 (37.5)	30 (52.6)			2 (50.0)	34 (49.3)		
Dependency to carers								
Yes	13 (81.3)	42 (73.7)	0.385	0.535	4 (100.0)	51 (73.9)	1.385	0.239
No	3 (18.8)	15 (26.3)			0	18 (26.1)		
Bedbound status								
Yes	13 (81.3)	42 (73.7)	0.385	0.535	4 (100.0)	51 (73.9)	1.385	0.239
No	3 (18.8)	15 (26.3)			0	18 (26.1)		

The association between the resident's demographic profiles and the polypharmacy status and the PIM status was tested using the Chi-square test of independence. A $P < 0.05$ was considered statistically significant. PIM=Potentially inappropriate medications

blockade.^[24] Cardiprin, a low-dose aspirin formulation combined with glycine, offers similar benefits with reduced gastric irritation. Their frequent use reflects the notable cardiovascular disease burden in this age group and the need for preventive therapy.^[25] Therefore, regular medication reviews are essential to minimize bleeding risk and optimize treatment outcomes.^[25,26]

In addition, the two most prescribed anti-diabetic agents in this study were metformin and gliclazide. Metformin, a biguanide, remained the preferred first-line therapy for type 2 diabetes because it reduces hepatic glucose production and enhances insulin sensitivity with a strong safety profile.^[27] Gliclazide, a sulfonylurea, lowers blood glucose by stimulating insulin secretion but carries a higher risk of hypoglycemia in older adults, requiring cautious use.^[28] Some diabetic older adults in this study received insulin therapy, including short-acting Insulin Actrapid and biphasic Insulin Mixtard, particularly when glycemic control could not be achieved with oral agents alone. Insulin therapy requires careful dose titration and monitoring to prevent hypoglycemia. Regular medication review and adherence to updated clinical guidelines are essential for optimal diabetes management of diabetes in older adults.^[28,29]

Older adults on iron supplements received either hematinic acid or ferrous fumarate. Ferrous fumarate is an effective oral iron salt used for treating iron deficiency anemia, but may cause gastrointestinal discomfort.^[30] Hematinic acid, often referring to folic acid or iron-vitamin combinations, was used to support blood formation in cases of nutritional deficiency and was commonly prescribed in older adults.^[31] Ferrous fumarate remained the mainstay treatment, with hematinic acid often used to complement therapy.

This study also found that older adults taking nerve supplements received either a combination of Vitamin B1, B6, and B12 (Neurobion) or Vitamin B12 alone. Neurobion contains thiamine, pyridoxine, and cyanocobalamin – neurotropic vitamins essential for nerve metabolism, myelin maintenance, and antioxidant protection.^[32] Vitamin B deficiencies were common in older adults due to reduced gastric acid and impaired absorption, potentially leading to mild cobalamin deficiency.^[33] Adequate intake of these vitamins has been associated with a lower risk of cognitive impairment in older populations.^[34]

In addition to the medication profiles, this study found polypharmacy in one-fifth (21.9%) of older adults in this institution. Previous local studies reported a higher prevalence, 39.2% in Hospital Kuala Lumpur,^[10] 48.3% in 17 private aged care homes,^[8] and 45.9% at the University

Malaya Medical Centre.^[9] While polypharmacy could be clinically appropriate, it was associated with adverse drug reactions, hospitalizations, and nonadherence, particularly in older adults due to altered pharmacokinetics and pharmacodynamics.^[35] Strategies such as deprescribing, comprehensive medication reviews, and patient-centered approaches supported by electronic health records helped reduce risks and improve medication safety.^[36-38]

However, considering that prescribing multiple medications remained almost inevitable in many older adults due to the multiple comorbidities, the adverse impact could be reduced through periodical screening to identify unnecessary use of PIMs. This study used the AGS Updated Beers Criteria®, a guideline for identifying PIM that posed higher risks or reduced benefits in older adults. Age-related physiological changes in drug metabolism and clearance increased these risks, and the 2023 update provided evidence-based recommendations for safer geriatric prescribing.^[39]

In this study, PIM prevalence was 5.5 % according to the AGS Updated Beers Criteria® 2023, compared to 12.3 % using the 2019 version, primarily due to the removal of ranitidine in 2023 following its withdrawal from the United States market, although it remained available in Malaysia. Nevertheless, previous Malaysian studies reported notably higher PIM prevalence, including 32.7% in Penang^[15] and 36% in Klang Valley.^[8] Internationally, PIM prevalence was also higher: 21.04% in Tehran,^[40] 53.1% in Kuwait,^[41] while 57.6% of older adults were prescribed at least one PIM to be avoided, and 37.5% received at least one PIM to be used with caution in Saudi Arabia.^[42] The lower prevalence in this study likely reflected strict government monitoring and precautionary prescribing at the institution, emphasizing the importance of regular medication reviews and adherence to updated guidelines.

The four PIMs identified in this study were prazosin, lorazepam, chlorpromazine, and colchicine. Prazosin, an alpha-1 blocker for hypertension, poses a high risk of orthostatic hypotension and syncope, and is not recommended routinely in older adults.^[43] Lorazepam, a benzodiazepine, increased the risk of cognitive impairment, delirium, falls, and fractures;^[44,45] therefore, the AGS strongly recommended avoiding its use in older adults.^[16] The next identified PIM was chlorpromazine, a first-generation antipsychotic, due to its significant anticholinergic properties and sedative effects, which were associated with cognitive impairment, delirium, and an increased risk of falls and orthostatic hypotension.^[46,47] The AGS advises caution in prescribing chlorpromazine to older adults, emphasizing these associated risks.^[16]

The final drug included under PIM is colchicine, used for hyperuricemia, which carries risks of gastrointestinal, neuromuscular and bone marrow toxicity, necessitating dose adjustment, and careful monitoring in older adults.^[48]

To manage Malaysia's growing older population, healthcare providers and policymakers must have a comprehensive understanding of polypharmacy trends and PIM use. Gathering data on the extent of polypharmacy and the types of PIM commonly used within this demographic will provide valuable insights for informing policy and developing targeted interventions to improve treatment outcomes. Patient well-being should be closely monitored, especially when polypharmacy or unavoidable PIM prescribing occurs.^[49]

Limitations and future studies

This cross-sectional study captures medication use at a single point within one older adults' care institution, limiting generalizability. Nonetheless, the findings offer useful insights into medication trends. Future nationwide longitudinal studies across various healthcare settings are recommended to better understand long-term medication patterns and guide national health policies.

CONCLUSION

The prevalence of polypharmacy in this study was moderate, with a low prevalence of PIM. The use of PIM, however, should be reconsidered to minimize adverse drug reactions and to improve the health conditions of this frail population.

AUTHOR'S CONTRIBUTIONS

Azlini Ismail: Conceptualization, Design, Definition of Intellectual Content, Literature Search, Data Acquisition, Data Analysis, Statistical Analysis, Manuscript Preparation, Editing, Review. Basma Ezzat Mustaffa: Conceptualization, Design, Definition of Intellectual Content, Literature Search, Data Acquisition, Manuscript Preparation, Editing, Review. Farah Natashah Mohd: Conceptualization, Design, Definition of Intellectual Content, Data Acquisition, Manuscript Editing, Review. Muhd Firdaus Che Musa: Conceptualization, Design, Definition of Intellectual Content, Data Analysis, Manuscript Editing, Review. Nazih Shaban Mustaffa: Conceptualization, Design, Definition of Intellectual Content, Data Acquisition, Manuscript Editing, Review. Khairani Idah Mokhtar: Conceptualization, Design, Definition of Intellectual Content, Manuscript Editing, Review. Yunita Dewi Ardini: Conceptualization, Design, Definition of Intellectual Content, Literature Search, Manuscript Editing, Review. Omar Abdul Jabbar Abdul Qader: Conceptualization, Design, Definition of Intellectual Content, Data Acquisition, Manuscript Editing, Review.

Financial support and sponsorship

This study was supported by the International Islamic University Malaysia.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Guido G, Ugolini MM, Sestino A. Active ageing of elderly consumers: Insights and opportunities for future business strategies. *SN Bus Econ* 2022;2:8.
- Abdullah JM, Ismail A, Yusoff MS. Healthy ageing in Malaysia by 2030: Needs, challenges and future directions. *Malays J Med Sci* 2024;31:1-13.
- Rudnicka E, Napierała P, Podfigurna A, Męczekalski B, Smolarczyk R, Grymowicz M. The World Health Organization (WHO) approach to healthy ageing. *Maturitas* 2020;139:6-11.
- Tian F, Chen Z, Zeng Y, Feng Q, Chen X. Prevalence of use of potentially inappropriate medications among older adults worldwide: A systematic review and meta-analysis. *JAMA Netw Open* 2023;6:e2326910.
- Drenth-Van Maanen AC, Wilting I, Jansen PA. Prescribing medicines to older people-how to consider the impact of ageing on human organ and body functions. *Br J Clin Pharmacol* 2020;86:1921-30.
- Chang CT, Mohd Shariff SM, Abu Bakar NS, Ramzuzzaman NS, Lim CK, Lim EY, *et al.* Polypharmacy and potentially inappropriate medications among hospitalized older adults with COVID-19 in Malaysian tertiary hospitals. *J Pharm Policy Pract* 2023;16:2.
- Azidah AK, Hasniza H, Zunaina E. Prevalence of falls and its associated factors among elderly diabetes in a tertiary center, Malaysia. *Curr Gerontol Geriatr Res* 2012;2012:539073.
- Hasan SS, Kow CS, Verma RK, Ahmed SI, Mittal P, Chong DW. An evaluation of medication appropriateness and frailty among residents of aged care homes in Malaysia: A cross-sectional study. *Medicine (Baltimore)* 2017;96:e7929.
- Lim LM, McStea M, Chung WW, Nor Azmi N, Abdul Aziz SA, Alwi S, *et al.* Prevalence, risk factors and health outcomes associated with polypharmacy among urban community-dwelling older adults in multi-ethnic Malaysia. *PLoS One* 2017;12:e0173466.
- Hor JY. Prescription drug use among elderly admitted to medical wards in a Malaysian Government Hospital. *Med J Malaysia* 2008;63:125-30.
- Chang CT, Ang JY, Islam MA, Chan HK, Cheah WK, Gan SH. Prevalence of drug-related problems and complementary and alternative medicine use in Malaysia: A systematic review and meta-analysis of 37,249 older adults. *Pharmaceuticals (Basel)* 2021;14:187.
- Reis da Silva TH. Pharmacokinetics in older people: An overview of prescribing practice. *J Prescr Pract* 2024;6:374-81.
- Zhu X, Zhang F, Zhao Y, Zhang W, Zhang Y, Wang J. Evaluation of potentially inappropriate medications for the elderly according to beers, STOPP, START, and Chinese criteria. *Front Pharmacol* 2023;14:1-12.
- Whitman AM, DeGregory KA, Morris AL, Ramsdale EE. A comprehensive look at polypharmacy and medication screening tools for the older cancer patient. *Oncologist* 2016;21:723-30.
- Chen LL, Tangiisuran B, Shafie AA, Hassali MA. Evaluation of potentially inappropriate medications among older

- residents of Malaysian nursing homes. *Int J Clin Pharm* 2012;34:596-603.
16. By the 2023 American Geriatrics Society Beers Criteria® Update Expert Panel. American Geriatrics Society 2023 updated AGS Beers Criteria® for potentially inappropriate medication use in older adults. *J Am Geriatr Soc* 2023;71:2052-81.
 17. Shariff Ghazali S, Seman Z, Zainuddin NH, Omar MA, Sooryanarayana R, Ariaratnam S, *et al.* Prevalence and factors associated with multimorbidity among older adults in Malaysia: A population-based cross-sectional study. *BMJ Open* 2021;11:e052126.
 18. Reith C, Preiss D, Blackwell L, Emberson J, Spata E, Davies K, *et al.* Effects of statin therapy on diagnoses of new-onset diabetes and worsening glycaemia in large-scale randomised blinded statin trials: An individual participant data meta-analysis. *Lancet Diabetes Endocrinol* 2024;12:306-19.
 19. Wang JG, Palmer BF, Vogel Anderson K, Sever P. Amlodipine in the current management of hypertension. *J Clin Hypertens (Greenwich)* 2023;25:801-7.
 20. Jiang J, Zhong Q, Zhou X, Zhou L, Zheng J, Liu B, *et al.* Adverse events associated with amlodipine: A pharmacovigilance study using the FDA adverse event reporting system. *Front Cardiovasc Med* 2025;12:1-16.
 21. McCarthy CP, Bruno RM, Rahimi K, Touyz RM, McEvoy JW. What is new and different in the 2024 European society of cardiology guidelines for the management of elevated blood pressure and hypertension? *Hypertension* 2025;82:432-44.
 22. Laurent S. Evidence for benefits of perindopril in hypertension and its complications. *Am J Hypertens* 2005;18:155S-62S.
 23. Mostafa S, Shabana H, Khalil F, Mancy IM, Zedan HA, Elmoursi A, *et al.* Evaluation of the safety and efficacy of dual therapy perindopril/amlodipine in the management of hypertension. A systematic review and meta-analysis. *High Blood Press Cardiovasc Prev* 2022;29:565-76.
 24. Schäfer A, Flierl U, Bauersachs J. Anti-thrombotic strategies in elderly patients receiving platelet inhibitors. *Eur Heart J Cardiovasc Pharmacother* 2020;6:57-68.
 25. Darraj A. Effect of low-dose aspirin on the elderly. *Cureus* 2024;16:e54658.
 26. Manirajan P, Sivanandy P. Drug utilisation review among geriatric patients with noncommunicable diseases in a primary care setting in Malaysia. *Healthcare (Basel)* 2023;11:1665.
 27. Noh J. Pharmacological management of diabetes in older adults. *Cardiovasc Prev Pharmacother* 2025;7:13-20.
 28. Fouad Algendy A, Illigens B, Alyazeedi A. Increased frequency of severe hypoglycemia with the modified-release gliclazide compared to glimepiride in diabetic older adults; propensity score-adjusted analysis. *Diabetes Metab Syndr Obes* 2022;15:1563-75.
 29. Elena C, Borretta G, Attanasio R, Alberto B, Agrimi D, Argese N, *et al.* Older adults with type 2 diabetes treated with metformin: AME-MET study – A multicentric real-world study in Italy. *Endocr Metab Immune Disord Drug Targets* 2023;23:818-25.
 30. Pantopoulos K. Oral iron supplementation: New formulations, old questions. *Haematologica* 2024;109:2790-801.
 31. Nguyen M, Tadi P. Iron supplementation. In: *StatPearls. Treasure Island (FL): StatPearls Publishing; 2025.* Available from: <https://www.ncbi.nlm.nih.gov/books/NBK557376/>. [Last updated on 2023 Jul 03].
 32. Baltrusch S. The role of neurotropic B vitamins in nerve regeneration. *Biomed Res Int* 2021;2021:1-9.
 33. Stover PJ. Vitamin B12 and older adults. *Curr Opin Clin Nutr Metab Care* 2010;13:24-7.
 34. Chen Q, Huang J, Shi X, Peng Y, Chen A, Huang L, *et al.* Associations between dietary B vitamin intakes and cognitive function among elderly individuals: An observational study. *Nutrition* 2025;134:112716.
 35. McGettigan S, Curtin D, O'Mahony D. Adverse drug reactions in multimorbid older people exposed to polypharmacy: Epidemiology and prevention. *Pharmacoepidemiology* 2024;3:208-22.
 36. Hughes C. Appropriate and inappropriate polypharmacy-choosing the right strategy. *Br J Clin Pharmacol* 2021;87:84-6.
 37. Huffmyer MJ, Keck JW, Harrington NG, Freeman PR, Westling M, Lukacena KM, *et al.* Primary care clinician and community pharmacist perceptions of deprescribing. *J Am Geriatr Soc* 2021;69:1686-9.
 38. Li E, Clarke J, Ashrafian H, Darzi A, Neves AL. The impact of electronic health record interoperability on safety and quality of care in high-income countries: Systematic review. *J Med Internet Res* 2022;24:e38144.
 39. Panel of American Geriatrics Society Beers Criteria® Update Expert, Fick DM, Semla TP, Steinman M, Beizer J, Brandt N, *et al.* American Geriatrics Society 2019 updated AGS beers criteria® for potentially inappropriate medication use in older adults. *J Am Geriatr Soc* 2019;67:674-94.
 40. Gholamnezhad M, Armand N, Ghamkhar L. Addressing medication safety in the elderly: Prevalence of potentially inappropriate medications in outpatient geriatrics by Beers criteria 2023. *J Gerontol Geriatr* 2024;72:89-95.
 41. Awad A, Hanna O. Potentially inappropriate medication use among geriatric patients in primary care setting: A cross-sectional study using the beers, STOPP, FORTA and MAI criteria. *PLoS One* 2019;14:e0218174.
 42. Alhawassi TM, Alatawi W, Alwhaibi M. Prevalence of potentially inappropriate medications use among older adults and risk factors using the 2015 American Geriatrics Society beers criteria. *BMC Geriatr* 2019;19:154.
 43. Rivasi G, Rafanelli M, Mossello E, Brignole M, Ungar A. Drug-related orthostatic hypotension: Beyond anti-hypertensive medications. *Drugs Aging* 2020;37:725-38.
 44. Liu L, Jia L, Jian P, Zhou Y, Zhou J, Wu F, *et al.* The effects of benzodiazepine use and abuse on cognition in the elders: A systematic review and meta-analysis of comparative studies. *Front Psychiatry* 2020;11:1-11.
 45. Tannenbaum C. Inappropriate benzodiazepine use in elderly patients and its reduction. *J Psychiatry Neurosci* 2015;40:E27-8.
 46. Haddad C, Salameh P, Sacre H, Clément JP, Calvet B. Effects of antipsychotic and anticholinergic medications on cognition in chronic patients with schizophrenia. *BMC Psychiatry* 2023;23:61.
 47. Guo M, Tao S, Xiong Y, Dong M, Yan Z, Ye Z, *et al.* Comparative analysis of psychiatric medications and their association with falls and fractures: A systematic review and network meta-analysis. *Psychiatry Res* 2024;338:115974.
 48. Stamp LK, Horsley C, Te Karu L, Dalbeth N, Barclay M. Colchicine: The good, the bad, the ugly and how to minimize the risks. *Rheumatology (Oxford)* 2024;63:936-44.
 49. Rodrigues DA, Plácido AL, Mateos-Campos R, Figueiras A, Herdeiro MT, Roque F. Effectiveness of interventions to reduce potentially inappropriate medication in older patients: A systematic review. *Front Pharmacol* 2021;12:777655.