

Factors influencing drug regimen complexity, its impact on geriatric patients' attitude toward deprescribing, and opportunities for simplification

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ABSTRACT

Background: This study aims to identify factors associated with medication regimen complexity (MRC), its impact on patients' attitude toward deprescribing, and the potential regimen simplifications.

Methods: A cross-sectional study was conducted among older adults attending outpatient clinics at a teaching hospital in Kuantan, Malaysia. MRC was assessed using the MRC Index (MRCI), while patients' attitudes toward deprescribing were measured using the revised Patient Attitudes Towards Deprescribing (rPATD) questionnaire. For bivariate analyses, t-test and one-way ANOVA were used for continuous variables. Alternatively, Mann-Whitney U-test, Kruskal-Wallis and Wilcoxon-signed rank were used for nonparametric variables. The Spearman correlation was used to evaluate the correlation of high MRCI with patients' attitude toward deprescribing. Multivariate analyses were performed to determine predictors of MRC and perceived medication burden which was measured using the burden domain of the rPATD.

Results: A total of 378 older adult patients participated, with a median MRCI score of 14 (range: 10.0–19.0). Polypharmacy [$p < 0.001$], Charlson Comorbidity Index (CCI) [$p < 0.001$], and management of medications [self-managed: $p = 0.009$, partially self-managed: $p = 0.015$] significantly predicted high MRCI. The perceived medication burden was significantly associated with monthly income [$p = 0.029$] and polypharmacy [$p < 0.001$]. It was found that 52.2% of the patients want to be involved in decision-making about their medications and 94.8% of the patients were willing to stop one or more of their medications. A moderate correlation was observed between MRCI and perceived burden [$r = 0.333$, $p < 0.001$]. Theoretical regimen simplification resulted in a statistically significant reduction in median MRCI scores [$p < 0.001$].

Conclusion: Older adults often experience moderate to high regimen complexity, which impacts their perceived medication burden. Future research should focus on implementing practical strategies for regimen simplification in clinical settings.

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1. Introduction

The growing population of older adults with comorbidities and the use of multiple medications presents a significant global challenge for healthcare systems, especially in outpatient settings [1]. It is estimated that the prevalence of comorbidities ranges from 15.8% to 83.0% among older adults in the community [2]. Consequently, polypharmacy and complex drug regimens tend to be more prevalent among older adults [3]. Though a clear definition of medication regimen complexity (MRC) is not yet established, complexity is not limited to the number of medications taken but also correlates with dosage form, medication administration times, medication schedule, preparation requirement, and administration instruction [4]. Several tools have been developed to measure MRC, among which the

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Medication Regimen Complexity Index (MRCI) is considered the gold standard in quantifying regimen complexity [5]. This tool has been translated into multiple languages and tailored for older adults in different care settings [3]. Higher score on this open-ended index means more complexity in the drug regimens. The MRCI gives a clearer picture of a patient's medication burden by showing how complex different medications can be, since each drug may come in various forms and with instructions that require different levels of effort to follow correctly [4]. Interest in the MRC issue has expanded worldwide due to negative health outcomes associated with complex drug regimens such as decreased quality of life, increasing risk of medication errors, hospital readmission, adverse drug events, and nonadherence to medication [6,7]. In Malaysia, approximately 53% of older adults reported moderate to high MRC [7].

Deprescribing is one of the globally adopted approaches to address polypharmacy and MRC in older adults. It involves the process of clinician-supervised dose reduction or withdrawal of inappropriate medications [8]. Deprescribing has a considerable positive impact on the treatment burden and health status, which may lessen adverse drug reactions, enhance patients' quality of life and improve medication adherence [9]. However, clinicians face various challenges in deprescribing, including a lack of deprescribing guidelines, misconceptions about patients' priorities and time constraints [10]. One of the major barriers of deprescribing is patient's resistance to changing their medication regimens [11]. Thus, understanding patients' attitudes toward deprescribing can help in guiding patient-centered care to achieve the desired outcomes [12]. The revised Patients' Attitudes Towards Deprescribing (rPATD) questionnaire was developed to assess patients' attitude toward deprescribing [13]. It is a validated tool that covers four key domains, which are involvement, burden, appropriateness, and concerns about stopping medications [15]. Theoretically, patients with a high MRC may wish to reduce the number of their medications or simplify their regimen to lessen the daily burden of managing their medications. However, this assumption has not been examined yet. Therefore, understanding the association between high MRCI and patients' attitudes toward deprescribing may help in identifying the strategies for reducing the medication complexity. Simplifying medication regimens is regarded as an effective way to enhance adherence among patients with chronic conditions [14]. This approach reduces complexity by decreasing the number of prescribed medications, often through strategies like fixed-dose combinations (FDCs) or once-daily dosing regimens, when appropriate, making it easier for patients to manage their medication [14].

To the best of our knowledge, little is known about the factors associated with high MRCI and the association between MRC and patients' attitudes toward deprescribing in Malaysia. Therefore, this study aims to identify the factors contributing to high MRC and the impact of MRC on patient's attitudes towards deprescribing. Also, the study investigated whether theoretical simplification of the complex regimens would reduce the MRCI.

2. Methodology

2.1. Study setting, design, and population

This cross-sectional study was conducted among older adult patients attending the outpatient clinics and outpatient pharmacy of Sultan Ahmad Shah Medical Centre at the International Islamic University Malaysia (SASMEC@IIUM), which is a referral teaching hospital in Kuantan, Pahang state, the largest state in Peninsular Malaysia. Study participants were recruited between November 2024 and January 2025 and were invited to participate in this study by explaining the study's aim. Patients were eligible to participate in this study if they were aged ≥ 60 years old and were taking more than one prescribed medication for any chronic disease. Participants with cognitive impairment or unwilling to give consent were excluded from this study.

2.2. Sample size

The sample size was calculated using the OpenEpi sample size calculator. For this study, the estimated population size was 10,000, the confidence level was 95%, and the prevalence of high MRCI was 53% [7]. Thus, the recommended sample size for the study was approximately 369 older adult patients.

2.3. Data collection and variables

Data was collected using questionnaires via face-to-face interviews with the study participants and through reviewing the patient's appointment or medical book. The participants were invited to participate in this study during their routine care appointments at the respective outpatient clinics. A written consent was obtained from each patient before conducting the survey in assurance of confidentiality. The questionnaire consisted of three parts: demographic characteristics, medical information, and the patient's attitudes toward deprescribing.

2.4. Measurement tools

2.4.1. Medication regimen complexity

MRC was computed using the MRCI tool, developed by George et al [5]. MRCI was a validated 65-item tool that was designed to measure and quantify the complexity of the regimen. MRCI consists of 3 components: section A is dosage form (32 items), section B is dosing frequency (23 items), and section C is additional directions (10 items). The overall MRCI score was calculated by summing the values from each section. Based on the total score, medication regimen complexity was categorized as follows: scores below 15 indicate low complexity, scores between 15.5 and 20 indicate moderate complexity, and scores above 20.5 indicate high complexity [15]. To ease the calculation, we used automated calculation of MRCI by using Microsoft Access v1.0 [16].

2.4.2. The revised patients' attitudes towards deprescribing (rPATD)

The revised Patients' Attitudes Towards Deprescribing (rPATD) questionnaire is a validated 22-item tool designed to measure patients' attitudes toward deprescribing [13]. The questionnaire was translated into the Malay language and validated [17]. The questionnaire assesses attitudes across four domains, which are involvement (items in relation to the patients' knowledge of their medications and involvement in making decisions), burden (questions related to the burden of medication taking), appropriateness (the perceived benefits and harms of their medications), and concerns about stopping (concerns expressed in relation to stopping their medications). The questionnaire also included the global factor, which consisted of two questions. The questionnaire was used after obtaining written permission from the developers. The scoring system is implemented according to the developers' instructions. Each domain and the global factor were measured on a 5-point Likert scale, ranging from strongly agree to strongly disagree, with scores assigned as follows: strongly agree = 5, agree = 4, unsure = 3, disagree = 2, strongly disagree = 1. Statements in the appropriateness domain were reverse scored because the statements were negatively worded, such as "I feel that I may be taking one or more medicines that I no longer need". Subsequently, strongly agree was given 1 point while strongly disagree was given 5 points. Higher scores in this domain means higher positive belief about the appropriateness of the medications. There is no overall score calculated for the entire questionnaire, and the two global questions are excluded in any of the scoring. For each domain, mean scores were calculated by averaging the individual item scores associated with that domain [13].

2.4.3. Simplifying medication complexity

The MRC was theoretically simplified by comparing the list of patients' prescribed medications with the hospital formulary of SASMEC@IIUM. Every theoretical simplification strategy was evaluated based on the individual list of medications. Then, several interventions were theoretically proposed. For instance, twice daily administration of metformin was theoretically simplified to an extended-release formulation with once daily frequency. This aims at identifying the possible theoretical simplification of the regimen to reduce the MRCI.

2.4.4. Charlson Comorbidity Index (CCI)

The Charlson Comorbidity Index (CCI) was utilized in evaluating the clinimetric properties of patients' morbidity [18]. The Charlson Comorbidity Index (CCI) classifies the severity of comorbidities into three categories based on the CCI score: mild (1–2), moderate (3–4), and severe (5 or more) [19].

2.4.5. Operational definitions

Diseases were categorized according to the International Classification of Diseases, 11th Revision (ICD-11), a global standard for reporting health classifications and diagnostic information [20]. Medications were classified using the Anatomical Therapeutic Chemical (ATC) classification system, which organizes drugs based on their active ingredients and relation to different body systems. Polypharmacy was defined as the concurrent use of five or more medications [21].

2.5. Statistical analysis

Collected data were analyzed using Jamovi for Windows (version 2.6.13). Descriptive statistics summarized patients' demographics, medication regimens, and comorbidities. Categorical variables were expressed as frequencies and percentages (%), whereas continuous variables were described as means with standard deviation (SD) or medians with interquartile ranges (IQR). The Shapiro-Wilk test was used to assess the normal distribution of the variables. Factors associated with high MRCI, and perceived burden were evaluated using bivariate and multivariate regression models. For bivariate analyses, t-test and one-way ANOVA were used for continuous variables. Alternatively, Mann-Whitney U-test, Kruskal-Wallis and Wilcoxon-signed rank were used for nonparametric variables. The Spearman correlation was used to evaluate the correlation of high MRCI with patients' attitude toward deprescribing.

3. Results

The final analysis included 387 patients. Most of them (62.3%) were aged 60-69 years old. The majority of respondents were unemployed or retired (95.1%), and most participants managed their medications independently (80.9%). A high proportion of the patients (82.7%) had polypharmacy and 49.9% of the total patients were categorized as having moderate CCI (Table 1).

Table 1. Demographic and medical characteristics along with MRCI values (n = 387).

Variable	Patients: N (%)	MRCI	p-value
MRCI		14(10 -19)	
Low complexity (≤ 15)	200 (51.67)		
Medium complexity (15.5-20)	114 (29.46)		
High complexity (>20)	73 (18.86)		
Age			
60-69 years old	241 (62.3)	14 $\pm$ 6.25	0.408 ^b
70-75 years old	97 (25.1)	15 $\pm$ 5.86	
≥ 75 years old	49 (12.%)	13 $\pm$ 7.06	
Gender			
Male	229 (59.2)	14 (10.0-18.0)	0.401 ^a
Female	158 (40.8)	15 (10.0-19.0)	
Level of education			
Primary school/ No formal education	101 (26.1)	15 (11.0-19.0)	0.122 ^c
Secondary school	182 (47.0)	15 (10.3-18.8)	
University level	104 (26.9)	13 (9.75-18.0)	
Employment status			
Employed	19 (4.9)	13 (8.5-14.5)	0.072 ^a
Unemployed/ retired	368 (95.1)	15 (10.0-19.0)	
Monthly income			
<RM1000	185(47.8)	16 (11.0-19.0)	0.096 ^c
RM1000-RM4500	157 (40.6)	13 (10.0-18.0)	
>RM4500	45 (11.6)	13 (9.0-18.0)	
Management of medications			
Self-managed	313 (80.9)	14.4 $\pm$ 5.87	0.019 ^b
Partially self-managed	44 (11.4)	15.8 $\pm$ 6.78	
Fully managed by family members	30 (7.8)	17.5 $\pm$ 8.54	
Polypharmacy			
No	67 (17.3)	7 (5.0-8.50)	<.001 ^a
Yes	320 (82.7)	16 (12.0-19.0)	
Level of CCI			
Mild	16 (4.1)	8 (6.0-10.5)	<.001 ^c
Moderate	193 (49.9)	11 (9.0-14.0)	
Severe	178 (46.0)	18 (15.0-21.8)	

Note: ^aMann-Whitney U test, ^bOne-way ANOVA test, ^cKruskal-Wallis test.

According to the ICD-11 classification, the most common comorbidities were circulatory system diseases (49.0%), followed by endocrine, nutritional, and metabolic diseases (29.7%) and other diseases (10.3%). In terms of the ATC classification, the most prescribed medications were those for the cardiovascular system ($n = 1452$), alimentary tract & metabolism (28.1%) and blood and blood-forming organs (6.5%) (Table 2).

3.1. Factors associated with high MRCI

The median MRCI score was 14 (IQR = 10.0–19.0), with 29.5% and 19% having moderate and high complexity, respectively. Next, bivariate analyses were conducted to identify the factors associated with high MRCI. Having polypharmacy, management of medications by family members, and severe CCI were found to be significantly associated with high MRCI (Table 1). A multivariate linear regression model to adjust for potential covariates was applied. In addition to clinically important factors, we included factors that might have significant relationship with the high MRCI. It is widely practiced to include variables that showed potential significance in the bivariate analysis using $P < 0.25$ as a cutoff value [22,23]. The final model explained 44.6% of the variance in MRCI ($R^2 = 0.446$, adjusted $R^2 = 0.431$), indicating that this linear regression model is a good fit for the data. All assumptions required for the multivariate analysis were met before running the model. After applying the multivariate regression model, having polypharmacy, dependent management of medications and severe CCI level remain significantly correlated with high MRCI (Table 3).

3.2. Attitudes towards deprescribing

3.2.1. Older adults' perceptions

Most of the surveyed participants reported that they were satisfied with their current medications (86.8%). Conversely, 94.8% were willing to stop one or more of their medications if their doctor said it was possible. About 52.2% of respondents wanted to be involved in decision-making regarding their medications. Moreover 30.8% of the patients felt that their medications were burden to them, while 95.1% of them were keen to stop their medications if taking for a long time. On the other hand, only 18.9% of the respondents experienced side effects from their current medications (Fig. 1 and Supplementary Table S1).

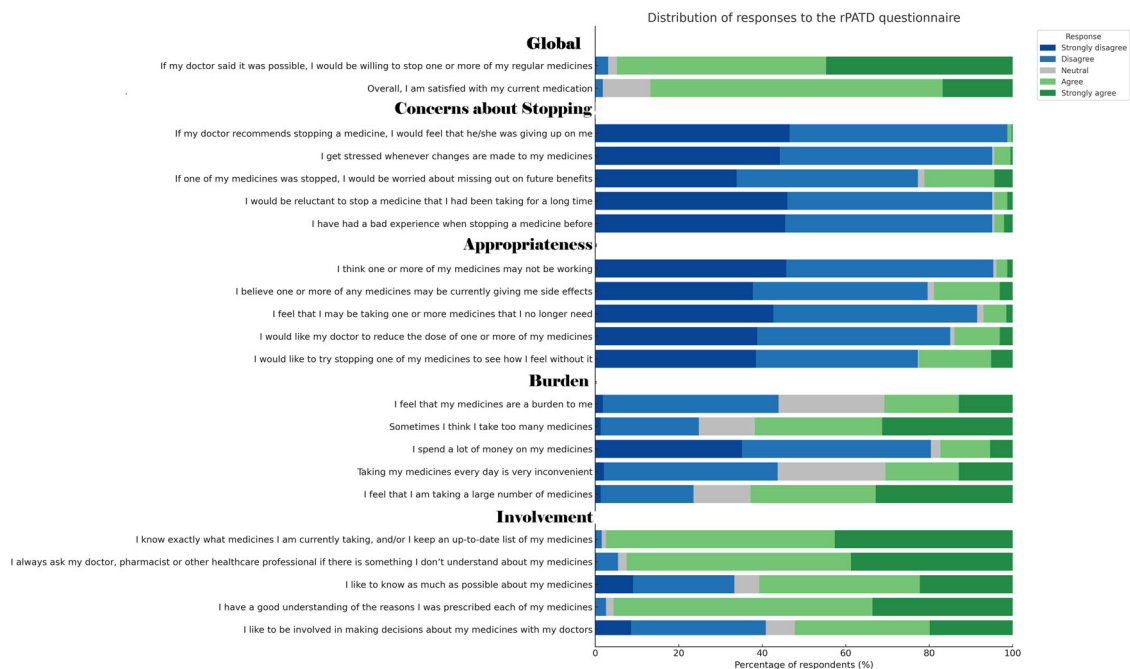
Table 2. Diseases and medications of the study populations ($n = 387$).

Variable	Frequency
Diagnosis (based on ICD-11 classification)	Number of diseases (%) ($n = 1346$)
Circulatory system diseases	660 (49.0)
Endocrine, nutritional and metabolic diseases	400 (29.7)
Genitourinary system diseases	50 (3.7)
Musculoskeletal system and connective tissue diseases	41 (3.0)
Respiratory system diseases	37 (2.7)
Gastroenterology diseases	20 (1.5)
Other diseases	138 (10.3)
Therapeutic groups according to ATC classification	Number of medications (%) ($n = 2834$)
Cardiovascular system	1452 (51.2)
Alimentary tract & metabolism	796 (28.1)
Blood & blood-forming organs	185 (6.5)
Respiratory system	102 (3.6)
Musculoskeletal system	45 (1.6)
Nervous system	70 (2.5)
Genitourinary system	52 (1.8)
Sensory organ	30 (1.1)
Dermatological	50 (1.8)
Systemic hormones	40 (1.4)
Antineoplastic	2 (0.1)
Anti-infective and various	10 (0.4)

Table 3. Factors associated with high MRCI using multivariate linear regression (n = 387).

Independent variable	β	95% CI	p-value
Level of education			
Primary school/ No formal education	0.523	−1.077-2.122	0.521
Secondary school	0.443	−0.820-1.706	0.491
University level	1	Ref	Ref
Monthly income			
<RM1000	0.340	−0.797-1.477	0.557
>RM4500	1.312	−0.363-2.987	0.124
RM1000-RM4500	1	Ref	Ref
Management of medications			
Self-managed	−2.417	−3.134-1.974	0.009
Partially self-managed	−2.755	−4.978-(−0.532)	0.015
Fully managed by family members	1	Ref	Ref
Polypharmacy			
Yes	6.130	0.4409-0.8950	<.001
No	1	Ref	Ref
Level of CCI			
Mild	1	Ref	Ref
Moderate	−0.580	−3.134-1.974	0.655
Severe	5.001	2.347-7.655	<.001

$R^2=0.446$, adjusted $R^2=0.431$.

**Figure 1.** Distribution of the patients' responses to the rPATD questionnaire (n = 387).

3.2.2. Relationship between MRCI and attitudes towards deprescribing across four domains

The correlation between MRCI and patients' attitudes toward deprescribing was analyzed using Spearman correlation analysis. Table 4 depicts a moderate positive correlation between the perceived medication burden and MRCI ($r=0.333$, $p<0.001$).

3.2.3. Influence of characteristics on attitudes towards deprescribing

The mean (SD) values for the attitudes towards deprescribing for each domain were 3.60 (0.816) for involvement, 2.73 (0.885) for burden, 1.64 (0.601) for appropriateness, and 0.827 (0.659) for concerns about stopping. Next, bivariate analyses were conducted to determine the factors associated with the rPATD domains. The involvement domain showed significant associations with ages between 60-69 years old, high-education level, monthly income > 4500RM, self-management of medications, and mild CCI. Similarly, the burden domain was significantly associated with female gender, low education level, monthly income > 4500RM, having polypharmacy, and high CCI. Additionally, male gender, high education level, monthly income > 4500RM, management of medications by family members, and mild

Table 4. The correlation between MRCI and attitudes towards deprescribing across 4 domains (n = 387).

	Involvement		Burden		Appropriateness		Concerns about stopping	
	r value	p value	r value	p value	r value	p value	r value	p value
MRCI	−0.023	0.653	0.333	<0.001	−0.060	0.238	0.036	0.477

Table 5. Factors associated with the perceived burden using multivariate linear regression (n = 387).

Independent variable	β	95% CI	p-value
MRCI	0.00992	−0.00707-0.0269	0.252
Gender			
Female	0.07959	−0.08887-0.2481	0.353
Male	1	Ref	Ref
Level of education			
Primary school/ No formal education	0.08996	−0.17650-0.3564	0.507
Secondary school	0.10279	−0.10901-0.3146	0.341
University level	1	Ref	Ref
Monthly income			
<RM1000	0.33589	0.14128-0.5305	<.001
>RM4500	0.31488	0.03158-0.5982	0.029
RM1000-RM4500	1	Ref	Ref
Management of medications			
Self-managed	0.06888	−0.23816-0.3759	0.659
Partially self-managed	0.13614	−0.24056-0.5128	0.478
Fully managed by family members	1	Ref	Ref
Polypharmacy			
Yes	0.60761	0.35825-0.8570	<.001
No	1	Ref	Ref
Level of CCI			
Mild	1	Ref	Ref
Moderate	−0.34830	−0.77401-0.0774	0.109
Severe	0.01013	−0.44093-0.4612	0.965

$R^2=0.468$, adjusted $R^2=0.219$.

CCI were found to be significantly associated with higher positive beliefs about the appropriateness of their medications. For concerns about stopping medications, significant associations were observed with monthly income > 4500RM, management of medications by family members, and moderate CCI (Supplementary Table S2).

Then, a multivariate linear regression model was applied to identify significant predictors of perceived burden while adjusting for potential covariates. Variables with a significance level of $p < 0.25$ were selected for inclusion in the multivariate analysis. The multivariate linear regression model yielded an R^2 value of 0.468, indicating that these predictors could explain approximately 46.8% of the variance in perceived burden. All assumptions required for the multivariate analysis were met before running the model. After applying the multivariate regression model, only monthly income and polypharmacy remain significantly associated with perceived medication burden. (Table 5).

3.3. Theoretical simplification of medication regimen complexity

Of the 387 patients included in the study, simplification was possible in 46 of them based on the available drug dosage forms in the hospital formulary. The median (IQR) MRCI scores before and after the theoretical simplification process was slightly but significantly reduced from 17.5 (13.3-22.0) to 16.5 (12.3-21.0), $P < 0.001$. The most common proposed adjustments included transitioning to long-acting formulations (particularly, metformin and theophylline), which reduced the frequency of administration and contributed to the overall reduction in complexity

4. Discussion

In this study, we employed a validated MRCI tool to assess the complexity of regimens among older adult patients. Our findings revealed a median MRCI score of 14 (IQR:10.0–19.0), classifying most regimens as low complexity (≤ 15). This aligns with a previous study among Malaysian older adults diagnosed with acute infections, such as urinary tract infections (UTIs), which reported a median MRCI

score of 14 [24]. In contrast, a study among older adults in Kuantan reported moderate complexity (15.5–20), with a median MRCI of 17 [7]. The variation in MRCI scores across these studies highlights differences in medication regimens, reflecting the unique characteristics of patient populations, disease profiles, and healthcare practices within distinct settings.

The study found that the presence of polypharmacy and higher CCI scores as significant determinants of high MRCI scores using a regression model. The results are consistent with previous studies showing that older adults with comorbidities and polypharmacy tend to have more complex medication regimens. It is expected that older adults with multiple comorbidities require the use of various concurrent medications, each with specific instructions for proper use resulting in a more complex regimen [21]. Overall, this finding aligns with other studies that reported a correlation between MRC with higher CCI scores, and polypharmacy [25]. Given that polypharmacy and comorbidity strongly predict regimen complexity, targeted medication reviews in these patients are essential to reduce regimen complexity. Our study also found that patients who self-managed or partially managed their medications had notably lower MRCI scores compared to those who required assistance from family members. This finding is consistent with another study, which reported that individuals with an MRCI score over 20 were more likely to receive help managing their medications [26]. This clearly shows that reducing regimen complexity enhances independence in managing medications. In order to reduce the drug burden in older adult patients, medication review should prioritize managing the number of daily doses, simplifying medication administration instructions, and minimizing the overall number of medications prescribed to the patients (deprescribing) [27]. In patients with multiple comorbidities and polypharmacy, reducing regimen complexity can enhance medication adherence, decrease adverse drug events, prevent hospitalizations, and improve quality of life [27].

Our findings revealed a significant reduction in the median complexity scores after proposing theoretical simplifications. This underscores the need for further exploration of potential simplifications, such as eliminating unnecessary medications (deprescribing) and optimizing dosing schedules and additional instructions. Reducing dosing frequency, particularly by using long-acting medications, is one of the most effective strategies for simplification without compromising the therapeutic objectives of pharmacotherapy [17]. This approach is especially relevant for older patients with cognitive impairments and limited support in managing their medications [28]. Moreover, educating patients on the proper use of complex medications, especially those requiring administration devices, can enhance their independence in managing pharmacotherapy and self-care [27]. Therefore, healthcare professionals must actively engage with patients to optimize and simplify dosage regimens.

In this study, most participants expressed satisfaction with their medications. However, 94.2% of participants were also willing to deprescribe their medications if the doctor recommended so. The findings of our study align with studies from other countries among older adults. Studies conducted in New Zealand, Canada, and France found that the proportion of participants willing to have their medications deprescribed by their doctor was 83.8%, 85%, and 89.5%, respectively [12,29,30]. Similarly, 60.2% of multi-ethnic community-dwelling older patients in Malaysia expressed a willingness to stop one of their medications. These findings are noteworthy, considering that previous studies indicated that doctors are often reluctant to deprescribe medications for older adults, believing they were generally satisfied with their current medications [17]. Nearly half of the respondents in our study had a desire to be involved in decision-making. This finding agrees with the other study from Malaysia, where 68.1% of the participants also wanted to be involved in decision-making [17]. On the other hand, this contrasts with a study conducted in the UK, where participants showed less desire to be involved in decision-making [31]. Given patients' interest in their treatment, clinicians should recognize patients' willingness to engage in decision-making and consider deprescribing as an opportunity to initiate it in hospital settings [12]. Furthermore, the high willingness of patients to deprescribe highlights a window of opportunity for clinicians to engage in shared decision-making. Regarding the attitude about the appropriateness of medications, only about 7% of our participants felt that they may be taking one or more medications that is/are no longer needed. This percentage is lower than that reported from France (12.8%) [30], Canada (22%) [29], New Zealand (27%) [12] and Malaysia (27.8%) [17]. This difference may be attributable to the greater degree of trust that patients place in the prescribing decisions

of specialists, in contrast to findings from studies in which general practitioners (GPs) were responsible for the treatment of the patients.

To date, this is the first outpatient survey to investigate the correlation between MRC and attitudes toward deprescribing in Malaysia. Our data revealed a correlation between high MRCI scores and the perceived medication burden, indicating that patients with complex regimens experience greater therapeutic strain. Moreover, patients with higher perceived medication burden are more keen to be engaged in shared decision-making and consider deprescribing appropriate, making them a priority for medication reviews and deprescribing initiatives in different healthcare settings [12]. This finding highlights the need for healthcare providers to proactively identify high-complexity regimens and implement targeted interventions -such as regimen simplification, deprescribing, and patient education- to reduce burden and improve adherence in this population. However, multivariate analysis showed no significant association between MRCI and perceived burden. This contrasts with previous studies on older inpatients in New Zealand, where higher MRC scores were linked to greater perceived burden [12]. The different perceptions of medication burden among patients may be shaped by their health beliefs, understanding of medication necessity, coping abilities, and the complexity of their regimens.

Further analyses revealed several factors influencing the perceived medication burden, including the presence of polypharmacy and monthly income. Individuals with multiple comorbidities are often prescribed with numerous medications, increasing the burden of managing daily medication routines. This aligns with a study on geriatric patients' attitudes toward deprescribing, which reported that polypharmacy was associated with a higher burden score [32]. Next, while lower income was significantly associated with a higher perceived medication burden, findings from other studies have suggested otherwise. A study of older adult inpatients from Saudi Arabia indicates that patients do not perceive financial strain from their medications, despite the high number of prescriptions, likely due to the availability of subsidized or free healthcare services in government hospitals [33]. However, the discrepancies in findings may be explained by the specific characteristics of the study population. Participants in our study predominantly had chronic diseases requiring long-term care, leading to sustained treatment costs. This aligns with research reported that non-communicable diseases such as diabetes, hypertension, and arthritis are significantly associated with out-of-pocket health expenditures (OOPHE) [34]. Therefore, it is critical for doctors to consider cost implications in therapeutic decision-making and drug selection for older patients, as these individuals are more likely to require prolonged medical care, contributing to polypharmacy [17].

This study highlights the need for intervention trials to test whether regimen simplification improves adherence, adverse drug outcomes, and hospitalization risk. Future studies should also evaluate system-level strategies, such as embedding deprescribing tools into electronic prescribing platforms.

Our study has several limitations. First, the information regarding additional instructions for the prescribed medications was not thoroughly updated in the electronic health record system, which may lead to an underestimation of the MRCI. Furthermore, this research was conducted in a single center in Kuantan, Pahang, which limits the ability to generalize the findings to the broader Malaysian older adult population. Additionally, while convenience sampling offers a quick, cost-effective, and accessible method for selecting participants, its main limit lies in the potential for sampling bias. Consequently, the generalizability of the findings is constrained.

5. Conclusion

The study showed that about half of the older adult patients have moderate or high medication regimen complexity. It was found that multiple comorbidities and polypharmacy are significant determinants of high complex drug regimens. Moreover, the responses to the rPATD questionnaire showed that more than half of the patients want to be involved in decision-making about their medications and that the majority of patients are willing to stop one of their medications whenever it is possible. This suggests that integrating routine MRCI assessment into outpatient practice can help identify older adults at highest risk of medication burden, especially those with multimorbidity and polypharmacy. Additionally, physicians and pharmacists should utilize the patients' willingness to deprescribe to optimize treatment plans and reduce unnecessary complexity in regimens in order to improve medication

adherence, reduce medication errors, and enhance the quality of care provided to older adults. Future research should focus on developing and implementing practical strategies for deprescribing and medication regimen simplification across different healthcare settings.

Declarations

Ethics approval and consent to participate

All participants were given detailed written information about the study, and informed consent was obtained from each participant before their involvement. The study was reviewed and approved by the IIUM Research Ethics Committee (IREC UG 2024-059) and the Department of Education and Research in SASMEC@IIUM (IIR24-06) before commencing the study to ensure compliance with ethical guidelines.

Availability of data and material

Data are available upon request from the corresponding authors.

Competing interests

The authors declare no conflict of interest related to this work.

Author contributions

Conceptualization: MEA., Methodology: MEA., Data Collection: SZZA., Formal analysis: SZZA., Writing Original draft: SZZA., Writing review & editing: MEA, SZZA.

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